EXPLORATION OF EFFECTIVE PROFESSIONAL DEVELOPMENT CHARACTERISTICS FROM THE PERSPECTIVE OF INTEGRATED TEACHING PROJECT'S COORDINATOR, FACILITATOR, AND PARTICIPANTS

by

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ABSTRACT

EXPLORATION OF EFFECTIVE PROFESSIONAL DEVELOPMENT CHARACTERISTICS FROM THE PERSPECTIVE OF INTEGRATED TEACHING PROJECT'S COORDINATOR, FACILITATOR, AND PARTICIPANTS

It is quite important for policy makers and practitioners to invest in the most efficient learning environment for teachers to reinforce their learning and ultimately student achievement. Even though scholars are aware of Professional Development's (PD) importance, review studies showed that effects of PDs are far from what is expected. Therefore, this phenomenological study aimed to discover effective PD characteristics by collecting data from each person with different roles involved in a PD. In this way, it was expected to discover remaining unknown aspects of maintaining effective PDs. Under the scope of this study, interviews were conducted with one PD coordinator, one facilitator, and five participants. Results supported each element of the effective PD *consensus view*. However, it was also discovered that even though some PD characteristics such as *inclusion of assessment process, iterative and sustainable process, using instructional modellings, considering cognitive load,* and *PD venue* were discussed in the literature, they were still overlooked. Additionally, new insights to the literature such as *scope of the PD* and *learning how to learn* were proposed and implications for future studies are offered.

Key words: Professional Development, Online Professional Development, Teacher Learning, Teacher Change, Professional Development Effects on Classroom.

ÖZET

BÜTÜNLEŞİK ÖĞRETMENLİK PROJESİ'NİN KOORDİNATÖRÜ, EĞİTİMCİSİ VE KATILIMCILARININ BAKIŞ AÇISINDAN ETKİN MESLEKİ GELİŞİM ÖZELLİKLERİNİN KEŞFEDİLMESİ

Politika yapıcılar ve uygulayıcıların, öğretmenlerin öğrenmesi ve bunun sonucu olarak öğrenci başarısı elde edebilmek adına verimli öğrenme ortamlarına yatırım yapmaları oldukça önemlidir. Akademisyenlerin mesleki gelişimin öneminin farkında olmasına rağmen, inceleme çalışmaları mesleki gelişim programlarının etkilerinin beklenenden çok uzak olduğunu göstermiştir. Bu nedenle, bu fenomenolojik çalışma, mesleki gelişim programında yer alan farklı rollere sahip her bir kişiden veri toplayarak etkin mesleki gelişim programı özelliklerini keşfetmeyi amaçlamaktadır. Bu çalışma kapsamında, mesleki gelişim koordinatörü, eğitimcisi ve beş katılımcısı ile görüşmeler yapılmıştır. Sonuçlar, etkin mesleki gelişim programı hakkında *fikir birliğine* ulaşılan her bir özelliği desteklemektedir. Bununla birlikte, literatürde bahsedilen fakat üzerinde çok durulmamış *değerlendirme sürecinin dahil edilmesi, yinelemeli ve sürdürülebilir süreç, öğretimsel modellemeler kullanma, bilişsel yük* ve *mesleki gelişim mekânı* gibi özellikleri de bulmuştur. Ayrıca, bu çalışma *mesleki gelişim programı kapsamı* ve *nasıl öğrenileceğini öğrenmek* gibi özelliklerle de literatüre yeni bakış açıları önermiştir.

Anahtar Kelimeler: Mesleki Gelişim Programı, Çevrimiçi Mesleki Gelişim Programı, Öğretmen Öğrenmesi, Mesleki Gelişim Programlarının Sınıfa olan Etkisi.

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LIST OF ACRONYMS/ABBREVIATIONS

ITP	Integrated Teaching Project
OPD	Online Professional Development
PCK	Pedagogical Content Knowledge
PD	Professional Development
R	Researcher
STEM	Science, Technology, Engineering, Mathematics
TPACK	Technological Pedagogical Content Knowledge

1. INTRODUCTION

In today's world, each day comes with its special needs. To keep up with this change, as all fields of science, educational sciences are working on it to be reformable as well. For example, as all we experienced nowadays, with COVID-19 outbreak came into our lives, most of the teachers and students tried to turn their faces into online education. Therefore, if the aim is to raise students with 21st century skills and as make them adaptable global citizens, then it could be reasonable to have teachers such abilities and thinking skills (Darling-Hammond & McLaughlin, 1999; Fullan &Miles, 1992; Sykes, 1999).

At this point, designing learning environments for teachers comes into view. Since most of the teachers are already working in the field (Fullan &Miles, 1992; Guskey, 1986; Guskey & Huberman, 1995; Momanyi, 2016; Sparks & Loucks-Horsley, 1989), this study got interested in Professional Development (PD) process of in-service teachers. It is important to remember that learning is a non-stop process for everyone and every profession, including teachers. As students need guidance for better learning, teachers may also require professional support to make the learning and teaching process better (Ball & Cohen, 1999; Borko, 2004; Putnam & Borko, 1997, 2000). Therefore, PD becomes one of the keystones of successful educational reform movement. It is believed that if teachers evolve as a person and teacher then, eventually it is expected that this evolution can be transmitted into their classrooms (Borko, 2004; Borko & Putnam, 1995; Desimone, 2009; Garet et al., 2001; Loucks-Horsley et al., 2009; Stewart, 2014).

After realizing importance of PD, many studies tried to put rigorous work on how to design PD for teachers and how to make these programs more efficient (Borko, 2004; Desimone, 2009; Garet et al., 2001; Loucks-Horsley et al., 2009; Putnam & Borko, 1997, 2000; Stewart, 2014). It is known that a lot of time, energy, and grants are spent on designing

and implementing PD for teachers and it is not wanted to waste any of these resources. Basically, if ideal PD characteristics are specified, it may be much more practical to design successful PD. Thus, the amount of time, energy, and money waste would decrease (Hill et al., 2013).

Since the importance of PDs was realized long time ago, there is considerable literature that investigates the best ways of designing PD for better teacher learning and ultimately, higher student achievement. Even though some viewpoints of PD approach were slightly modified over the years (Cochran-Smith & Fries, 2005), some agreed upon aspects of effective PD remained as important. Some scholars preferred to call these well-established characteristics as *consensus view* (Borko et al., 2010; Caena, 2011; Darling-Hammond et al., 2017; Darling-Hammond et al., 2009; Desimone, 2009; van Driel et al., 2012; Hill et al., 2013; Kennedy, 2016; Wayne et al., 2008).

Basically, effective PD should be content-focused so that participants can expand their professional knowledge and skills (Darling-Hammond et al., 2017; Desimone et al., 2002; Desimone, 2009; Garet et al., 2001; Guskey, 2003; Kennedy, 1998; Yoon et al., 2007). It should give participants opportunity for engaging in active learning thereupon participants can be active participants of the learning process (Garet et al., 2001, Desimone, 2009; Loucks-Horsley et al., 2009). It should be coherent with each aspect of teachers' beliefs, classroom experiences, and needs (Desimone, 2009; van Driel et al., 2012; Garet et al. 2001; Little, 1993; Penuel et al., 2007). Otherwise, PD may remain as insubstantial.

Additionally, adequate amount of time should be devoted so that, participants could have chance to internalize what they learn and have time to apply their knowledge in their classrooms (van Driel et al., 2012; Garet et al. 2001; Loucks-Horsley et al., 2009; Wayne et al., 2008; Yoon et al., 2007). In this way, they may have the opportunity to discuss over their experiences with their PD facilitator and colleagues. This feature also refers to final effective PD characteristics which is collective participation (Borko, 2004; Desimone, 2009; Garet et

al. 2001; Guskey, 2003; Little, 1993; Loucks-Horsley et al., 2009). It was emphasized that for teachers attending PD with people whom they have something in common such as teaching the same subject, the same grade or being in the same school becomes an important factor, which make their discussions more valuable. Since they will have similar background, it is expected to create more interactive learning community around teachers who have something in common.

However, over the years it has been discussed that the expected results of PDs were far from the reality. Even though they may develop teachers' learning (Desimone et al., 2002; Fishman et al., 2003; Garet et al., 2001; Penuel et al., 2007), their ultimate effect on classrooms mostly remained somehow inadequate (Garet et al., 2008; Garet et al., 2011; Garet et al., 2016; Jacob et al., 2017). This situation brought the idea of maybe there is something missing in regard of considering each layer of PD – design, implementation, and effect (Darling-Hammond et al., 2017). Therefore, it was suggested to take all the phases into consideration while questioning its effectiveness.

Within this study, the aim was to collect data from different agents of one particular PD program so that every possible perspective over effective PD can be discovered. In this manner, Integrated Teaching Project was chosen as the setting of the study because it had theoretical framework, structured design, and the goal of sustainability. Under this project, there were two kinds of PDs. As context of this study, one of the Advanced STEM Courses – Block-based coding application integration – was chosen, since it had heterogonous group of participants in regard of their backgrounds. This heterogeneity may increase the reflectiveness of the study even though it had qualitative nature and had limitations over generalizability.

It is important to point out that interview questions of study participants were not focused on the context of the PD but prepared in a more inductive way to discover high-quality PD in general. In other words, it was not intended to find block-based coding

integration related – which was the content of the PD that I chose – or STEM integration related – which was the context of the project – PD characteristics. The aim of this study was to discover high-quality PD characteristics from the perspectives of each person with different roles involved in a PD.

Finally, it is important to underline that qualitative study's data and its analysis has emergent nature. For example, because of chosen PD was conducted online, some of the findings were specific to Online PD (OPD). This situation gave the opportunity for examining one of the most emphasized dichotomy of PD research: comparison of online and face-to-face PD. Similarly, some additional emergent research questions were added because some other unexpected findings were discovered during data analysis.

2. LITERATURE REVIEW

2.1. Understanding Professional Development Study Background

2.1.1. Professional Development

Educational reform movements around the world expect from students to reach advanced thinking and problem-solving skills (Ball & Cohen, 1999; Borko, 2004; Garet et al., 2001; Loucks-Horsley et al., 2009; National Research Council [NRC], 2000; Putnam & Borko, 1997, 2000). However, the classroom settings are not only composed of students. If there is a need for change in one of the components of the classroom, also the other active players of classroom setting should be taken into consideration. That is why, if there is a need for improvement in student learning, also there might be a need for teacher change. This kind of expectation from students might not take place without teachers because they are the practitioners of the reform movements (Darling-Hammond & McLaughlin, 1999; Fullan &Miles, 1992; Sykes, 1999). If it is expected teachers to make this immense of changes happen, then support and guidance for teachers is well-suggested (Ball & Cohen, 1999; Borko, 2004; Putnam &Borko, 1997, 2000; Thoonen et al., 2011).

Even though teacher education programs in universities are putting rigorous work on training pre-service teachers according to 21st century classroom needs for high-quality education, need of such a PD opportunity for in-service teachers may still remain as a problem. Because of the fact that the large amount of teachers is not the novice teachers who just step into the field, they are the ones who already in service, the need for enhancement in professional abilities of current teachers is in the agenda (Fullan &Miles, 1992; Guskey, 1986; Guskey & Huberman, 1995; Momanyi, 2016; Sparks & Loucks-Horsley, 1989). This realization has increased the promotion of the educational scholars and policy makers to

make PDs accessible for in-service teachers to enhance their instructional practices (Ball & Cohen, 1999; Borko, 2004; Garet et al., 2001; Guskey, 2000; Loucks-Horsley et al., 2009).

Professional Development (PD) is defined in various ways in the literature. For example, Guskey (2000) described PD as the "processes and activities designed to enhance the professional knowledge, skills, and attitudes of facilitators so that they might, in turn, improve the learning of students" (p.16). Little (1987) described PD as "any activity that is intended partly or primarily to prepare paid staff members for improved performance in present or future roles in the school districts" (p. 491).

Most of the educational efforts generally aim to reach higher student achievement, therefore PD research started with process-product philosophy. There was a time that teacher learning process was ignored during training. Focus of teacher education was considered only as student outcomes. In other words, the expectation was that if structured education is given to teachers, better student outcomes may arise consequently. However, after late 1950s, researchers discussed that also the part of teacher learning occurs was way too important to be ignored thereupon focus of teacher education slid into teacher cognition as well as student achievement (Cochran-Smith & Fries, 2005). Thus, the appreciation of PD has changed. Studies showed that if both teacher learning and training become successfully accomplished, then instruction might improve as well as student outcomes (Borko, 2004; Cochran-Smith & Fries, 2005; Desimone, 2009; Fishman et al., 2005; Kennedy, 2016; Opfer & Pedder, 2011; Putnam & Borko, 1997; Stewart, 2014). Nowadays, high-quality PD mostly refers to where teacher learning occurs, teacher knowledge and skills develop thereupon this development reflects on their classrooms.

Even though its focus and mean varied over time, PDs maintain its importance. Nowadays, PD is considered as one of the essential elements of the educational reform movements. Mainly, the literature showed that high-quality PD links to high-quality instruction and in turn, high-quality instruction links to higher student achievement (Borko,

2004; Borko & Putnam, 1995; Desimone, 2009; Garet et al., 2001; Loucks-Horsley et al., 2009; Stewart, 2014). PDs should be designed to improve teachers' each domain of knowledge, instructional skills, enthusiasm toward what they teach and facilitation of new learning strategies (Borko & Putnam, 1995; Guskey & Huberman, 1995; Hawley & Valli, 1999; Loucks-Horsley et al., 2009) as well as both communicative and comprehensive skills that leads the belief of each student can achieve higher thinking and problem-solving skills. It is regarded as important for teachers to embrace practices of high-standard curriculum and integrate into their instructional strategies (Darling-Hammond & McLaughlin, 1999; Darling-Hammond et al., 2017; Garet et al., 2001; Hawley & Valli, 1999; Sykes, 1999). Basically, PDs aim to enhance teacher learning that ultimately leads teacher change.

Because of the fact that there are high numbers of expectations from teachers to achieve in these programs, decision making process on PD design has become investigation area for researchers (Darling-Hammond et al., 2017; Desimone, 2009; Desimone & Garet, 2015; Garet et al., 2001; Hawley & Valli, 1999; Kennedy, 1998; Loucks-Horsley et al., 2009). Until early 21st century, limited number of studies proposed direct evidence to high quality PD programs' list of characteristics (Garet et al., 2001). These studies mainly conducted surveys to understand teacher outcomes or collected self-reports from teachers and facilitators (Dede et al., 2009; Fishman et al 2013; Guskey, 2003; Penuel et al., 2007). On the other hand, it is said that currently much more comprehensive studies are conducted in regard of high-quality PD design by focusing on how PD occurs and how teachers learn whereby how teachers effect their students (Fischer et al., 2018; Jacob et al., 2017).

2.1.2. How Does Professional Development Occur?

There is a large body of research on how teacher change occurs (Clarke & Hollingsworth, 2002; Guskey, 1986, 2002; Richardson, 1990). Since most of the times the ultimate goal of PDs is to increase teacher knowledge and skills whereby better student outcomes, the expectation is to create change in teachers' instructional practices. This is

why, by some researchers the effect of PDs was perceived as only behavioral change of teachers (Evans, 2014). On the other hand, PD is considered as more complex than only changing behavior (Borko & Putnam, 1995; Clarke & Hollingsworth, 2002; Guskey, 1995). Therefore, in Guskey's (1986) PD definition, there is also highlight on change in teachers' beliefs and attitudes alongside with change in their classroom practices.

In Evans's (2014) "umbrella" (p.188) definition of PD, she claimed that PD is composed of tree essential processes. The first one is *behavioral* development that deals with the what people do at their workplace. The second one is *attitudinal* development which is about what people perceive, believe, and see in their professional lives. It includes all kinds of motivational factors of professional work. Finally, *intellectual* development is about people's cognition (Richardson, 1990). It deals with what they comprehend, how they understand profession-related knowledge, and how they reflect it in their diverse contexts. So, according to Evan (2014) for person to be able to say professionally developed, all these components should be considered.

For example, as it shown in the Figure 2.1., Guskey (1986)' s teacher change model claimed that actual PD occurs not after changing instructional practices of teachers' but after seeing the positive effects of instructional change. In this way, it would be viewed as not only teachers' behaviors and possibly intellectuals' but also teachers' professional attitudes develop. It is important to keep mind that without considering people's beliefs, motivations, and cognitive processes, their behavioral change might be superficial, and it might not last very long (Guskey, 2002; Evans, 2014).

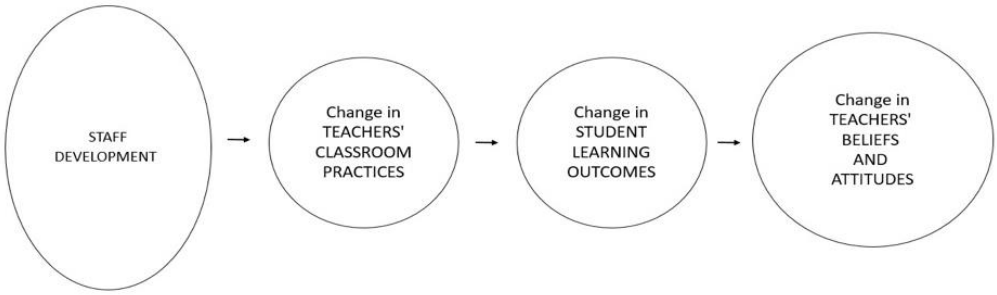


Figure 2.1. Model of the process of teacher change (Guskey, 1986, p.7).

On the other hand, as in the Figure 2.2, Clarke and Hollingsworth (2002) put implicit and non-linear model that seeks to explain professional growth. In their model, there are more than developing people's behaviors, attitudes, and intellects. They underlined that there can be salient outcomes and external factors which are also effective in professional growth. Therefore, it is seen as more complex than moving step by step linearly. They specifically underlined the complexity of human growth and importance of including people's personal differences (Richardson, 1990).

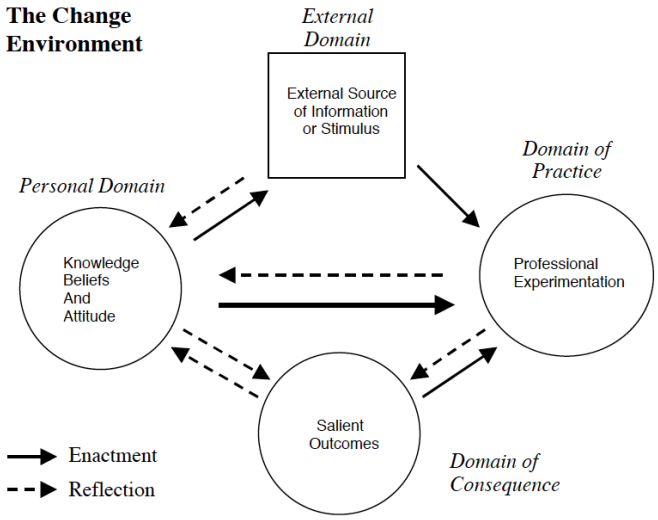


Figure 2.2. The interconnected model of professional growth (Clarke & Hollingsworth, p.951).

One of the reasons of the most obvious change is considered as behavioral because it can be imposed by external others such as administrators and leaders (Evans, 2014; Richardson, 1990, 1998). However, PD does not necessarily occur with one structured program or education. It might also happen very naturally within real-life contexts. (Brown, Collins, & Duguid, 1989; Contu & Willmot, 2003; Greeno, Collins, & Resnick, 1996; Lave & Wenger, 1991). Evans (2014) explains this situation as follows:

> It may occur in any context and, indeed, most frequently does so accidentally or incidentally, as part and parcel of daily [working] life and interaction with a myriad of stimuli that can spark off an idea or thought that leads [immediately or eventually] to enhanced professionalism. In this way – as well as through designated, planned provision – teachers may be led towards, or arrive at, recognition of different elements of practice as 'better' for them in their current circumstances (pp. 193-194).

This does not necessarily mean that deliberate learning environment cannot be designed. On contrary, here, the main underlining point is that within learning environment it becomes important to include in key elements of professional growth. For example, instead of proposing some *better ways* to teach some knowledge, it would be important to give the key idea of why the *better way* is better than the traditional way (Richardson, 1990). This directly means including both intellectual and attitudinal development stages as well as behavioral development. In spontaneous learning, one would need for change and seek for related information. In such case, people have their autonomy for learning. However, in most cases of learning environments, some external individual says what to do or what needs to be changed. This situation may end with resistance to change (Richardson, 1990, 1998). On the other hand, for deliberate learning environment same recognition processes should be provided for teachers as well.

2.1.3. Teacher Learning

When it is talked about PD for teachers, the learning theory cannot be overlooked. Effective PD characteristics are directly related to teacher learning studies since, the audience of the PD are teachers and they are the learners in PD setting. It is discussed that

effectiveness of PD is highly correlated with suitability of teacher learning (Desimone & Garet, 2015; Elliot, 2017; Fisher et al., 2006; Fishman et al., 2013; Ginsburg et al., 2004). Therefore, before presenting high quality PD characteristics, teacher learning literature would be shared under *How People Learn* framework (NRC, 2000).

The cause-and-effect relationship has an important influence on teaching and learning (Kennedy, 2016; Opfer & Pedder, 2011). As a gist of educational reform movements which is student learning is the ultimate goal of each educational effort (Borko, 2004; Putnam & Borko, 1997; Stewart, 2014). That is why studies tried to find ways to make it better, and they found that instruction has a significant effect on student learning. Therefore, studies started to investigate how to improve instruction.

In teacher training point of view, most of the studies have only process-product nature in it in late 1950s to early 1980s. Teacher behavior is the beginning point, and student learning is the end point in this process. The role of the teacher is mainly the transmission knowledge for this perspective. It was assumed that effective teacher behaviors are clearly identified to get higher student scores. That is why sufficient attention was not given for the phase between teacher training and student outcomes during this time period (Cochran-Smith & Fries, 2005). However, after late 1980s teacher training was considered as learning problem, and its focus slid into teacher knowledge, cognition, belief, and attitude as well as student achievement (Cochran-Smith & Fries, 2005).

By this way, the philosophy of teacher training studies has changed. This change was needed because it was realized that teaching and learning process cannot be linear transmission of knowledge, rather it is socially exchange of knowledge. Teachers have also the role of learner as well as their school reformer identities. All these attainments showed that if teacher learning have become successfully accomplished, then instruction might improve in addition to student outcomes. In other words, if the aim is to improve student learning, then it is important to understand how teachers learn and, thus, foster teacher

learning (Borko, 2004; Cochran-Smith & Fries, 2005; Desimone, 2009; Fishman et al., 2005; Kennedy, 2016; Opfer & Pedder, 2011; Putnam & Borko, 1997; Stewart, 2014). However, the entire cause-and-effect relationship of aforementioned variables and other extraneous variables (Opfer & Pedder, 2011), understanding teacher learning, and stimulating teacher change became dynamic and complex process (Ball & Cohen, 1999; Clarke & Hollingsworth, 2002; Hammerness et al., 2007).

It is proposed that awareness of higher student achievement is hard to take place without teacher change (Fullan &Milles, 1992) and this teacher change is hard to occur without any guidance or support (Putnam & Borko, 1997; The Teaching Commission, 2004) led to realization of one big need –professional development – (Borko, 2004). The Teaching Commission (2004) proposed to meet high standards of educational reform movements, ongoing PD that has scope needs to be provided for each teacher. Furthermore, studies have a consensus on if it is wanted to make changes in classroom practice; PD programs are needed to be designed accordingly to make these changes happen (van Driel et al., 2012; Kennedy, 2016; Stewart, 2014; The Teaching Commission, 2004). That is why, studies on PD programs became an important investigation area (Borko, 2004; Opfer & Pedder, 2011).

Research on teacher learning mostly covers the questions of how teachers learn, what they need to learn, and how to integrate what they learn into practice (Feiman-Nemser, 2008; Hammerness et al., 2007). As teacher learning is regarded as complex and dynamic process and contains many variables in it, *How People Learn* (NRC, 2000) is considered as one of the theoretical frameworks to explain teacher learning. *How People Learn* framework mainly covers four perspectives on learning environments: (a) learner-centered perspective, (b) knowledge-centered perspective, (c) assessment-centered perspective, and (d) community-centered perspective (Bransford et al., 2007; NRC, 2000). If the aim is to enhance teacher learning, all four components of this framework must be taken into consideration and combined in PD design (Bransford et al., 2007).

Learner-centered perspective includes the idea of learners came with personal characteristics, cultural background (Ball & Cohen, 1999), experiences and preconceptions (NRC, 2000). In this sense, teachers have different knowledge, beliefs (Desimone, 2009; Putnam & Borko, 1997), attitudes, self-efficacies, and motivations toward their learning processes (Bransford et al., 2007; Clarke & Hollingsworth, 2002; Guskey, 1986, 2002; Opfer & Pedder, 2011; Richardson, 1990). To create more effective learning environment for teachers, it becomes important to keep in mind all these learner characteristics have mutual relationships with teacher learning (Opfer & Pedder, 2011).

Knowledge-centered perspective mainly focuses on what to learn – subject matter–, why is learned – understanding behind the subject matter –, and learning goals (NRC, 2000). Subject matter is the question of what teachers need to know (Ball & Cohen, 1999). In this perspective Shulman (1986) proposed three domains of teacher knowledge: (a) content knowledge, (b) pedagogical knowledge, and (c) pedagogical content knowledge (PCK). It is important to bear in mind that covering all these components of knowledge is crucial for advancing classroom practices and enacting new implementations (Hammerness et al., 2007; Kennedy, 2016; Putnam & Borko, 1997). It also involves the curriculum, tools, materials (Fishman et al., 2005; Hammerness et al., 2007), and activities that are planned to use during learning process because these contributory resources construct the context. Without knowing what to learn and giving any attention to the content, teacher learning would not be exactly accomplished and that's why related studies have specifically underlined the importance of content focus (Bransford et al., 2007; Desimone, 2009; Garet et al., 2001; Kennedy, 2016; NRC, 2000).

In this sense, how they acquire the content is also in the knowledge-centered perspective's interest. Given the content in a related context is highlighted here (Fishman, et al., 2005). Because of the fact that learning concepts in particular context may lead to construct connected (NRC, 2000) and coherent knowledge (Desimone; 2009; Garet et al., 2001), learning within context is one of the key factors for better learning.

It is thought that the main focus of assessment-centered perspective is feedback (Bransford et al., 2007; NRC, 2000). Assessment procedures do not necessarily have to be formal and may come from outside resources. Being reflective on their own learning procedure also may provide the opportunity for learners to become active participants (Desimone; 2009; Garet et al., 2001; Putnam & Borko, 1997) and expand their thinking skills (Ball & Cohen, 1999; Borko, 2004). Revision and reassessment of their learning mostly gives learners to new and better perspectives because it gives time to think on their learning progress and what went wrong and what went well (Hammerness et al., 2007; NRC, 2000). These self-reflection procedures may also provide guidance for researchers to understand teacher learning better, design PD programs, and conduct studies accordingly.

Community-centered perspective is interested in creating learning environments that are flexible, aided, unbiased, and empowered to work collaboratively with other members of community (Fishman et al., 2005; Kennedy, 2016; Little et al., 2003). It is viewed as important for learners to have such settings that they can share their ideas, questions, and criticisms in a comfortable climate to evaluate their own performances (Bransford et al., 2007; Hammerness et al., 2007; Kennedy, 2016; NRC, 2000). Community here implies not only outside of the school that includes cultural norms, house (NRC, 2000), and other external sources (Clarke & Hollingsworth, 2002) but also classroom and school environment.

When it is talked about school environment, teachers specifically involve the authorized people like principal or administrators (Garet et al., 2001), and recent studies also take this variable into account while they were investigating teacher learning and change (Thoonen et al.,2011; Veelen, Sleegers, & Endedijk, 2017). Furthermore, it was underlined in the literature that creating social networks in the same school, grade or department could enhance teacher learning because it arranges potential interaction settings (Desimone, 2009; Garet et al., 2001; Kennedy, 2016; Opfer & Pedder, 2011) without too much effort to meet and they share similar problems in that particular learning environment.

2.1.4. Effective Professional Development Characteristics

After awareness of PD importance in education field, research on effective PD characteristics has emerged. Because of the fact that policy makers and practitioners want to invest their efforts on effective PD programs so that they can reach their educational reform expectations from the most efficient way as it is possible. Naturally, one can expect that they do not want to lose any time or money (Hill et al., 2013). Therefore, the large amount of literature started to grow in the field (Borko et al., 2010; Darling-Hammond et al., 2009; Darling-Hammond et al., 2017; Desimone & Garet, 2015; Desimone, 2009; van Driel et al., 2012; Fisher et al., 2018; Garet et al., 2001; Guskey, 2000; 2003; Hawley & Valli, 1999; Penuel et al., 2007; Sims & Fletcher-Wood, 2018; Thompson & Zeuli, 1999; Wayne et al., 2008; Yoon et al., 2007).

In the literature, the effective PD was defined in various ways but commonly reaching expected outcomes of PD was the essential criteria for defining it as effective. In a nutshell, it can be defined as structured teacher learning that ends up with instructional changes and thereupon better student learning outcomes (Borko et al., 2010; Darling-Hammond et al., 2017).

As a problematic view, in first attempts of searching for effective PD characteristics was supported by only PD facilitator surveys and teachers' self-evaluation reports (Fishman et al., 2013; Garet et al., 2001; Guskey, 2003; Hill et al., 2013). However, in time, it was realized that there is a need for more evidence-based data to support claims of effective PD characteristics. Thus, large-scale research programs started to be conducted. Some of these empirical studies only focused on the change in teacher knowledge and implementation (Desimone et al., 2002; Penuel et al., 2007) whereas, some studies worked on not only teacher change stance but also student achievement (Garet et al., 2008; Garet et al., 2011; Garet et al., 2016; Fischer et al., 2018; Jacob et al., 2017; Yoon et al., 2007). It is important

to remember that ultimate goal of PD is mostly considered as improving instructional strategies and higher student achievement.

After many empirical studies, review studies started to be worked on to combine all the discovered effective PD characteristics (Borko et al., 2010; Darling-Hammond et al., 2017; Dede et al., 2009; van Driel et al., 2012; Kennedy, 2016; Wayne et al., 2008; Sims & Fletcher-Wood, 2018). In this way, policy makers and practitioners could be able to evaluate PD effectiveness systematically. Throughout the literature on effective PD characteristics, the literature safely started to call some well-established PD characteristics as *consensus* (Borko et al., 2010; Caena, 2011; Darling-Hammond et al., 2009; Darling-Hammond et al., 2017; Desimone, 2009; van Driel et al., 2012; Hill et al., 2013; Kennedy, 2016; Wayne et al., 2008). According to *consensus*, Wayne et al. (2008) summarized definition of effective PD as follows.

> [Effective PD] is generally accepted that intensive, sustained, job-embedded PD focused on the content of the subject that teachers teach is more likely to improve teacher knowledge, classroom instruction, and student achievement. Furthermore, active learning, coherence, and collective participation have also been suggested to be promising best practices in PD (p. 470).

This *consensus* view was accepted by policy makers of USA, UK, and EU to design PD programs (Caena, 2011; Sims & Fletcher-Wood, 2018). Now, these PD characteristics will be presented, then some additional PD characteristics that were considered as effective in the literature will be explained.

2.1.4.1. Content Focus. While designing PD, the most highlighted characteristic is being content focus (Darling-Hammond et al., 2017; Desimone et al., 2002; Desimone, 2009; Garet et al., 2001; Guskey, 2003; Kennedy, 1998; Yoon et al., 2007) because subject matter is the question of what teachers need to know (Ball & Cohen, 1999; Putnam & Borko, 1997). Specifically, being relevant with what teacher will teach and giving related pedagogical aspects – PCK – is the most effective way to improve instruction (Garet et al., 2001; Guskey, 2003; Desimone et al., 2002; Penuel et al., 2007; Yoon et al., 2007).

Being content focus also involves the curriculum, tools, materials (Fishman et al., 2005; Hammerness et al., 2007), and activities that are planned to use during learning process because these contributory resources construct the context. Without focusing what to learn and giving any attention to the content, teacher learning may not be exactly accomplished thereupon studies specifically underlined the importance of content focus (Bransford et al., 2007; Desimone, 2009; Garet, et al., 2001; Kennedy, 1998; 2016; National Research Council [NRC], 2000).

2.1.4.2. Active Learning. The second underlined feature is the *active learni*ng. Desimone et al. (2009) was characterized active learning as "listening to lecture, can take a number of forms, including observing expert teachers or being observed, followed by interactive feedback and discussion; reviewing student work in the topic areas covered; and leading discussions" (p.184). If it is wanted to be PD is serving active learning environment, it can be viewed as important to pave the way for teachers to make meaningful discussions, plan applicable classroom implementations, to share their own experiences and get experienced from other colleagues, and to produce some works such as presentations, written assignments, or micro teaching sessions (Desimone, 2009; Garet et al., 2001; Loucks-Horsley et al., 2009). Active learning means that PD facilitators using authentic works, interactive activities, and other strategies provides deeply embedded, highly contextualized professional learning. It is the exact opposite of sit-and-listen (Darling-Hammond et al., 2017).

2.1.4.3. Coherence. In PD context, coherence refers to *consistency* between what was learned during PD and what teachers know and believe. In other words, what is learned from the PD should be consistent with facilities of schools, administrations, cultures of the neighborhoods, and potentiality of students (Desimone, 2009; van Driel et al., 2012; Garet et al. 2001; Little, 1993; Penuel et al., 2007). In this respect, being coherent involves three main bases: (1) consistency of objectives of the PD and its activities, (2) inclusiveness of educational reform movements and national or international policies, and (3) interaction level of others which are school administrators, PD facilitators, or colleagues (Garet et al,

2001). Besides, it was advised that PD should be about not only expected educational reforms but also teachers' daily needs, the possible problems they may face with during implementation, and any external pressure in the way (Borko et al., 2010; Desimone, 2009; van Driel et al., 2012; Hawley & Valli, 1999). To sum up, it is the link between what was thought and real-life implementations.

2.1.4.4. Duration. The fourth underlined feature of the effective PD in the literature is *duration*. Almost all studies have an agreement on one-shot PD cannot reach its goals in many ways because it cannot provide sustainable environment for learning (van Driel et al., 2012; Garet et al. 2001; Loucks-Horsley et al., 2009; Wayne et al., 2008; Yoon et al., 2007). What is meant by that, PD should allow teachers time to implement and experience what they see and learn from the PD. There should be enough time to discuss, share, and apply what they get informed from the PD. It does not matter, if the knowledge is content-based facts, pedagogical considerations, or PCK. For example, in their empirical studies, Yoon et al. (2007) proposed that only more than 14 hour-long PD showed positive and significant effect on students. Thus, their advice is to provide higher *dose* PD for teachers. The main highlight here is that sustained duration higher the efficacy of PD because it gives time for teachers to process their cognition on PD content (Borko et al., 2010; Darling-Hammond et al., 2017; Desimone, 2009; van Driel et al., 2012; Garet et al., 2001; Guskey, 2003; Penuel et al., 2007; Thompson & Zeuli, 1999).

2.1.4.5. Collective Participation. Another stressed out feature of the effective PD is that *collective participation* that refers to participation of PD consists of same grade level, school, or department teachers (Borko, 2004; Desimone, 2009; Garet et al. 2001; Guskey, 2003; Little, 1993; Loucks-Horsley et al., 2009). With this way, teachers would have a chance to discuss over common needs of theirs. Because of the fact that most of them would go through with same school environment, common curriculum materials, or similar conditions, they can share experience one to another and help them to see different perspectives of instructional contexts within these conditions (Hawley & Valli, 1999; Guskey, 2003). When teachers spend more time in the same environment, as well as the time spent in PD, they

would have more chance to discuss over their gains from the PD, problems, or questions. Another aspect of collective participation is the chance of growing as a group as well as growing as an individual. In other words, there would be mutual development in regard of professional development between group of teachers and each teacher as an individual (Borko et al., 2010; Darling-Hammond et al., 2017; Penuel et al., 2007; Wayne et al., 2008). It is important to create awareness from different eyes of opinion within the same learning environment.

2.1.5. Additional Characteristics from the Literature

2.1.5.1. Inclusion of Evaluation. Inclusion of evaluation process into PD process specifically underlined some studies in the field (Darling-Hammond et al., 2017; Guskey, 2003). It was considered as important because participants would have a chance to discuss over their own experiences that is based on expected PD implications. Evaluation process of PD includes that teachers producing their own tailored curricular materials (e.g., lesson plans, applications, projects), and getting feedbacks about these documents from their colleagues or PD facilitator. It also involves self-reflection process over this production process (Darling-Hammond et al., 2017; Guskey, 2003). In this sense, Guskey (1995) recommended that *think big* but *start small*. This PD characteristic is also linked to sustained duration because it refers to cycle for implementation and revisions over implementation. Obviously, this takes time and requires collaborative work among teachers (Hawley & Valli, 1999; Thompson & Zeuli, 1999).

2.1.5.2. Modelling of Instructional Strategies. Using specific modeling during the PD guides teachers by making the practical expectations concrete. In this way, it can be easy for teachers to visualize some abstract and conceptual practices and implement in their own situation (Borko et al., 2010; Darlin-Hammond et al., 2017; Yoon et al., 2007). Darling-Hammond et al. (2017) explained this situation as “Curricular or instructional models and modeling of instruction help teachers to have a vision of practice on which to anchor their

own learning and growth" (p.11). These modelling methods can be supported by videos or microteaching sessions, lesson plans, student work or assessment products, curricular materials, observations, and so on. The main underlining point is to provide preview of actual implementation so that proximity to practice when evidence is provided that teachers give vision that can be transformed most directly into the practice to help them prepare for their classroom practice (Borko et al., 2010; Penuel et al., 2007).

2.1.5.3. Expert Support. Just like teachers are considered as the experts for students to guide them to reach learning objectives, it is seen that PD facilitators are experts who scaffolds and share their experiences to support their colleagues (Darlin-Hammond et al., 2017). In this sense, some studies specifically underlined the importance of expert support during the PD (Darlin-Hammond et al., 2017; Penuel et al., 2007; Yoon et al., 2007). Actually, this is one of the essential parts of PD implementation. Just like ineffective instruction may cause poor student outcomes, inefficient implementation of PD may easily cause PD to be less efficient than expected. The expert support here mostly implies to coaching the colleagues who were at the beginning of the adventure they were once in (Darling-Hammond et al., 2009; Darlin-Hammond et al., 2017; Little, 1993). This is why, it mostly involves scaffolding based on experts' own experiences. Teachers who receive help from more expert colleagues may also receive important new information from interactions that broaden what they have learned from their formal PD experience (Penuel et al., 2007).

2.1.5.4. Sustainability. It is a well-accepted feature for successful PD that maintaining ongoing and sustained PD (Borko et al., 2010, Darlin-Hammond et al., 2017; van Driel et al., 2012; Garet et al., 2001; Guskey, 2000; Wayne et al., 2008). In general, sustainability was mentioned in regard of duration of the PD (Darlin-Hammond et al., 2017; van Driel et al., 2012). Since learning is viewed as an ongoing process, the regarded enough time and sources should be provided to participants. So that, they can move in their learning processes without feeling lonely or helpless. It is said that it is important to remember that teachers might need guidance for not only understanding the PD content but also implementing it (Borko et al., 2010; Darlin-Hammond et al., 2017; Garet et al., 2001). Loucks-Horsley et al.

(2009) approaches sustainability little different than others. They proposed that capacity check should be done for sustainability so that regarded scope can be accomplished in a sustainable environment. For example, if the scope is designed school-based, then the regarded capacity check should be done such as how many leaders would be needed, support systems to maintain PD providers, what would be the scope either reformed changes or scaling up with new methods. So that, PD can sustain itself until broader scope of the PD will be accomplished.

2.2. Understanding Context and Content of Investigated PD

Since the context and content of PDs also have an effect on their designs and implementation, it becomes important to give information about in what context PD – that was investigated for this study – took place. Therefore, under this section of literature review, some contextual review is presented. Since investigated PD conducted in Turkey, it was part of STEM Integration Project and it was OPD that specialized in block-based coding integration, all these fields and their related literature introduced the readers in this section. Also, theoretical framework of the PD project – that was chosen as setting for this study – is explained in this section so that readers can understand the scope and philosophy of the project.

2.2.1. PD in Turkish Context

As any other countries in the world, importance of PD on teachers and students' achievement is one of the main fields of study for Turkish Education System. Officially, PD is under Ministry of National Education's responsibility. There is a separate unit under Ministry of National Education that is called Ministry of General Directorate of Teacher Training and Development. Their duties are specifically written in the Presidential Decree under Ministry of Education duties article 312.

Ministry of General Directorate of Teacher Training and Development is responsible from establishing policies for the determination and development of public-school teachers' qualifications and competencies. For this purpose, they are responsible from cooperating with the relevant units, institutions, and organizations. Moreover, they have duty to provide pre-vocational and in-vocational training, to open courses, to organize specialist programs, seminars, symposiums, conferences and similar events for public school teachers and private educational institutions' teachers upon their requests. They are responsible for making researches on issues related to education to be given to teachers. To be able to reach these aims, they have to cooperate with public institutions and organizations, universities and non-governmental organizations in matters coinciding within the scope of their duties; organizing collaboration, research, training programs, and advisory boards and commissions (MoNE, 2018a).

First of all, there are different kinds of PD programs as part of Ministry of General Directorate of Teacher Training and Development. There is one called *Professional Studies*. During the mid-term breaks, in the period between the first working day of September and the beginning of the lessons and in the period between finishing lessons and the first working day of July, administrators and teachers carry out professional studies determined by the school directorate, provincial / district national education directorate and the Ministry of Education. These studies are conducted in administrators' and teachers' own schools. However, within the framework of the program prepared by the provincial / district national education directorates and within the scope of vocational education issues determined by the relevant general directorates, teachers can be subjected to vocational education in certain centers or other schools according to their subjects (Millî Eğitim Bakanliği Okul Öncesi Eğitim ve İlköğretim Kurumlari, 2019).

The participation for professional studies is mandatory for administrators and teachers. The professional study program is prepared by the school directorate considering the needs of the school and the environment and is announced to the teachers a week in advance (Millî Eğitim Bakanliği Okul Öncesi Eğitim ve İlköğretim Kurumlari, 2015 June).

Content of these studies is based on finding ways to increase the general culture, content, and pedagogical knowledge, to gain new skills, and to find solutions to problems encountered in education and training (Millî Eğitim Bakanliği Okul Öncesi Eğitim ve İlköğretim Kurumlari, 2015 July).

On the other hand, studies argued that these professional studies only remain on official documents (Ceylan & Özdemir, 2016). Teachers have expectations from these trainings (Baştürk, 2012). However, it is found that professional studies cannot be conducted according to their purpose (Boydak-Özan et al., 2014; Saracaloğlu et al., 2016) and professional study periods cannot be evaluated effectively (Tonbul, 2006). So, they remain as inefficient (Sıcak & Parmaksız, 2016). However, professional study periods can play an important role in ensuring the personal and professional development of teachers as well as preparing for the new school year and evaluating the completed school year, if they planned and implemented well (Gültekin et al., 2018).

There are also PD programs called in-service training. They are under two different directories which are responsible from central operations and local operations. Under central directory of in-service training, there are both face-to-face and OPD options are available. According to Ministry of General Directorate of Teacher Training and Development Unit Annual Report for 2018 – as it is shown in Table 2.1. – 290 face-to-face and 34 online in-service training operations were conducted. Additionally, there 10 local in-service training institutions in different regions of Turkey. Under these institutions, in 2018, 35,084 face-to-face in-service training operations were conducted. In total, there were 1,181,246 participants. Within these participants, 468,196 people attended more than one in-service training operations. Training hours per teacher was specified as 38.5 in the annual report for 2018.

In-service training needs of teachers are determined based on demands of teachers, legislative requirements, developments in science and technology, audit reports, action plans

and other top documents. For 2019 in-service teacher training need analysis, the online system that teachers log in by using their ID numbers and activity numbers was used. This online platform is called MEBBIS. Teachers' applications for in-service trainings and evaluation process of the applications also processed electronically via MEBBIS. Final participant list is created, after the approval of the teacher's school / Institution, District National Education Directorate, Provincial Directorate of National Education, and the responsible Ministry Unit (MoNE, 2018b).

Table 2.1. Ministry of general directorate of teacher training and development unit annual report.

Year		Central Activities		Local Activities		Overall Total		Total Number of Activity	Total Number of Participant
		Number of Activity	Number of Participant	Number of Activity	Number of Participant	Number of Activity	Number of Participant		
2016	Face-to-face	375	30,393	37,290	1,410,881	37,665	1,441,774	37,798	1,729,016
	Long-distance	48	283,150	85	4,092	133	287,242		
2017	Face-to-face	400	26,850	27,319	955,585	27,719	982,735	27,752	1,047,477
	Long-distance	33	65,042	-	-	33	65,042		
2018	Face-to-face	290	15,537	35,084	1,099,059	35,374	1,114,956	35,408	1,181,246
	Long-distance	34	66,650	-	-	34	66,650		

Content and variety of these in-service trainings separated into many categories which are personal development trainings, teacher trainings, special qualified trainings, management and corporation trainings, and seminars. According to need analysis survey for 2019, teachers mostly preferred to attend teacher trainings (41%) and personal development trainings (32%). The General Directorate of Teacher Training is responsible for the planning, approval, and implementation processes of the central in-service activities of public-school teachers. Governorships carry out local in-service training activities' planning, approval, and

implementation processes. After completion of in-service trainings, teachers get electronic certificate within the MEBBIS system.

According to 2018 in-service training codes of practice (MoNE, 2018a), applications for in-service trainings are volunteer but, after application was approved, participation is viewed as mandatory. Teachers can only apply for one central and five local in-service training within one year. When in-service training plan document for 2018 that is published in Ministry of National Education website was analyzed, it was found that 436 in-service activity was planned to be conducted but, 152 was cancelled because of various reasons (MoNE, 2018a). Unfortunately, no statistical data that shows cancellation rates was available in the Ministry of National Education website. This shows that in action, there are some problems to conduct these in-service trainings according to the plan. So that, even if some teachers are willing to attend in-service training, it could not be possible sometimes.

When specific attention was given to currently having 10 different local in-service training institutions and giving authorization to school administrators to preparing professional studies for teachers, it can be said that localization toward educational needs tried to be considered by Turkey's PD context as many other countries such as UK (Altun, 2011), Finland, China/Shanghai (Elçiçek & Yaşar, 2016). However, in the implementation, these efforts remain on the paper (Saracaloğlu et al., 2016; Sıcak & Parmaksız, 2016).

In Turkey, there are also many private institutions. Some private schools are conducting various PD programs for their administrators and teachers. As one of the main sources of branding policy for private schools is that having well-equipped teachers. So that, providing professional education for their teachers is one of the keyways to establish this aim (Akyol &Yılmaz, 2016). When, web pages of well-known private school are checked in Turkey, it can be realized that PD programs for teachers is one of the main underlining.

There are also universities' lifelong learning centers and some private entrepreneurs who provides paid PD programs for teachers. For example, in Bogazici University, under Lifelong Centre there is one unit that is called *Teachers Academy*. They provide both individual and corporate trainings in a wide range of content. However, any scientific research about these programs could not be found. So, there is not enough evidence on these PD programs. Furthermore, when TUBITAK (Mission of The Scientific and Technological Research Council of Turkey) which is one of the fund resources for PD was examined, various grants were distributed among both private and public schools (TUBITAK, 2020). This shows that there are various efforts for PD. However, within the literature, it was noticed that these applications did not turn into research. Most of the research focus on public school teachers' PD activities that is conducted by Ministry of National Education.

Therefore, PD could be considered as one of the biggest problematic issue in Turkey (Ceylan & Özdemir, 2016; Elçiçek & Yaşar, 2016; Özdemir, 2016a, 2016b). Even though the large percentage of teachers who are already in-service, there is unbalanced investment between pre-service education and in-service PD programs. In other words, according to the MoNE minister's statement, although 95 thousand teachers are needed and 500 thousand candidates are available, every year; many universities are trying to train 10 thousand new candidates through education faculties and formation (Elçiçek & Yaşar, 2016). However, this does not mean that there is no investment on in-service teacher training According to Ministry of General Directorate of Teacher Training and Development Unit annual report for 2018, 45,140,072 TL were granted for in-service trainings. The main issue is that whether or not this kind of big investment is well-spent.

As one of the biggest criticisms for PD programs in Turkey, they are considered as inadequate and ineffective in terms of quality and quantity. As a result of this, the teacher's views toward PD negatively developed over the years (Elçiçek & Yaşar, 2016; Özdemir 2016b). They mostly consider PD programs as something to complete mandatorily (Elçiçek & Yaşar, 2016; Özdemir 2016b) and bunch of theoretical knowledge that they cannot use in the classroom (Altun, 2011; Özdemir 2016b). Moreover, PD programs in Turkey are still

mostly composed of seminars and conferences (Ceylan & Özdemir, 2016; Elçiçek & Yaşar, 2016; OECD, 2009; Özdemir, 2016a, 2016b) even though there is a large amount of literature that says one-shot PD have almost no or less effect on teacher change (van Driel, 2012; Garet et al., 2001; Yoon et al., 2007). Teachers repeatedly highlighted seminars and conferences that are mostly based on theoretical and top down statements are ineffective to improve their instruction (Akçay-Kızılkaya, 2012; OECD, 2009; Özdemir, 2016a). Obviously, formal PD programs are not working for in service teachers and there is a need for rigorous research on PD programs that are conducted by private investors.

Therefore, there is an urgent need for developing vision for new PD programs in Turkey. Within such a problematic environment for PD, this study aims to put comprehensive work to understand what characteristics high quality PD should have. I aimed to explore high quality PD characteristics by considering every practitioner that is involved in PD design and implementation and exploring their visions in the field. So that, policy makers can put rigorous attention is given to this area, which is obviously in need of investment.

2.2.2. Need for Online Professional Development

With the advancements of digital technology, our lives have changed in most of its aspects. One can conclude that it provides us many opportunities like assessing variety of sources in any time, at any place (Collins & Liang, 2015). People who had the motivation for learning had the chance for reaching any source in any topic from various websites, blogs, forums, and so on. It means that nowadays, learning evolved in whole new dimension. It is more on-demand and self-directed learning period (Albers et al., 2015; Beach, 2017; Collins & Liang, 2015). Fisher, Higgins and Loveless (2006) calls it *renaissance* for teaching profession. Accordingly, also PD programs started to be transformed in more digital venues. In this way, it was aimed to benefit from advantages of digital technology.

Additionally, even though there is an awareness over PD's importance and large amount of studies on PD (Fischer et al., 2018; Darling-Hammond et al., 2009), current PD programs mostly remained inadequate in regard of connectivity to teacher's practices and learning (Collins & Liang, 2015; Wei et al., 2010), implementing educational reforms to classrooms and reaching better student outcomes (Barnett 2002; Dede et al., 2009; Hill et al., 2013). It is important to keep in mind that not only policy maker's time, energy, and money spent on these programs, also teachers spend so much effort on it. They try to save extra time and energy for these programs so that, they can reach certain improvements in their profession. Otherwise, teachers may start to consider PD as redundant and earn some credits for certification (Elliot, 2017; Taylor, 2011). Hence, it is important to provide PD programs for teachers in the most efficient way that suits teachers' already busy schedules (Dash et al., 2014; Dede et al., 2009).

Effectiveness of PD programs is key point to explain why Online Professional Development (OPD) programs have arisen in addition to technological advancements, because if teachers are devoting their times and efforts to these programs, they should not get frustrated from these programs (Brunvand et al., 2003; Collins & Liang, 2015; Dede et al., 2009; Elliot, 2017). The need for PD that is available in each field, that is suited for teachers' intensive programs (Elliot, 2017), and that provides well-structured, innovative, sustainable, applicable, and realistic resources has caused the evolution of OPD (Collins & Liang, 2015; Dede, 2004; Vu et al., 2014). OPD can be defined as accomplishing teacher learning completely or partially in a web-based context (Elliot, 2017; Fishman et al., 2013).

Since online platforms serves many advantages for teachers especially in financial and logistic aspects, there is a big investigation area for teacher education researchers (Bates et al., 2016; Collins & Liang, 2015; Dede et al., 2009; Fishman et al., 2013). Internet can give the opportunity for not only teachers but also everyone to access any source on any topic. So, one can say it is very useful for getting instant assistance according to particular need (Albers et al., 2015; Cheawjindakar et al., 2012). Teachers can reach these programs in any time at any place. So, most likely teachers would not face problems like spending too much

time while they were joining the face-to-face PD programs. (Bates et al., 2016; Dede et al., 2009; Means et al., 2009).

Moreover, OPD provides opportunities for teachers such as creating online communities (Carey et al., 2008; Elliot, 2017; Treacy et al., 2002; Trust et al., 2016), comfortable settings for teachers who often prefer to be silent in face-to-face programs, and so many audio-visual educational aids (Dede, 2004). They can get help or assistance in moment (Bates et al., 2016) and they can reflect others who may attend from their school environment and their disciplinary programs or may attend from the other end of the world (Carey et al., 2008; Fishman et al., 2013; Trust et al., 2016). By being part of one various online community, teachers could have chance for improving themselves professionally according to their own interest and needs (Macià & García, 2016).

It is well-accepted fact that digital technology serves so many resources. However, still it is very different form of teaching and it takes time for facilitators to design OPD and facilitators to get adopt how to manage it. It is not reasonable to expect to directly turn from face-to-face PDs to online platforms. Systematically, they work in different ways (Elliot, 2017; Prestridge & Tondeur, 2015). Therefore, even though there are some commonalities in design characteristics between traditional and OPD programs, there are also some different points to consider (Collins & Liang, 2015; Elliot, 2017; Fishman et al., 2013; Parsons et al., 2019; Russel et al., 2009; Taylor, 2011).

First of all, there are many studies that try to understand impact factors of face-to-face and OPD on teacher's knowledge, instructional change, and student outcomes. Most studies find that not only OPD (Dash et al., 2014; O'Dwyer et al., 2010; Parsons et al., 2019) but also, face-to-face PD positive effects on teacher change (Fishman et al., 2013; Means et al., 2009; Russel et al., 2009). When they compare face-to-face and OPD, they mostly found equal effect on teacher knowledge and instructional change (Bernard et al., 2004; Fishman et al., 2013; Means et al., 2009; Russel et al., 2009). According to these studies, there is a relatively small difference in regard of teacher change (O'Dwyer et al., 2010) or no

significant change in regard of student outcomes (Dash et al., 2014). On the other hand, Means et al., (2009) reached higher scores in teacher knowledge and instructional change when they compare blended PD with face-to-face and online. This means that blended PD which is facilitated partly face-to-face and partly online might be more effective than other two forms because it has chance to take advantages of both forms.

Secondly, there are many discussions over if OPD should be facilitated or not. Since OPD is mostly depends on self-directed learning, some argues that teachers can learn with their own pace and this is one of the beneficial characteristics of OPD. Nowadays, learning takes place more on-demand. So that, teachers are participating voluntarily with high motivation and it is better for their learning (Albers et al., 2015; Beach, 2017; Prestridge & Tondeur, 2015; Wynants & Dennis, 2018). In this context, self-discipline and intrinsic motivation are key factors for learning (Wynants & Dennis, 2018; Vu et al., 2014). On the other hand, some argues that OPD is more useful when it is more structured and formal. It is proposed that it is more helpful if discussion forums are encouraged and triggered by facilitator (Prestridge & Tondeur, 2015; Richardson, Maeda, Lv, & Caskurlu, 2017; Treacy et al., 2002). It was showed that there are no significantly different results between self-paced learning and facilitated learning (Carey et al., 2008). However, these results can vary according to the content and the community.

As another discussion point, online environments are considered as better in regard of building communities and getting instant helps from one another. Also, social media tools are highly acceptable ways for teachers to improve themselves professionally (Albers et al., 2015; Campana, 2014). By following and interacting other colleagues, they can reach through practical and on-purpose examples for their particular circumstances (Bates et al., 2016; Beach, 2017; Carey et al., 2008). This is another reason for online environments are seen as better service for self-directed learning. Everybody can find flexible, convenient, self-directed activities for their own interests (Albers et al., 2015; Bates et al., 2016; Carey et al., 2008; Collins & Liang, 2015). This does not necessarily mean that one group of teachers who has same interests or same needs cannot be part of structured OPD.

As a matter of fact, OPD can take place in many formats. It can be accessed formally or informally. So, it is more flexible than traditional PD programs and teachers can easily find OPD that suits best for their interests and needs. It happens more voluntarily and self-directed (Albers et al., 2015; Elliot, 2017; Prestridge & Tondeur, 2015). OPD can also be designed as synchronous or asynchronous. Most of these formats come with different instructional design needs (Bates et al., 2016; Elliot, 2017; Parsons et al., 2019). This is why, in OPD study, there are variety of approaches to consider and research.

Little and Housand (2011) suggested five formats of implementation for OPD. These formats listed as (a) accessible websites or online resources, (b) technology for interacting with face-to-face audiences in real time, (c) Professional development supported with asynchronous online discussion, (d) video conferencing, and (e) the construction and facilitation of an ongoing online community.

Cheawjindakar et al. (2012) proposed five fundamental factors to consider for successful online education design which are 1) Institutional Management, 2) Learning Environment, 3) Instructional Design, 4) Services Support and 5) Course Evaluation. They presented these factors for higher education institutions, but it also applies for structured OPD platforms. First of all, *institutional management* includes market research which is for need assessment (Brunvand et al., 2003), program framework which is for determining scope of the program, operational plan which is for embedding online learning into overall teaching framework, and cost effectiveness which is for optimized financial plan (Cheawjindakar et al., 2012).

Secondly, *learning environment* includes course management system, technical infrastructure, interactive learning, and access and navigation. Some instructional designers and facilitators prefer to design OPD by combining different formats of online learning under one structured course management system so that, they can take advantage of each of these formats (Cheawjindakar et al., 2012; Elliot, 2017; Ginsburg et al., 2004). It is the

system for tracking down all the course materials. It is the venue for facilitating the OPD and keeping everything under record. It is one of the most appreciated features of the OPD by participants (Parsons et al., 2019). Some researchers see technical infrastructure is necessary for processing OPD smoothly by providing every necessary tool (Cheawjindakar et al., 2012). For example, variety of communicative tools should be provided for interactive learning (Elliot, 2017). This is viewed as one of the main underlining because according to some studies, online platforms serve better opportunities for building communities. However, if related communicative tools would not be provided and guided to how to use them (Cheawjindakar et al., 2012) then, it might not be possible (Collins & Liang, 2015; Ginsburg et al., 2004). Also, the system interface should be designed user-friendly and well-thought so that, participants can easily get used to it and be able to use (Elliot, 2017).

As third factor of successful OPD design, *instructional design* is very important. It includes content and pedagogical stances of knowledge (Cheawjindakar et al., 2012; Elliot, 2017). For example, stating clear learning objectives could be very important starting point. Then, well-thought content structure is very essential baseline for any learning platform. While designing the instruction, taking learning theories (Collins & Liang, 2015; Fisher et al., 2006; Fishman et al., 2013) and using variety of teaching strategies into consideration are very significant (Cheawjindakar et al., 2012). Instructional design is the stage that includes most of the essential decision-making processes of the content. For example, presenting coherent examples that suits teachers' daily practices is one of the most underlined points of instructional design (Brunvand et al., 2003; Collins & Liang, 2015 Ginsburg et al., 2004). For this reason, specifically this factor applies for not only OPD but any PD design.

As forth, *services support* is another underlined factor for OPD design (Cheawjindakar et al., 2012; Treacy et al., 2002) because readiness for online learning and self-efficacy for technology enhancement may vary according to each participant (Collins & Liang, 2015; Parsons et al., 2019; Redmond, 2011; Vu et al., 2014). For example, without any experience in online learning settings, one might get lost in technicalities and can feel information

overload (Collins & Liang, 2015). This is also highly correlated with instructional design factor. So, if it is possible, it is important to give basic information about the course management system or being prepared for the possible challenges is very key factors for smoothly implemented OPD (Cheawjindakar et al., 2012; Vu et al., 2014). It can be very useful to provide technical support whenever it is needed.

Finally, implementing assessment process in online learning is regarded as very significant as any other learning platforms. It should cover all stages of instruction by using summative and formative assessment tools (Cheawjindakar et al., 2012). Getting reflection and building constructivist discussions over assessment tools are productive ways of learning (Prestridge & Tondeur, 2015). It is important to keep in mind that assessment is very inherent part of participants' learning. Also, it is a chance for facilitators to tailor their OPD design.

2.2.3. Integrated STEM Education

Need for STEM integrated PD can be seen as an obvious fact to help teachers to equip their students gaining required 21st century skills (Sanders, 2009). Since PD that was chosen to investigate for this study had the scope of meeting this need, integrated STEM education literature is discussed in this part of the literature review to get the essence of the research better.

STEM is an acronym that even to people who works on it may still have some misconceptions (Bybee; 2010; Sanders, 2009). That is why it would be helpful to start with explanation what is stands for. STEM is the acronym for Science, Technology, Engineering, and Mathematics. Even though STEM is a contemporary term which was used for the first time in early of 2000s to bring different disciplines together (Dugger, 2010) interdisciplinarity and possibilities of providing integrated curricula were longstanding discussion points (Czerniak et al., 1999; Ozacar Helvacı, 2018). As Bybee (2010) pointed

out, any event, policy, program, or practice that includes one or more STEM disciplines was called STEM. According to definition of Corlu, Capraro, & Capraro (2014) "knowledge, skills, and beliefs which are collaboratively constructed at the intersection of more than one STEM subject area" (p.75). According to Dugger (2010), STEM is a "chance [for students] to make sense of the integrated world we live in rather than learning fragmented bits and pieces of knowledge and practices about it" (p.2).

There is no doubt that STEM did not burst into the scene out of nowhere. There was a fund of knowledge that was emerged throughout the years (Clark& Ernst, 2007) and a there was a need for STEM integrated education to satisfy needs of 21st century (Akaygun & Aslan-Tutak, 2016; Bybee, 2010; Dugger; 2010; Sanders, 2009). Integrated STEM education has comprised of various theoretical frameworks such as constructivist (Piaget, 1972) and situated approaches (Greeno et al., 1996; Lave & Wenger, 1991). John Dewey's legend phrase *learning by doing* was based on constructivist approach and this was one of the keystones of STEM education. Constructivist approach deals with the real-life problems without discriminating them into separate disciplines (Clark& Ernst, 2007). STEM is considered as an actual attempt to bring each individual into action to solve one of the biggest challenges of our era (Akaygun & Aslan-Tutak, 2016; Bybee, 2010; Dugger, 2010). Dealing with the real-life problems in an experiential learning setting – learning by doing – provides for students to develop situative learning (Lave & Wenger, 1991), conceptual understanding and scientific inquiry skills (Kärkkäinen & Vincent-Lancrin, 2013; de Miranda, 2004 as cited in Hernandez et al., 2014; Sanders, 2009).

After mentioning its theoretical framework, it would be important to explain what kind of needs STEM meet. 21st century came with its economic challenges. The only industries that are able to tackle the challenges posed by the 21st century's nature are the ones that base on innovation (OECD, 2010). As the National Academies of Sciences, Engineering, and Medicine pointed out that "the primary driver of the future economy and concomitant creation of jobs will be innovation, largely derived from advances in Science, Mathematics, Engineering, and Technology (STEM) disciplines" (NRC, 2011).

Interdisciplinary STEM education transcends four separate subject areas to the solution of problems that overlap four disciplines and sub-categories within these disciplines (Nite et al., 2017).

Eventually, one can say that STEM education exists to encourage interdisciplinary knowledge and skills in life and prepares students for a knowledge-based economy (NRC, 2011). The ultimate goal of the integrated STEM education is to raise the current generation with innovative thinking skills (Corlu et al., 2014). Skills to keep pace with 21st century such as adaptability, complex communication, social skills, non-routine problem solving, self-management/self-development, and systems thinking (Bybee, 2010; NRC, 2010) can be acquired through integrated STEM education (Akaygun & Aslan-Tutak, 2016).

As it was mentioned before, at some points of STEM integration, there are some misunderstandings. For example, even though implications of technology and engineering has a critical role in 21st century's everyday life, for some STEM still was considered as only its mathematics and science components (Bybee, 2010; Hernandez et al., 2014). On the other hand, technology is one of the key catalysts of integrated curricula, because of the fact that it provides by its nature to combine various content areas with the disciplines that are difficult to integrate into different subject matters like mathematics (Bybee, 2010; Clark & Ernst, 2007; Sanders, 2009). An actual STEM education should enhance students' cognitive synthesis of common natural sciences and mathematics in order to have improvements in engineering and technology. In addition, an integrated approach to STEM education naturally requires authentic experiences to study how things work and how technologies are created. In STEM education, it is generally accepted that technology and engineering are directly involved in problem solving, innovation and design (Bybee, 2010; Hernandez et al., 2014).

It is essential to underline the fact that these kinds of tremendous expectations are hard to meet without any guidance or help (Akaygun & Aslan-Tutak, 2016; Kärkkäinen &

Vincent-Lancrin, 2013; Nite et al., 2017). After all, it is not an easy thing for teachers to develop instructional units based on integrated STEM education at once (Bybee, 2010). Being part of PD programs based on STEM integration into education is suggested to be important aspect of teachers' lives. They need to be eager to learn and discuss over possible challenges of implications of integrated STEM education (Nite et al., 2017). There is no doubt that PD should be designed according to teachers' needs. As well as content knowledge of STEM education, pedagogical aspects of integrated education can be examined during these PD programs (Kärkkäinen & Vincent-Lancrin, 2013).

As any educational reform movements requires time to make it active, taking STEM integrated education into practice takes time and lots of energy (Kärkkäinen & Vincent-Lancrin, 2013). Many studies focus on results of students' learning right after their teachers' PD. However, it may take time for teachers to embrace the integrated educational thought and it necessitates to make many practices until it gets better (Nite et al., 2017). For adoption of this technology-supported and interdisciplinary models, sustainable and fully comprehensive support from policy makers is essential (Kärkkäinen & Vincent-Lancrin, 2013). During this time, it can be said that significant for teachers to work collaboratively with other fields and their colleagues. As students improve their learning skills in an integrated and collaborative environment (Nite et al., 2017), also teachers need integrated, interrelated and hands on learning environments and practices rather than isolated packs of knowledge. Eventually, it is expected from teachers to create environments that combines technological design with scientific inquiry in the situated context of real-life problems (Sanders, 2009). To reach this aim, one of the most important aspects of STEM education is what is provided to students as a context, activity, or a problem.

This study had the purpose of discovering views of PD coordinator, PD facilitator, and PD participants in regard of characteristics of high-quality PDs. To reach this purpose, PD that had a theoretical framework and that was inductively developed was chosen as a setting. Since selected PD focuses on integrated STEM education in both face-to-face and online forms, in the literature both STEM education and OPD were tried to be inspected.

Now, theoretical framework of the Integrated Teaching Project is presented to readers to understand scope of the PD setting better.

2.2.3.1. Integrated Teaching Framework. Integrated Teaching Framework was the theoretical framework of PD project that was used as setting of this study. STEM stands for Science, Technology, Engineering, and Mathematics. The essence of STEM education is described as integration of more than one disciplines in their own unique teaching and learning structures which involves skills, knowledge, attitudes by considering teachers' and students' interests and experiences (Corlu et al., 2014). There is a well-known need for *learning by doing* as underlined Dewey's (1910) statement of "Relate to school to life and all studies are of necessity correlated" (p.32). STEM education tries to fulfill these goals of education because it has the awareness of education is simply life itself (Corlu, 2017). Integrated STEM approach has a purpose to deal with real-life problems in classroom context with applications of science, technology, engineering, and mathematics disciplines (Hernandez et al., 2014; Tsupros et al., 2009).

Starting point of this framework was to integrate one STEM course with at least another one or as it is called being an interdisciplinary. Since life existed as a whole with many aspects, education cannot be minimalized with one or two disciplines separately (Corlu et al., 2014; Corlu, 2017; Sanders, 2009). There should be connection and interaction among disciplines and this framework has a purpose to assist teachers in this manner. Thus, the framework involves essential components of STEM education approach.

As it can be seen in Figure 2.3, Integrated Teaching Framework was gathered around four main domains: (1) principles, (2) social products, (3) cognitive processes, and (4) scope and sequence (Aşık et al., 2017). The first domain had the principles of *equity*, *relevance, interdisciplinarity,* and *rigor*. These were considered as principles that give teachers opportunity to be balanced in their acts and practices (Corlu, 2017). The second domain included *knowledge society, professional learning community in school* and *beyond, flexible*

curriculum in classroom, and *theory and practice*. Cognitive processes were considered as third domain and it covered scientific inquiry, project-based learning, computational thinking, and mathematical modeling. The fourth domain which is Scope and Sequence is shaped by curricula of STEM courses. The center of the Integrated Teaching Framework was called as Authentic Problem of Knowledge Society (APoKS) (Aşık et al., 2017; Corlu, 2017). APoKS was the dynamic and complex problems that 21st century' knowledge society experience. Integrated Teaching Framework expected teachers to be able to (Corlu, 2017):

- Make contribution to turn society into *knowledge society*, without restriction of school ecosystem.
- Bring learning culture as part of Professional Learning Community to school.
- Make a contribution to theory and practice by acting based on results of related literature, doing active research when it is needed, or working with academicians collaboratively.
- Prepare dynamic and open to change flexible curriculum for their school.

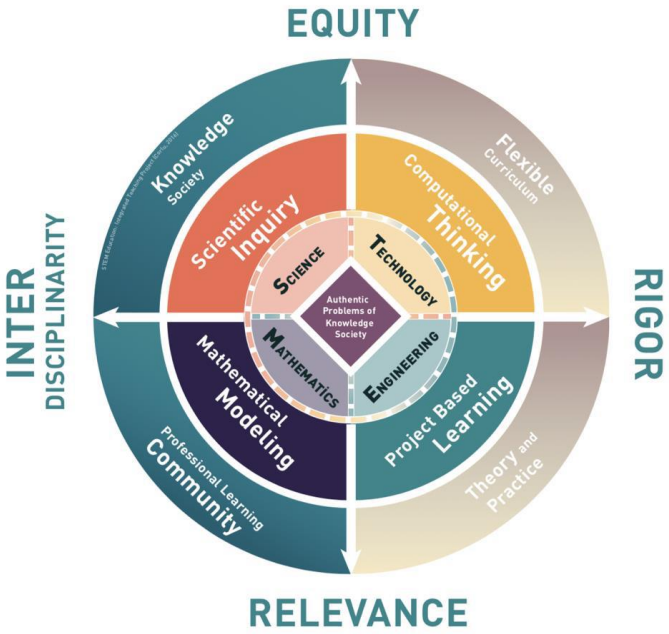


Figure 2.3. STEM: Integrated teaching framework (Corlu, 2017).

2.2.4. Block-based Coding Application – Scratch – Integration

Since the content of PD that was chosen for this study to investigate, related literature is presented to readers. Even though the focus of interview questions for data collection was not content of the PD, it may have an effect on study participants' answers and comments. So that it might be useful to give PD content-related literature to readers as well.

Today's children are growing in the world that is so different than their parents grow in. The term, *digital natives*, was started used for them because nowadays, they are already familiar with many digital devices since they were born. This awareness caused some other issues like new world comes with new needs. It is so natural that changing world expects its citizens to update themselves to be prepared what is needed (Resnick, 2007). Thus, upcoming generation should possess 21st century skills that are basically what will be needed in today's world.

Even though, there are many lists over 21st century skills that students should have in the literature, ISTE (2016) categorized these skills very explicitly. These standards for students listed as empowered learner, digital citizen, knowledge constructor, innovative designer, computational thinker, creative communicator, and global collaborator (ISTE, 2016). Even though they proposed seven different categories, it would be important to keep in mind that all these standards are not very strictly separated on contrary, they are highly engaged to one another.

Within these standards, the one with that is directly related to this study's context is being computational thinker. Its definition was discussed, and its understanding widely varied in the literature (Brennan & Resnick, 2012; Grover &Pea, 2013). However, Wing's (2006) study, had huge impact on many studies by proposing Computational Thinking's (CT) characteristics. First of all, the biggest misunderstanding over CT is that considering it equal to programming or thinking like computers. On the contrary, programming is just one

of the tools to improve one's computational thinking skills and the main starting point to have this ability is to think like human by being creative and imaginative (Wing, 2006). In a nutshell, Wing (2006) proposed that "CT involves solving problems, designing systems, and understanding human behaviors, by drawing on the concepts fundamental to computer science" (p.33).

It can be safely said that the changing world expects from new generation to be adaptable in unexpected circumstances and CT gives students this flexibility. In other words, being adaptable in various contexts is possible not only knowing one information but also how much person knows about it and knowing how to integrate it in other situations (Resnick, 2007). This means that it is not enough to consume knowledge anymore, also the ability to create new knowledge that suits in various and unexpected circumstances (Brennan & Resnick, 2012; Resnick, 2007; Sáez-López et al., 2016). Resnick (2007) explained this process as "they learn to develop their own ideas, try them out, test the boundaries, experiment with alternatives, get input from others, and generate new ideas based on their experiences" (p.18). Based on Wing's (2006) definition on CT and Resnick's (2007) practical list over creativity is a very understandable approach for how CT would be part of students' lives. As it was mentioned earlier CT is one of the 21st century skills that can only be developed with other 21st century skills.

While making CT as part of students' lives, there is a big misunderstanding over using digital technology that is also one of the reasons that computer science could not be part of curriculum (Webb et al., 2017), even though its importance was realized many years ago. There is big difference between using what was given and trying to produce something new. Over the years, just clicking and using basic commands of computer was considered as using the digital technology (Resnick, 2007; Resnick et al., 2009). This ended up with seeing no significant difference on students' higher order thinking skills. On the other hand, using computers as devices to create and share new systems with functionality based on human imagination is a way to have CT skill (Brennan & Resnick, 2012; Resnick et al., 2009).

On the way of practicing aforementioned creating something new, some of the beginners of computer had hard times with understanding language of programming. This was one of the major reasons that people tend to quit easily and consider it as hard and complex (Resnick et al., 2009; Wilson & Moffat, 2010). In this exact spot, Papert's (1980) paper had a huge effect on new studies. He suggested to create tool that people can easily start to use programming language to express themselves and can widen their visions over the period. It is important to remind that the main focus is not teaching programming, it is only tool for people to express themselves and be creative on the interest that they engaged in (Grover & Pea, 2013; Resnick et al., 2009; Webb et al., 2017). In this way, people will not get frustrated in first glance, can proceed on more complex projects if they intend to and have a chance to pursue one interest that suits for their styles. This was respectively objectified as *low floor*, *high ceiling*, and *wide walls* (Grover & Pea, 2013; Papert, 1980; Resnick et al., 2009).

Based on this idea, many graphical programming environments was developed such as Scratch (Maloney et al., 2010; Resnick et al., 2009), Blockly, and Snap. Among these examples, the most well-known block-based coding language was Scratch (Demir & Seferoğlu, 2019). It was launched by the Lifelong Kindergarten Group at the MIT Media Lab in 2007. The Scratch website (http://Scratch.mit.edu) became online community that people create, share, discuss, and tailor one another's projects. Scratch is accessible and engaging for everyone and easy to learn (Maloney et al.,2010; Resnick, 2007; Resnick et al., 2009). This is why, its community all around the world is very big. As of 12 March 2020, the number of registered users in the official Scratch website is 52.820.458.

Resnick et al. (2009) explained one of the goals of Scratch as reaching the people who had no imagination of going further on programming. They aimed that once Scratchers easily learn how to program by using block-based tools, they will become think creatively, reason systematically, work collaboratively, and express their ideas by producing (Maloney et al., 2010). In other words, Scratchers are expected to become people who have essential 21st

century skills. In a nutshell, Scratch's design was based on being more tinkerable, meaningful, and social than other programming environments (Resnick et al., 2009).

With these innovations that make programming easier, the earlier discussion of computer science inclusion K-12 curriculum came into the view again (Gadanidis et al., 2017; Papavlasopoulou et al., 2019; Webb et al., 2017). Many countries started to include computer science into their curriculum. As it was mentioned before, realization of its importance was not new. With Papert's (1980) statement of "renaissance of thinking about education", the spark over inclusion of computer science reignited globally (Grover & Pea, 2013; Kalelioğlu, 2015; Papavlasopoulou et al., 2019). For example, UK (Gadanidis et al., 2017; Papavlasopoulou et al., 2019; Sáez-López et al., 2016; Webb et al., 2017), Canada, Australia, New Zealand, Israel and throughout Europe, studies on Computer Science curricula has emerged and developed since 1980s (Grover & Pea, 2013; Popat & Starkey, 2019; Webb et al., 2017).

There is also growing body of empirical research on using block-based coding applications in the classroom (Demir & Seferoğlu, 2019; Popat & Starkey, 2019). Studies mostly agreed on using these applications in the classroom have a huge impact on students' positive engagements and attitudes toward the lesson (Calder & Taylor, 2010; Demir & Seferoğlu, 2019; Kalelioğlu, 2015; Ke, 2014; Sáez-López et al., 2016; Wilson & Moffat, 2010). In academic and thinking skill stances, results are sometimes controversial (Popat & Starkey,2019) because some argues its positive impact on students' problem solving, logic, critical thinking, higher order thinking skills and also academic achievements (Calder & Taylor, 2010; Demir & Seferoğlu, 2019; Ferrer-Mico et al., 2012; Grover &Pea, 2013; Ke, 2014; Korkmaz, 2016; Sáez-López et al., 2016). It was underlined that especially teaching certain mathematical concepts, heuristic knowledge of problem solving, and programming plays an important role (Calder & Taylor, 2010; Feurzig, Papert, & Lawler, 2011).

On the other hand, some proposes that there is no significant change in students' reflective thinking skills toward problem solving (Falloon, 2016; Kalelioğu & Gülbahar, 2014; Kalelioğlu, 2015). It is proposed that more studies are needed over reasons of this situation but, one of the main possible reason is design and implementation (Kalelioğlu, 2015; Popat & Starkey, 2019). Therefore, studying on how to integrate these applications into classroom and to make it so, working with teachers is considered as very essential. There is an obvious fact that curricular change or educational reform movements are hard to take place without PD for teachers. Thus, also PD on computer science integration over K-12 curriculum started to be conducted (Webb et al., 2017).

3. SIGNIFICANCE OF THE STUDY

Even though *consensus view* grew among PD studies, it was suggested that it would be better if it could be updated (Darling-Hammond et al., 2017; Hill et al., 2013; Wayne et al., 2008). Based on suggestions of review studies and making search in the literature, it was realized that taking different roles of PD into consideration was a gap in the literature. Even though, there were many studies that collect data from teachers (e.g., Garet et al., 2001; Penuel et al., 2007), and some studies that consider facilitators as important (Rogers et al., 2007; Tekkumru-Kisa & Stein, 2017) research that involves also PD practitioner – in this instance PD coordinator – and investigating different roles of PD in the same study could not be found. In this regard, effective PD perspectives of people who works at different layers of PD – design, implementation, reflection – might be important approach to consider. These two points reveal the originality and importance of this study.

3.1. Need for *Consensus View* Revision

As it was mentioned earlier, studies tried to investigate effective PD characteristics, so that policy makers and practitioners can invest PD programs without concerning. It means that money, time, and energy can well-spent. To meet this aim, studies tried to reach an agreement on high-quality PD characteristics. For example, in Eisenhower PD project, Garet and his team (2001) pieced together best practice PD activities and created set of PD characteristics. Then, they tested effects of these characteristics on teachers' knowledge and skills and ultimately their teaching practice according to teachers' self-reports. As a result, Garet et al. (2001) reached the result that to improve PD practice, specifically duration, collective participation, content-focus, active learning, and coherence plays a key role.

After this study, empirical studies tried to deepen effective PD understanding to make sure this set of core features as critical pieces of effective PD (Desimone et al., 2002; Fishman et al., 2003; Penuel et al., 2007). Then, Desimone (2009) used the term *consensus*

over this set of PD characteristics to define them as at least some of the critical features to enhance teacher knowledge and skills. After referring this set of PD characteristics as *consensus*, (Borko et al., 2010; Caena, 2011; Darling-Hammond et al., 2009; Darling-Hammond et al., 2017; Desimone, 2009; van Driel et al., 2012; Hill et al., 2013; Kennedy, 2016; Wayne et al., 2008) studies and practitioners started to use it as baseline. This *consensus* on high-quality PD characteristics became so widespread that USA, UK, and EU officially used as a design framework (Caena, 2011; Darling-Hammond et al., 2009; Kennedy, 2014; Sims & Fletcher-Wood, 201).

There is no doubt that PD programs are not only composed of design characteristics and its implementation. Its effectiveness should be measured via not only teacher's instructional changes but also students' outcomes. Over the years many empirical studies were conducted to see PD effects. Based on these studies, Fisher et al., (2018) underlined very significant finding that PD programs which is designed based on *consensus view* have an effect on teacher knowledge, instructional and behavioral change (Garet et al., 2001, Desimone et al., 2002; Fishman et al., 2003; Penuel et al., 2007). On the other hand, PD programs that possess most or all these features did not have a significant effect on student achievement (Garet et al., 2008; Garet et al., 2011; Garet et al., 2016; Jacob et al., 2017).

Most of recent economy-based studies on PD programs confirmed these results and therefore, investments for this sector remained as unsatisfactory (Hill et al., 2013). Review studies tried to deepen this flaw by making suggestions and proposing some possible unnoticed points of PD (Dede et al., 2009; Hill et al., 2013; Sims &Fletcher-Wood, 2018; Wayne et al., 2008). Still, it is unknown that why some well-designed PDs does not succeed ultimate goal of any PD which is improving teacher instruction thereupon student achievement. However, they highlighted that more investigation and possibly some revisions might be needed in this consensus view (Darling-Hammond et al., 2017; Hill et al., 2013; Sims &Fletcher-Wood, 2018; Wayne et al., 2008). Even the pioneers of the consensus view are still working on it to improve it (Desimone & Garet, 2015). Revision need for consensus view was the starting point for this particular study.

3.2. Including all Layers of PD in

After realizing revision need for consensus view review articles started to investigate possible flaws of PD design. For example, Wayne et al. (2008) suggested that this flaw shows need for evidence to explain each specific feature of an effective PD. It was suggested that there is not enough solid evidence on these characteristics separately. Also, Hill et al. (2013) proposed that studies tend to evaluate the PD programs as a whole instead of going through its specific features. That is why, it gets hard to tell which characteristics works or not and why.

On the other hand, Darling-Hammond et al. (2017) proposed some possible affective factors over poor results of PD under two main headlines. They are system-level and school level challenges. The system level includes PD design and implementation phase challenges and actions. Therefore, in this phase, policy makers or practitioners, PD facilitators, and PD participants are involved. The school level includes representations of PD. It means that it is the phase for teachers to act based on their PD education. Thus, in this phase, PD design and implementation process, PD participants and students are involved. Darling-Hammond et al., (2017) aimed to give a vision for policy makers and practitioners over being PD to be effective, there are more than one phase to consider.

In this regard, Tekkumru-Kisa and Stein (2017) figured the layers of PD design and implementation as *researcher/designer & facilitator, facilitator and teacher, and teacher and student* alongside with content (see Figure 3.1). Even though coordinators and facilitators of PD are as important component of PD as participants, there is not enough evidence to investigate PD coordinators' and facilitators' views. For this reason, this study particularly leans over the exploration of views of PD project coordinator as PD practitioner and one of the PD designers, PD facilitator as one of the PD designer and implementer, and PD participants regarding characteristics of effective PD. Since this study seeks to understand every aspects of these layers that are involved in PD design, Tekkumru-Kisa and

Stein (2017)'s figure got adopted as in Figure 3.2. for this study. It explains study participants and their roles during PD.

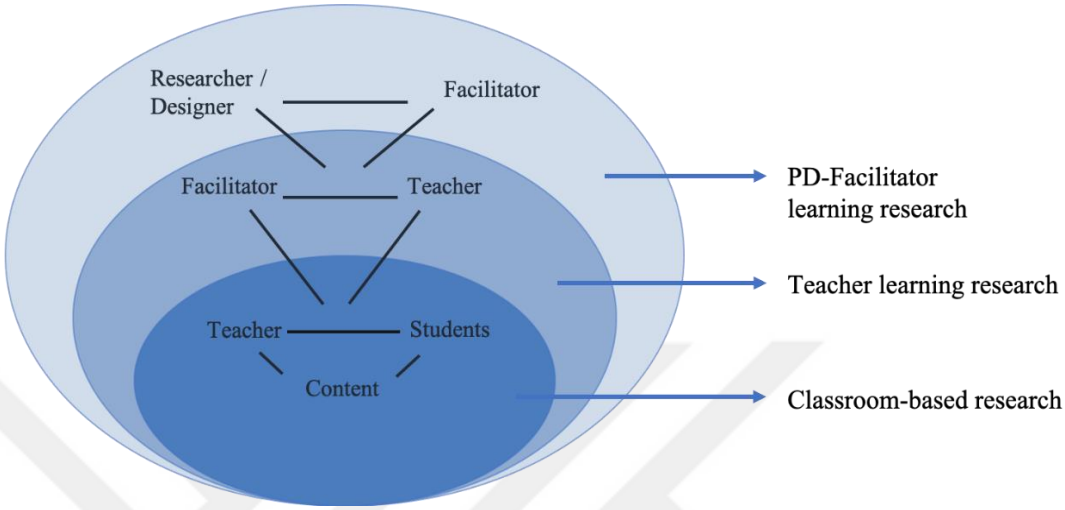


Figure 3.1. Layers of PD design (Tekkumru-Kisa & Stein, 2017).

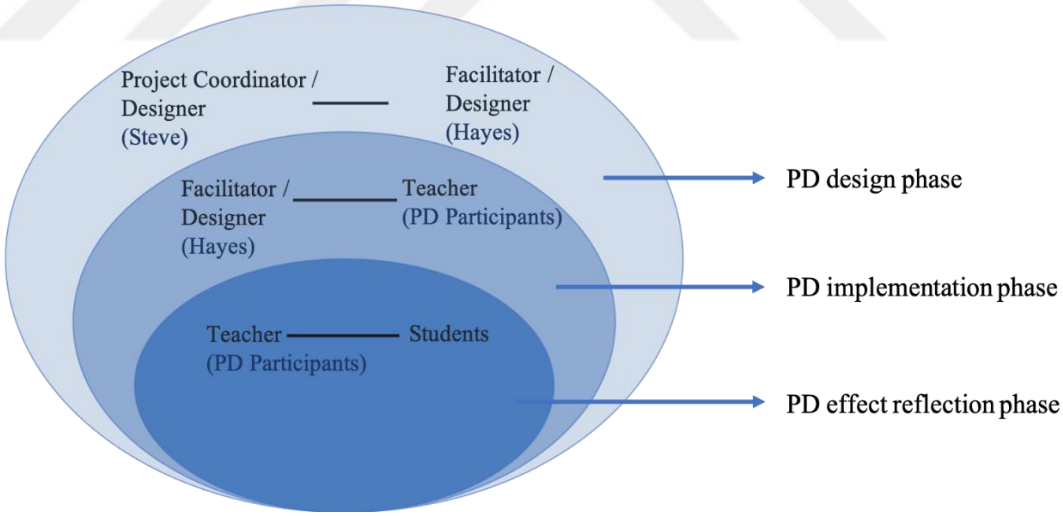


Figure 3.2. Determinant phases of effective PD characteristics.

3.2.1. Three Stances of PD Design and Implementation: Policy Makers/ Practitioners, Facilitators, and Participants

Within this study, it was aimed to take every possible phase of PD into consideration. So that, from PD design to carrying PD into classroom, the study aims to understand what characteristics that high-quality PD should have. Therefore, every person that was involved in PD design and implementation was included in this study as study participants.

While examining literature over PD, I realized that most of the decision making of PD design first get through from policy makers or practitioners. The main trigger for any effort to reach an agreement on high quality PD characteristics is to propose most likely well-working PD for policy makers and practitioners to invest in (Dede et al., 2009; Hill et al., 2013). Since they are fund-raisers of PD programs, they consider these programs within efficacy and optimal expense framework. Therefore, within this study, the coordinator of PD project was also one of the study participants. It was aimed that what kind of decisions was made in a broader perspective to make PD programs both efficient and financially optimized.

As another point, Darling-Hammond et al. (2017) proposed implementation process of PD as one of the possible flaws of unsatisfied results of well-designed PD programs. Studies claimed that even the well-designed PD can be unsatisfactory because of its implementation (Darling-Hammond et al., 2017; Hill et al., 2013). Since, it is such an important part of PD, they suggested to identify and develop PD experts or facilitators. It is important to keep in mind that PD facilitators are the ones who implement PD programs (Borko, 2004; Even, 2008; Popova et al., 2018). Tekkumru-Kısa and Stein (2017) explained facilitators' importance as "discussing high-quality PD without focusing on the facilitators and their role is like discussing high-quality instruction without mentioning teachers and their role" (4:2). Thus, PD facilitators are one of the key stones for PD design and implementation (Borko et al., 2010; Popova et al., 2018; Tekkumru-Kisa &Stein, 2017).

The role of a facilitator was started to be examined with Borko's (2004) study. She proposed three-phase approach for sustainable and scalable PDs, and the PD facilitators are one of the key pioneers of sustainable and scalable PDs. Afterwards, Hill et all. (2013) wrote an extensive review article and then proposed some crossroads over PD design. In Borko's study (2004), it was presented PD research stages including facilitators. The role of a facilitator is underlined especially in video-based PD programs, and there is growing body of literature about it (e.g., van Es & Sherin, 2009; Gaudin & Chalies, 2015; Tekkumru-Kısa & Stein, 2017). On the other hand, when it comes to other methodological designs for PD was overlooked the effect of PD facilitator and PD coordinator. The literature also suggests that there is need for more investigation for PD facilitators (Borko et al., 2010; van Driel et al., 2012; Elliott et al., 2009; Even, 2008; Tekkumru-Kisa & Stein, 2017).

Additionally, in most cases, practitioners or researchers are the ones who are responsible from the design of the PD (e.g., Jackson et al., 2015; Tekkumru-Kisa &Stein, 2017). Studies proposed that one of the possible flaws of successful PD implementation is the inconsistencies between PD designers' and PD facilitators' PD goal understanding (Borko et al., 2014; van Es & Sherin, 2017). To prevent possible misunderstandings, suggestion was given by Sims and Fletcher-Wood (2018) as instead of giving package of PD design characteristics, people who are involved as active players of PD should play role in its design. In this study's case, both coordinator and the PD facilitator played an active role in PD design. This is also why; it was decided to investigate this project as research context and conduct interviews with each people who was included decision making process of PD design.

Finally, teachers are the learners of PD programs (Clarke & Hollingsworth, 2002) and practitioners of classrooms environments (Darling-Hammond & McLaughlin, 1999; Fullan &Miles, 1992; Sykes, 1999). As a matter of fact, even though the goal is to achieve higher student outcomes, PD design and implementation is all about making teacher learning more efficient (Clarke & Hollingsworth, 2002). Teacher learning and teacher change lies behind any decision of PD design and implementation (Desimone & Garet, 2015; Elliot, 2017).

Therefore, their evaluations over PD design and implementation is very vital (Popova et al., 2018). So, if the aim is to investigate effective PD characteristics then, it is only reasonable to include teachers into the study as well. Therefore, I decided to make interviews with PD participants to find out effective PD characteristics as well.

There are some studies that investigates teachers' perspectives over designing better and improved PD (Bouchard Chval & Musikul, 2008; Shirley et al., 2013). However, in this study, it was aimed that to put each person who has different roles in the PD process under the scope. In this way, differences and commonalities among people who have different roles can be examined.

3.2.2. Three Stances of PD Effect: PD Design and Implementation, Instructional Change, and Student Outcomes

As it was mentioned before, the definition of effective PD involves three important phases. *Well-designed and implemented PD* provides structured professional learning that ends up with *instructional change* and *better student outcomes*. Therefore, for effective PD characteristics research, it is necessary to take also after PD process into consideration because even though it seems like it is well-designed and implemented but it still may have some practical drawbacks.

According to Bucynski and Hansen's (2010) study as cited in Darling-Hammond et al. (2017), even the well-designed and implemented PD sometimes cannot reach successful results because of some external factors that teacher cannot control. They listed some of these difficulties as follows.

> … a lack of time allocated to teaching curriculum that uses the newly acquired knowledge and skills; the need to teach mandated curriculum on a pacing a guide…; a lack of resources [such as curriculum materials, technology, or science equipment]; and classroom management issues (p.20).

This shows that even though teacher learning is sustained, and related teacher change is accomplished, there are some other factors that may cause poor implementation. So, these factors are also reasons of unsatisfactory PD results.

Within this study, also after PD process was examined. In other words, it was tried to understand if teachers become practitioners of PD content or not. If they did not, why? If they did, how? What changes they observed among students? During the interviews, in-depth questions about after PD process was asked to teachers to understand PD effects on teacher instruction and students' outcome. As one of the main limitations, the classroom environment could not be observed, and any student document could not be analyzed. However, teachers' final projects – lesson plans – were examined and related up interview questions were asked to teachers to understand their after-PD processes and related instructional changes.

In a nutshell, literature showed that even though there was a big body of PD research, still there is something unknown or undiscovered about how well-designed, implemented and reflected PD can be enacted. To discover it, this study put everybody that played a role in PD process in action. First, PD coordinator's perspective was added in the study as a PD practitioner who is responsible from extensive PD design decisions. It is important to remind that even though financial and other practical issues of PD design have an immense impact on its final conducted versions, PD practitioners' points of view were disregarded in the literature. Secondly, PD facilitators' perspective was included. In this context, both PD coordinator and facilitator were active in designing PD. Here, it is important to point out that while collecting data, it was realized that there were two more people who played a role during PD design. Therefore, interviews with these two PD design consultants were also added in this study. Finally, it was very essential to take teachers – PD participants' – perspectives since they were the learners in the PD and implementers of classroom environments. In this way, it was aimed to gather around all the possible information to design efficient PD for teacher change and ultimately better student outcomes.

4. STATEMENT OF THE PROBLEM

The PD that was under investigation was part of one project – Integrated Teaching Project. Since the aim of this study is to discover effective PD characteristics from different perspectives, it was important to find rigorous PD setting. This project had the structured design including syllabus and user-friendly website, theoretical framework that base their teaching on, and goal of sustainability. They already conducted their long-term face-to face PD for many years and then started to work on online PD. I chose to investigate one of the Advanced STEM Courses that was called Block-based Coding Applications in Mathematics for two reasons. First, it was online PD so that one of the biggest dichotomies of PD research – online and face-to-face – might be discussed during interviews. Second, this online PD had the heterogeneous group of participants in regard of their backgrounds. Even though this was a qualitative study, it was believed that heterogeneity of study participants might increase the relatability of this study to other PD contexts.

The main goal of this study was to discover effective PD characteristics from different perspectives who had different agencies in one particular PD. To reach this aim data were collected from the PD coordinator, PD facilitator, PD design consultants, and PD participants. The central research question in line with this goal was as follows:

- What are the characteristics of effective PD from the perspectives of one particular PD's coordinator, facilitator, and participants?

The sub-questions are as follows:

- How do perspectives of PD coordinator, PD facilitator, and PD participants on effective professional development differ from/similar to each other?

- What experiences that PD participants had after PD?

Since this study was qualitative in nature, some unexpected findings emerged during analysis. Therefore, I also added emergent research questions that are as follows.

- What are the controversial issues in regard of professional development?
- What are the characteristics of PD facilitator from the perspectives of one particular PD's coordinator, facilitator, and participants?

5. METHODOLOGY

This study seeks to discover high-quality PD characteristics from the perspective of one PD projects' – ITP– coordinator, PD facilitator, and PD participants. In this regard, it can be said that this study has some exploratory purposes because it goes deep into views of the coordinator of a PD, the facilitator of a PD and participants of a PD to understand what they consider as an high-quality PD and what expectations they have from the program and how these views and expectations similar or different. There are some hint words such as "understanding", "discover", and "meaning" in the purpose of this study. Qualitative research is the best to use if there is a need for exploration of a problem or an issue (Creswell, 2007). That is why; it was decided qualitative method is best suited for this study.

Qualitative research, as defined by Patton (1985), "is an effort to understand situations in their uniqueness as part of a particular context and interactions there" (p.1). In order to make sense and understand these situations in their uniqueness, Denzin and Lincoln (2005) explained what qualitative researchers do as "study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them" (p.3). In this sense, it can be said that qualitative research has its own unique way to explain situations. At the end, you get a written manuscript that includes different voices of participants, reflexivity of the researcher, and multi-sided interpretation of the problem. This final product either extends the literature or suggests new and urgent investigation areas (Creswell, 2007).

Each qualitative study has its own peculiar paradigm and worldview which means "a basic set of beliefs that guide action" (Guba, 1990, p.17). For this particular study, it can be said that social constructivism paradigm was influenced by because of the fact that main focus is to understand participants' views of the situation (Creswell, 2007). Rather than pursuing after one theory, it aims to generate new patterns of meaning and look after what

is unknown for the phenomena. Also, it was influenced by the interpretivist paradigm, which refers to construction of meaning based on both researcher and people who researched. It cannot be non-depreciable fact that conclusions that was reached are partly shaped by researchers already know and believe (Creswell, 2007) and this causes the point of "not a reflection of the reality so much as a perception of the reality" (Sims, 2000, p.41).

It could be useful to explain what qualitative research characteristics are for getting into this study's nature more. Merriam (2009) identified four characteristics and Creswell (2007) was inclusive of these characteristics in his book to understand the nature of qualitative research: (1) the focus is on process and has emergent design, (2) the researcher is the primary instrument of data collection and analysis, (3) the process is inductive, and (4) the product is richly descriptive and has holistic account.

The focus was seeking for the meaning and the understanding with a growing body of analysis of participants' reflections and that is why, this study was on process and unpredictable. The researcher is the primary instrument, because of the fact that main source of data collection and analysis is the researcher. Merriam (2009) explained human instrument as "which is able to be immediately responsive and adaptive" (p.15). This gives chance for researcher to expand their understanding through communication, on process information, check with participants for accuracy of interpretation, and see the undiscovered or unexpected responses. The process is inductive because during the study the researcher works as back and forth between the themes and data with the help of other researchers for the broader views over data, until they have inclusive set of themes. Finally, the product is descriptive because rather than numbers, words brings forth to complexity and multivocality of qualitative research. Instead of reaching exact conclusions and cause-and-effect relationships among factors, it provides bigger and broader picture over phenomenon in a holistic account (Merriam, 2009).

According to Creswell (2007), phenomenological research is the best suited when priority is to understand several individual's identification and experiences of a phenomenon. The main purpose is to get the essence of human experiences over shared phenomenon and to comprehend features of the phenomenon. For this study, main aim is to understand what the coordinator, the facilitator, and the PD participants characterizes as efficient features of PDs because all these three sides of views are important components of a PD. It seeks to understand how their description over high-quality PD characteristics meets on a common understanding or differs from one to another. Therefore, it was decided to follow phenomenological approach of conducting qualitative research.

5.1. Phenomenology as Research Design

Phenomenology is the philosophy or scientific approach to seek after discovering of how people experience a phenomenon and how they describe and apprehend the essence of the phenomenon (Creswell, 2007; van Manen, 1990; Marton, 1986; Merriam, 2009; Patton, 2002). Phenomenological research does not necessarily give certain answers to a phenomenon; it can give perspective to describe *lived experience* (van Manen, 1990) in a particular time within a particular context (Çiftçi, 2016). There is a chance to block different views of the experience, just because by looking constantly only the obvious and apparent theoretical patterns (Spiegelberg, 1965). As a qualitative research approach, phenomenological research provides opportunity to develop deeper understanding of the phenomenon even the parts that are never touched or attained. In specificity of this research, there is a purpose of discovering unexplored high-quality PD characteristics in addition to the features that are already in the literature.

There is a challenge for conducting phenomenological research and Creswell (2007) gives a suggestion to decide how and in what way the researcher's understandings were introduced, before a researcher starts to research. The challenge is the bracketing personal experiences of the researcher. There are two main approaches in this sense (Creswell, 2007):

(1) hermeneutic phenomenology which is adopted by van Manen (1990) and (2) transcendental or empirical phenomenology which is adopted by Moustakas (1994).

Moustakas (1994) argues that interpretations and experiences of the researcher should be put aside as much as possible despite interpretivist nature of phenomenology. This process is called as bracketing or Greek word *epoche,* which means refrain from the judgment. Even though Moustakas (1994) admits this is not perfectly case most of the time, there are some researchers set a place for describing their own experiences with the phenomenon and bracketing out their biases, prejudices, assumptions, and viewpoints as much as possible before interacting with others (Creswell, 2007; Merriam, 2009). In this approach, the researcher is required to transform these experiences of the participants into objective structures by interpreting.

On the other hand, van Manen (1990) claims that since people have certain backgrounds, beliefs and knowledge, it is impossible for researchers to put aside all these existences of them and be completely isolated even though he is aware of importance of bracketing experiences of the researcher. Also, it is impossible to be that person and gain the exact same experience of that person. One way or another, it involves interpretation of the researcher over person's experiences based on researcher's view of world (Çiftçi, 2016; Smith, 2004), because each description is ultimately interpretation (van Manen, 1990). In this approach, the researcher becomes the part of the context as it occurs. Thus, phenomenology is not perceived as not only description but also interpretation (van Manen, 1990). The analysis becomes the construction of meaning based on both researcher and researched.

Heidegger (1962) – who is the father of hermeneutic phenomenology –, says that "The meaning of phenomenological description as a method lies in interpretation.... The phenomenology... is a hermeneutic in the primordial signification of this word, where it designates this business of interpreting" (p. 37). On the other hand, there is an understanding

from Husserl's – who is the father of transcendental phenomenology – point of view that interpretation already refers to manipulation or some kind of rootles intuition. This is not necessarily to be the case. According to Gadamer (1986), one kind of interpretation is a *pointing to something*. What it means that interpretation implies to not reading the meaning directly but expressing it what the phenomenon itself refers to. Actually, this kind of interpretation allies with both Husserl's and Heidegger's phenomenological research point of view (van Manen, 1990).

Van Manen (1990) presents phenomenological study as "a dynamic interplay among six research activities" (p.30) and these are the activities that were followed during this study:

- turning to a phenomenon which seriously interests us and commits us to the world.
- investigating experience as we live it rather than as we conceptualize it.
- reflecting on the essential themes which characterize the phenomenon.
- describing the phenomenon through the art of writing and rewriting.
- maintaining a strong and oriented pedagogical relation to the phenomenon.
- balancing the research context by considering parts and whole.

Therefore, for this study, phenomenological research design was used since it had exploratory purposes over one lived experience of study participants. It tried to understand what constitute as high-quality PD characteristics to different perspectives in one particular PD context. Therefore, everybody that was involved in this PD process tried to be included so that each voice of the different roles of the PD could be heard. Even though this study had limitations over generalizability of the data since it was only one PD setting, following rich description of the setting and the participants may help readers to understand the context of the PD better, so relatability of this study to other contexts might be enhanced.

5.2. The Setting of PD

5.2.1. Integrated Teaching Project

The PD investigated in this study was one part of a very extensive research project called Integrated Teaching Project (ITP). I chose ITP as the setting for this study because it was a research-based program with its own theoretical framework – which was explained in the literature review – for both design and implementation (Aşık et al. 2017; Corlu, 2017). This project was designed for teachers to meet their needs by not bypassing their abilities but by guiding them to create their own way of classroom designs. In this way, teachers would be able to reflect what they learn and gain from the PD activities through their classroom in their own unique ways. It also involved many works and discussion and sharing environments with academicians. Its other goal was to be sustainable for teachers. Unlike designing one time or short-term PD programs, it aimed to help teachers as long as they need it. It was believed that working collaboratively with teacher facilitator academicians by doing and reflecting over what they learn and make throughout at least one academic year is very rewarding for teachers (Aşık et al., 2017; Capraro et al., 2016).

Within this project, there were two different PDs called: (1) STEM: Leader Teacher Professional Development Program and (2) Advanced STEM Courses. STEM: Leader Teacher Professional Development Program was the program that its teachers conduct a total of 92 hours of work, including face-to-face workshops, integrated STEM lessons, Authentic Problem of Knowledge Society (APoKS) writing meetings, online trainings based on preparation of STEM lesson plan, lesson plan writing and academics-based reflections on it, in-class practices, practice assessments, self-reflections and exams for eight months. The online learning systems played an important role in the program for the continuity of effective communication and interaction between teachers and academicians. STEM: Leader Teacher Professional Development Program aimed teachers to be able to:

- get first-hand experience by actually applying Integrated Teaching Framework during face-to-face workshops
- discuss and communicate about what they experience in their school environments
- integrate their theory and practice-based knowledge into their lesson plans
- revise their lesson plans through feedbacks
- reflect on their classroom practices with metacognitive awareness and self-evaluation abilities
- be part of a professional learning community by taking full responsibility of sharing what they experience with their colleagues and sense of belonging of that community.

At the end, after completing 92 hours of intensive work, teachers graduated from this program by getting the certificate of *STEM Leader Teacher*.

5.2.2. The PD Under Investigation: Advanced STEM Courses

Advanced STEM Courses were based on online interaction and sharing of professional experience through a web conferencing tool, Adobe Connect in this case. The PD was designed as synchronous online one-hour courses for six weeks. Its target group could fall in two categories. The first one was teachers who were successfully completed the STEM Leading Teacher Professional Development Program and want to be specialized at specific content. The second was the ones who were willing to learn more about teaching profession but had not enough accessibility to the resources. Motivation letter was asked from these teachers to express how much they were eager to learn and what background they have based on their personal endeavors. PD facilitator examined these motivation letters and only criteria to be selected was being eager to learn and motivated toward apply what will be learned. Since Advanced STEM Course participants had heterogenous backgrounds, this PD program was preferred as context of this study. So that study's reflectivity and relatability might be enhanced.

For each semester, four courses were offered by ITP researchers and trainers. Each course tried to be implied one of the cognitive processes of Integrated Teaching Framework which were *scientific inquiry*, *project-based learning*, *computational thinking*, and *mathematical modeling*. The attendance was a strict requirement for the courses. If participants who were missing more than one hour throughout the six weeks were dismissed from the program. Number of participants were limited to ten teachers. Each teacher can register for a maximum of one course in a given semester. Lessons were recorded and available for participants to watch again for lifetime. Each course had a final assignment which includes designing STEM integrated lesson plan. Teachers or teacher candidates who successfully completed the PD earned Course Completion Certificate.

5.2.3. Flexible Format for PD Facilitators

Even though preparation of syllabus for PD was responsibility of PD facilitators since they had the content expertise, coordination unit of the ITP proposed some pre-determined format for PD design.

- Timing of the PD was decided by coordinator unit of the project.
- Using Adobe Connect application was decided by coordinator unit of the project.
- Participant number was decided by coordinator unit of the project, but motivation letters were read by PD facilitator.
- PD facilitators had to prepare syllabus for the PD.
- Steve met each PD facilitator individually to explain theoretical framework and the scope of the project.
- Certification
- Attendance is mandatory with one absence option.
- Final project should be asked at the end of the PD.

Certification of the PD handed out by coordinator unit of the project. This is why, preconditions for it was decided by coordinator unit of the project. First of all, participants had to be in the PD session synchronically. They had only one session to miss the PD. Otherwise, they considered ineligible for certification. Besides, completing one final project at the end was another precondition for certificate. So that, coordination unit gave the flexibility of what kind of project can be designed to PD facilitators and their participants but, asking for final project wanted from PD facilitators.

5.3. Participants

5.3.1. Selection of Participants

First of all, it is important to give clarification over what is meant by participants. Since this study works with the PD coordinator, PD facilitator, and PD participants, it may confuse which participants are discussed. When it is meant to mention PD participants, the term of "PD participants" was used and when it was meant to mention participants of this study, simply the term of "study participants" was used during the study. Additionally, who was called as "PD coordinator" was the person constructed the Integrated Teaching Framework and the Principle Investigator of the Integrated Teaching Project. He was called as the coordinator because he played the key role in each step of the PD project. The PI of the project gradually delegated his coordinator role to the research team and then the leader teachers throughout the years. His ultimate goal of the delegation was to have a sustainable PD.

In most cases, the facilitator and the designer of the PD are the same person (Hill et al., 2013). However, it was not the case for this particular PD. Design decisions of this PD was made by the PD coordinator and facilitator. Basically, the coordinator shared his wisdom about theoretical framework of the project and experience that comes from eight-month long PD program with the PD facilitator. Moreover, the facilitator combined his

content specialization with the suggestions of the coordinator to compose the course (as mentioned by the PD coordinator during his interview). Therefore, not only the PD facilitator but also, the PD coordinator was included to this study. Also, as an exceptional situation, the PD coordinator was even one of the participants for Block Based Coding Applications in Mathematics Course. In fact, during the research, there was an intent to investigate more about how participants of the study define their roles for the PD.

Secondly, it would be useful to explain why this project was chosen as a setting to understand the nature of the participants better. Since this project had a theoretical background, it strengthened its implications in both ways which are theory and practice. Another reason was that this project did not aim to reach only one district or one participant setting. It was designed to offer sustainable and attainable full-scale PD on a national scale. It improved itself with feedbacks and experiences in time. After getting experience with long-term STEM: Leader Teacher Professional Development Program, it aimed to reach even broader range of participants by providing OPDs. All these characteristics of an ITP corresponded with the suggestions from literature over how to design PD.

As a focus, it was chosen to work within the scope of Advanced STEM Courses because there was the heterogeneity of the participants. In other words, both teachers who graduated from eight months long STEM: Leader Teacher Professional Development Program and in regard of integrated STEM education, self-improved teachers who want to participate with their own motivation and effort were included within Advanced STEM Courses. The variety of participants was desired for this particular study to get the gist of phenomenon from diversified perspectives. Also, Block-based Coding Applications in Mathematics Course was selected to investigate as an advanced STEM course because integration of coding experiences into mathematics course was one of the most struggled and acted timid issue (as mentioned by the PD coordinator during his interview). There was a chance to investigate the reasons and the experiences of this struggle and timidity with the ones who face these apprehensions.

Block Based Coding Applications in Mathematics Course had the aim of capturing the relationship between computer science and mathematics, to increase the level of students' motivation for learning mathematics, and to design enriched mathematics learning experiences. The syllabus of the course was prepared by the PD facilitator.

Purposeful sampling was the most preferred way to select participants while doing qualitative research. As Stake (2005) suggested "to choose that case from which we feel we can learn the most" (p.451), researchers tend to choose their participants according their proper selection criteria to get the best information out of them (Creswell, 2007; Merriam, 2009). However, for phenomenological study, it was suggested that data should be collected from as many individuals who have experience the phenomenon as possible (Creswell, 2007). However, despite of all efforts to reach all the PD participants, two out of seven did not respond being participant of the study invitation. Therefore, interviews were conducted with PD coordinator, PD facilitator, and five participants of this particular PD program. Besides, during the interview with PD facilitator two new names came up as consultant of PD design. One was called Ray who was the most involved person in PD design other than PD facilitator himself. I conducted an interview with Ray as well. Then, the other name was Sam who was the person create similar curricular design for integrating coding into math lesson. He gave some suggestions to PD facilitator and I collected data over points to consider while designing the PD in this content via e-mail.

PD participants were in two aforementioned groups. One group was that graduated from eight-month long STEM: Leader Teacher Professional Development Program and the other group was who wrote a motivation letter over importance of the coding for mathematics courses. There were three participants who wrote motivation letter and two *STEM Leader Teachers*. The further information about the PD participants collected during the interviews are presented in the following section.

5.3.2. Study Participants

First, since the profiles of study participants are key to make sense of the data presented under themes, description of study participants' background is provided. All the participant names are pseudonymous. It is important point out to avoid any confusion that Steve was in the role of PD coordination, design, and participation. Figure 5.1. represents agencies of study participants.

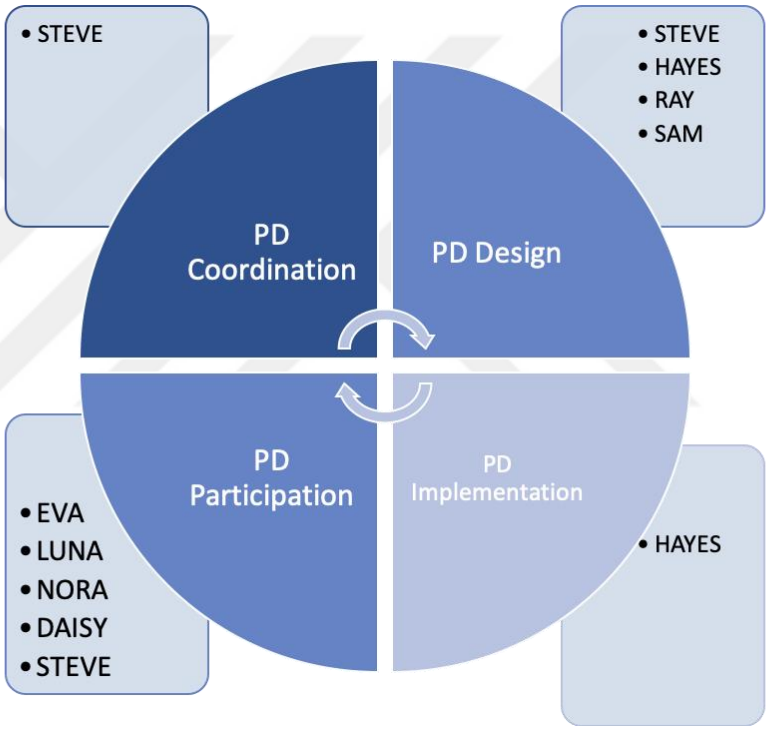


Figure 5.1. Roles of study participants.

5.3.2.1. PD Coordinator: Steve. The coordinator of this PD was an associate professor of mathematics education at one private university in Istanbul. He completed Teaching Mathematics Bachelor's Program in 2002 and then got his master's degree from the same English-medium public university in Istanbul in 2006. He got his PhD in Curriculum and Instruction in USA. He had eight years-long teaching experience in both national and

international schools. He taught not only mathematics but also biology, life science, earth science, and education technologies in both secondary school and high school levels.

Steve attended many PD programs before. These PD programs were sometimes mandatorily and sometimes voluntarily chosen. However, he stated that his motivation toward PD was always in its highest level. Beginning of his teaching years, he also started to give conferences to his colleagues locally. Later on, he started to take responsibilities also in designing PD, during his teaching in abroad. Also, while he was doing his PhD, he prepared PD for all teachers of one district in USA. When he came back to Turkey, he started make national observations in schools. He started to adapt his previous PD experiences into Turkey context. Thus, he came up with one unique theoretical framework. Later on, this theoretical framework formed the basis of this PD program.

Steve described his role in this particular PD as *interesting* because he was both PD coordinator and one of the PD participants. As PD coordinator, firstly, he explained the core principles of the theoretical framework to PD facilitators so that they can prepare their PD syllabi accordingly. Because of broad scope of the PD project, his primary intention was to coordinate PDs on specific contents without disregarding the theoretical framework. While proposing theoretical framework, coordination unit of the PD also shared some formats with PD facilitators to be consistent and sustainable through the years.

While preparation process of syllabi, coordination unit of the PD has trusted on expertise of the PD facilitators and they remained only in the role of guidance and sharing their previous PD experiences. Thus, content design of the syllabus was totally PD facilitator's responsibility. PD coordinator defined coordination unit's role as interactive with PD facilitators in each step of PD design and ready to provide guidance whenever they need help.

Steve stated that he was personally interested in the content of this PD and for this reason, he chose to be participant for it. His characteristics as being PD participant is explained below.

5.3.2.2. PD Facilitator: Hayes. The facilitator and also designer of the PD – Hayes – was project coordinator in one private school in Istanbul. Hayes completed Mathematics Bachelor's Program in 2000. He graduated from an English-medium public university in Istanbul. After his graduation, he worked as software engineer for two years. Then, he got pedagogical formation and started teaching mathematics in private schools. He had 15 years of teaching experience.

Hayes' interest toward block-based applications has started with working with fifth and sixth graders. While he was teaching, he realized that students were having hard time with understanding mathematics concepts. He felt need for something new and he started to research what was done in an international level. Besides, he had an interest toward coding since his childhood. Thus, he entered the world of Scratch. He stated that he learned this application via internet by his own effort. Since Hayes went through the same learning process before, he underlined that he was able to empathically approach teachers' learning processes based on his own experience. He described advantages of Scratch for beginners as easy to start and possible to go deeper. Also, since it had a big network, it was possible to find answers for the most possible questions.

Hayes designed and conducted one-session or weekend-long PD for teachers in the content of 3D design, robotic coding, and coding applications such as Ardunio, Scratch, etc. before. However, his first experience with long-term PD was this one. Hayes and Steve did not know each other, before this PD. Firstly, Steve explained the theoretical framework and the principles of the STEM Integrated Teaching Project to Hayes. Hayes considered projects' long-term results as promising and he said that for this reason, he agreed on being part of this project.

Hayes described Steve's role during the design of PD as *catalyzer*. Steve guided Hayes, whenever Hayes needed help. While Hayes was preparing syllabus of the PD, he contacted with some important names in the field and checked the similar programs via Internet. Specifically, one name – Sam – was underlined by Hayes during his interview and also PD process. Hence, I contacted with Sam via e-mail and asked some basic questions about his work. Additionally, Hayes stated that he got pedagogical help from one of his friends – Ray –, while he was designing the PD. That is why, I also conducted one additional interview with Ray, because he played an important role in PD design.

5.3.2.3. PD Design Consultant 1: Ray. Ray completed his bachelor's degree in Elementary School Teaching Program. He received his master's degree in Educational Administration, and he was currently PhD student in Educational Sciences. Ray worked as Elementary School Teacher for seven years in both public and private schools. He was in the administrative unit of one private school for last six years and now he works as academic coordinator in the same private school.

Ray explained his motivation toward coding applications as getting familiar with his wife and brother's jobs which are computer engineering and programming. He created vision toward what can be done with coding and programming in classroom setting. He stated that for constructionist learning, using coding applications is very effective because students should grasp the concept to explain it to the computer. Thus, he attended MOOC that is called Design and Development of Educational Technology. This was an online course designed by MIT.

Ray and Hayes were colleagues who support each other professionally. They stated that most of the times, they got ideas from each other, while they were designing PDs. They sometimes conducted some PDs even together. Ray defined his role in this PD design as "Hayes did most of the work. I just gave couple of suggestions. The stronger PD design gets,

the more PD achieves its goals…of course I had an impact on design process, but Hayes was the person took the main job and made adaptations all the time".

5.3.2.4. PD Design Consultant 2: Sam. Sam was Turkish academician who works at MIT in USA. He had teaching mathematics experience for two years in Turkey as well. He had previous works on preparation of curriculum for coding integration into mathematics. This is why, Hayes was following Sam's work specifically. Hayes stated that he got big help from Sam's examples and activities while he was adapting syllabus of this PD.

5.3.2.5. PD Participant 1: Eva. Eva was a newly graduate when she took this PD. She completed Secondary School Teaching Mathematics Bachelor's Degree Program in 2018 in Istanbul. She did not have teaching experience at that time other than mandatory internship that she attended.

Eva was aiming to develop herself especially in technology-based education by taking various elective courses from the university and by attending several PD afterwards. Since she correlated coding and mathematics to each other, she had tendency to select coding integration in mathematics PD. As another motivation for attending PDs, she stated that she tried to have some certificates because she wanted to find job in private schools.

Eva did a lot of research via internet to find this PD. Eva was little worried about if this PD seeks for only making money because according to Eva, there are many institutions who are not sincere toward teaching. When she saw the syllabus of this PD, she got so excited to see coding and mathematics together in one program. She was one of the participants who wrote motivation letter to attend this PD. While she was writing her motivation letter, she was concerned about not having teaching experience because most of the institutions take teaching experience into consideration and she was anxious about not getting accepted.

Because of her being new graduate, Eva had some anxiety toward being actively engaged to PD. She also mentioned that since this was the first coding-based PD she attended, and she did not know anyone in the PD beforehand could be the reasons for her anxiety and tendency to not interact.

Eva stated that she showed competence anxiety toward final project they prepared at the end. She had the feeling of *not good enough*. To minimize this anxiety, she claimed that she chose to prepare her lesson plan how PD facilitator possibly like it. She believed that since she did not work in any school yet, she could not reach any kind of support from any organization. In this sense, she felt alone.

During PD process, Eva was so satisfied with the chosen examples and the way they went through PD sessions. She divided her computer screen into two and while she was following Hayes. In this way, she could be able to apply the examples simultaneously. She had full attendance. On the other hand, she was one of the participants who was reluctant to be participative.

5.3.2.6. PD Participant 2: Luna. Luna completed Mathematics Bachelor's Degree Program in 2015 in Istanbul. She got pedagogical formation from same English-medium private university in Istanbul. She had five years of teaching experience in different private schools. She worked in both secondary school and high school levels.

Luna attended many PD programs before. Duration of the PD programs that she attended varied. Mainly, she attended PD programs that are specialized in STEM education, maker education, and robotic coding. After taking maker education PD and working with Ardunio, she realized effects of coding-based applications on students' conceptualization. Then, she started to make research more intensively and she found out SCRATH and later on this PD. While she was searching for PD in this content, she specifically wanted to attend OPD because she found it logistically more suitable to her very busy working schedule.

Besides, she trusted on reputation of the institution that coordinated this PD. She was aware that PD facilitators were able to share extensive works in an international level. Luna was one of the participants who wrote motivation letter to attend this PD. Luna believed that free of charge PD programs are not that effective and in general they seek after making an advertisement for their product or paid PD. She was also one of the participants who could not get any support from her school as an organization to develop herself professionally. Luna had one absence during PD process. In some sessions, she was actively engaging when she had something to share, but in some sessions, she remained as passive.

5.3.2.7. PD Participant 3: Nora. Nora completed Secondary School Teaching Mathematics Bachelor's Degree Program in Malatya. She was currently master student in the same public university in Malatya. She had seven years of teaching experience in private schools. She only had teaching experience in secondary school level.

Nora proposed that while she was doing her bachelor's degree, she tried to attend various courses to improve herself. Firstly, she went to basic computer usage course and then, programming course. Besides, she attended mostly technology-based PD before she started to work in her current private school. Nora graduated from eight months long STEM Leader Teacher PD program. She completed this PD in June 2016. Since she was STEM Leader Teacher, she attended this PD without writing motivation letter.

Since Nora correlated coding and mathematics to each other and she had some basic knowledge for programming based on her previous PD, she was interested in this PD. While she was choosing this PD, she was not expecting to encounter Scratch. Later on, she said that she checked her previous notes about programming quite often. She would have hard time if she did not have some basic knowledge beforehand. She also stated that her English level was not enough to follow suggested additional sources during PD.

Nora used two different computers and she had hard time to follow the instructions and apply the examples simultaneously. This is why, she said that at some point, she stopped applying the examples and just followed Hayes. Since PD took place after working hours in the evening, she also felt tired and had hard time to follow the PD. She had only one absence during PD process, but she was always reluctant to get interactive. She proposed that she did not want to say something *wrong*. In this sense, she showed anxiety, and preferred not to actively engage through the conversations. In fact, she could not get any feedback for her lesson plan and she did not get contact with Hayes. Hayes thought he gave the feedback to her.

5.3.2.8. PD Participant 4: Steve. Steve had experience in using Information Communication Technologies such as logo and excel during his teaching experience. However, he stated that he used these applications while he was teaching Education Technologies course not mathematics. He learned Latex during his PhD and later on, taught Latex and MathML to teachers. Additionally, he specifically stated that he only chose PDs that are relevant to his field which was mathematics.

Steve was one of the participants who wrote motivation letter for this PD. His motivation toward block-based coding applications in mathematics was based on his primary school years because of his early experiences with his father. He also mentioned 80s generational effect on his motivation as "We grew up with a computer. Computer technology has always been compelling thing for us. I mean I wrote my own codes to play games". He explained his self-efficacy toward this course as *on purpose curiosity* which means even though the content was some technology that he did not know about, he felt himself ready because of his background.

Steve had only one absence because of his work and he was the only participant who did not complete his final project. Steve was the most actively engaged participant. Most of the time, he answered all the questions that Hayes asked. He always shared his opinions and

doubts. He proposed that he was confident about mathematical concepts that they went through during PD. He had some doubts about Scratch since it had reputation with lower grades only, but later on, he proposed that there were variety of options to conduct activities in high school and even university level.

5.3.2.9. PD Participant 5: Daisy. Daisy completed Teaching Mathematics Bachelor's Degree Program in Istanbul. She had four years of teaching experience in private schools. She had teaching experience only in high school level.

Daisy graduated from eight months long STEM Leader Teacher PD program. She completed this PD in June 2018. While she was taking this PD, she was interested in Scratch and tried to learn by herself via internet. She had some basic knowledge about technicalities of Scratch. She also correlated coding and mathematics to each other. For this reason, she wanted to learn about it more. Since Daisy was STEM Leader Teacher, she attended this PD without writing motivation letter. She also attended face-to-face Ardunio course simultaneously in another institution.

Daisy specifically searched for OPD because of her busy working schedule. Since she had previous experience with this institution while she was taking STEM Leader Teacher PD, she could learn about this OPD easily. When Daisy read the syllabus and check the PD facilitator, she assumed that PD will mostly be based on SCRTACH because Hayes had several books in the content. Daisy had some doubts about Scratch since it had reputation with lower grades only, but later on, she proposed that there are variety of options to conduct activities in high school as well.

Daisy did not hesitate to share any thought, question, or answer when she had it. However, because of high cognitive load of the PD, she stated that it was hard to participate by writing. She used two computers that one is for following Hayes and one is for applying the examples simultaneously. According to Daisy, it was challenging to follow, apply, and

write your thought at the same time. She had full attendance, and she completed her final project. She was also one of the participants who could not get support from her school as an organization to develop herself professionally. Table 5.1. describes the overall background information of PD participants.

Table 5.1. Overall description of PD participants.

NAME	JOB DESCRIPTION	TEACHING EXPERIENCE	PARTICIPATION PREREQUSITE OPTION	FORMER PD EXPERIENCE FOCUS	FINAL PROJECT COMPLETION AND APPLICATION STATUS
Eva	Recently Graduated	No experience	Motivation Letter	Technology integration-focused PD programs	Completed but not applied in the classroom
Luna	Mathematics Teacher	5-year experience in all grades	Motivation Letter	Wide variety of PD programs	Completed and applied in the classroom
Nora	Mathematics Teacher	7-year experience in Secondary School level	STEM Leader Teacher	Technology integration-focused PD programs	Completed and applied in the classroom
Steve	Former Mathematics Teacher / Academician	8-year experience in all grades	Motivation Letter	Wide variety of PD programs	Not completed
Daisy	Mathematics Teacher	4-year experience in High School level	STEM Leader Teacher	Technology integration-focused PD programs	Completed and applied in the classroom

5.4. Data Collection

As a data collection tool in depth interviewing is the most preferred method for phenomenological study (Creswell, 2007; Marton, 1986) because it is important to understand how the participants express their experiences over one phenomenon. Interviews are part of qualitative research one way or another (Merriam, 2009). Patton (2002) had good explanation for why interviews are needed “We interview people to find out from those things we cannot directly observe… We cannot observe feelings, thoughts, and intentions…The purpose of interviewing, then, is to allow us to enter into the other person’s perspective” (pp.340-341). Interviewing has its advantages when the researcher tries to find past events and also it provides the researcher with opportunity to control questioning. In this way, the researcher can concentrate on the focus topic (Creswell, 2009; Merriam, 2009).

Tomlinson (1989) explained hierarchical focusing method's profits as "therefore require bearing in mind when considering strategy for 'having it both ways' in research interviewing: that is, for remaining open enough to gain access to interviewees' construal whilst nevertheless ensuring that they are consulted on the whole of the researcher's agenda" (p.162). It is important to keep in mind while conducting interviews both research agenda and interviewee's perspectives, definitions, reactions, and interpretations should be contemplated simultaneously (Tomlinson, 1989). The implications of hierarchical focusing method can be summarized as trying not to miss any important points not by directing participants to any possible answers. Using this method, the flow of the protocol can be followed by the researcher according to participants' answers and if there are unmentioned points about the phenomena that is intended to investigate then, the researcher has asked that point. Priority is always hearing from the participant first.

I prepared separate interview protocol for each participant of the study (Appendix D, E, F). Interviews were conducted in the order of participants being addressed to the PD program. In other words, the coordinator had the idea first, then the facilitator and the coordinator designed PD in a collaborative work and then participants got part of the PD and started to work with facilitator for six weeks. Therefore, the interviewing process started with the coordinator and move forward to the facilitator and then participants.

Before I started to prepare the protocol for the PD coordinator, I watched all six videos of the Block Based Coding Applications in Mathematics Course to get familiar with the PD setting and participants. All the interview questions were prepared based on PD participants' actions and tendencies during PD sessions so that they can be investigated. Moreover, the protocol was developed after the reviewing the related literature. This is because; the need for this study comes from the literature itself. There was a need for deep investigation of each pre-determined effective PD characteristics, as well as the undiscovered ones (Borko et al., 2010; Hill et al. 2013; Nipper et al., 2011; Wayne et al., 2008). However, this does not imply that interview questions are leading toward the literature. On contrary, the interview questions are designed hierarchically focusing. It means that by starting with the broad

questions, the chance of mentioning the points was given to the interviewee. If there were some unmentioned points that wanted to be investigated, then I asked sub-questions of the phenomenon.

The first versions of interviews were reviewed by two experts and after their reflections and feedbacks, the interview was reconstructed. Once the protocols were ready, the invitation e-mails were sent to the participants. The sample of an e-mail for participants was included in Appendix A. Information about the study, what was expected from them as participant, the procedure for data collection was explained in detail and if they want to be part of the research or not was asked in the e-mail. Participants attended the study voluntarily. After getting their permission to be part of the research, the proper time and place was asked to the participants by the fact that it is important for participants to be ready and feel comfortable to share. It was also paid attention place to be quiet, and comfortable environment for both interviewer and the interviewee.

At the beginning of the interview, the purpose of the study and their rights as a participant was reminded and consent forms were requested to be signed by participants (see Appendix B). Two kinds of consent forms were prepared. One was explanation of their responsibility as a participant and the purpose of the study. The participants were informed that there will be no positive or negative sanctions for the answers given. The participant had the option to stop the discussions, ask questions during and after the interview, refuse to answer the questions and there would be no sanctions at the end. The consent form was for the permission for audiotaping which was included in Appendix C. After that, some demographic information was asked to participants such as educational background, their previous PD experiences, and year of teaching.

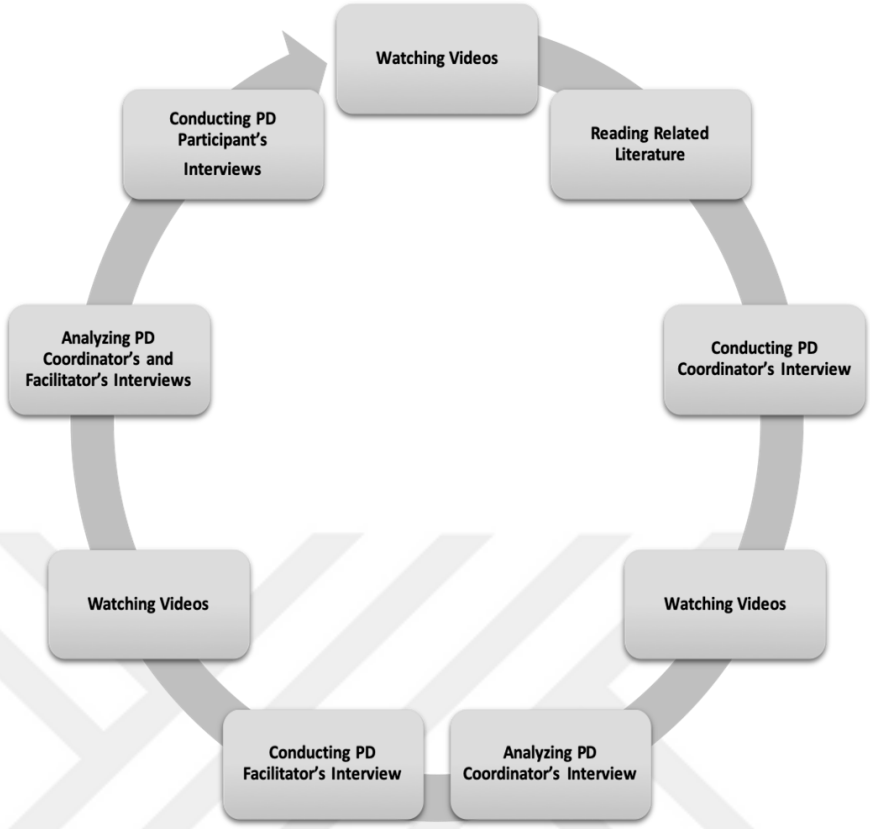


Figure 5.2. Data collection process.

As it can be seen in Figure 5.2., this was inductive research, emergent design was applied, when collecting the data. It means that each collected data nurtured the next step of data collection. Thus, data analysis started from the moment of first data collection. The interview protocol for the facilitator was designed based on the interview with the PD coordinator as well as video recordings of the PD and the related literature (included in Appendix E). Same process was followed for the interview protocol of the PD participants.

5.5. Data Analysis

Phenomenological reflection is an effort to get the essence of the lived experience over phenomenon. It is both so simple and complicated. It is simple because the essence of the phenomenon is handled by each individual in everyday life. It is complicated because

explication and determination of what a phenomenon is a hard work (van Manen, 1990). While dealing with the phenomenological reflection, phenomenologists generally refrain from relying on specific methods too much (Hycner, 1985). However, there are three basic process of data analysis for qualitative research regardless of which approach was followed. These are *preparing and organizing the data*, *reducing the data into themes through a process of coding and recoding*, and *presenting the data in tables or discussion* (Creswell, 2007). Even though, different authors (e. g., Huberman & Miles, 1994; Moustakas, 1994; Smith et al., 2009) proposes even more detailed or structured steps for data analysis strategies, mainly they all cover these three core elements of qualitative data analysis.

Data management is one of the most important steps for data analysis. As Patton (1980) says, "Sitting down to make sense out of pages of interviews and whole files of field notes can be overwhelming" (p.297). During this step, it is suggested that reading the data over and over again and writing memos are short phrases, ideas, or key concepts in the margins (Creswell, 2007; Saldana, 2013). Focusing on what the interviewee really tells you and be open to undiscovered categories of the phenomenon instead of getting stuck in predetermined thoughts and codes is essential part of qualitative data analysis (Crabtree &Miller, 1992; Creswell, 2007; Saldana, 2013).

Therefore, in this study, any word, sentence, or paragraph that refers to what constitutes as high-quality PD to the participant, I used that word, sentence, or paragraph as a unit of analysis. During deciding and naming the codes, I used different kinds of coding methods such as descriptive, open, or process coding (Saldana, 2013) to be more explicit and reflective over what the interview transcription told me. I was careful about not missing out any of the data since this study sought after exploratory purposes. Using different methods of codes helped me to reach this aim. For example, sometimes code was only one word as describing the such as "workload" because it was basically describing the workload aspect of duration for that participant.

> Nora: It wasn't limited to 1 hour, yes, it was six weeks, we could say six hours, but I watched each lesson 4 or 5 times over and over. So, at least for me to be able to reach the level that I can do it on my own, apply it on my own.

However, sometimes I preferred the process coding since it was explaining one process, but it was still about high-quality PD. For example, for following dialogue, I used the code "getting a vision for going further on the topic".

> R: What purpose do you think these sharing was made with you?
>
> Luna: [Hayes thought] 'OK we are making codes here, but you can also examine different codes or even you can even apply'. I think it was shared to fully expand our literature.

During every step of data analysis, I wrote analytic memos to keep my brain in a fresh form about the data. Analytic memo basically means that little conversations that we have with our data. In this way, they are reminders of your own analysis (Saldana, 2013). Eventually, those notes, and memos constitute initial categories or as they are called codes of the data. However, it should be paid attention to find multiple forms of evidence for each category will strengthen the core of the qualitative analysis (Creswell, 2007). Afterwards, these codes turned into categories and ultimately themes. While deciding on categories, on some occasions, only one code referred to the category so that they represented the same data. However, mostly, some recursive or similar codes constituted broader meaning over the data. For example, codes of "time is needed to apply what is learned", "time is needed to gain expertise", and "time is needed to get comfortable for being interactive" generated the category of "multiple doses" since they all emphasized the need of time intervals among multiple PD sessions.

Since themes constitutes to the ultimate meaning of the phenomenon and the core of the phenomenological reflection, it might be useful to what is considered as themes in detail. Themes refer to frequently repetitive element in the text. Therefore, thematic analysis is sometimes perceived as precise mechanical application of recurrence rate of coding in transcripts of the text (van Manen, 1990). Even though, it might be convenient for some occasions and it is suggested by some researchers (e.g., Huberman & Miles, 1994), some

does not feel comfortable in this sense. Because of the fact that this is a qualitative data analysis, counting through the codes is not necessarily gives the essential themes of the meaning of the phenomenon. On some occasions, even though it was not repeated as much of the others, it could be one of the most expositive points of the phenomenon (Creswell, 2007; van Manen, 1990). For example, theme of "assessment" was only mentioned by PD participants, but it does not necessarily mean it is something that can be overlooked. Thus, counting through the recurrence rate of the codes should not be only criteria for decision making process of theme construction.

The process of interpreting its meaning from a text or having experienced, a more accurate understanding, discovery or disclosure and formulating a thematic understanding is not a normative process, "but a free act of 'seeing' meaning" (van Manen, 1990, p. 79). After all, the theme concept is should be considered as a simple tool to achieve our notion. It gives control and order to our theme research and writing. When one phenomenon is started to analyze, in fact, the researcher tries to capture the *structures of experience* which constitutes what we call *themes*. They have the power of making further descriptions over phenomenon. Phenomenological themes are descriptions of the lived experience and hints of main aspects of phenomenon rather than being isolated statements.

Decision making process of themes also involves the reflections through the researchers' view of world. However, there is difference between pre-reflective lived understanding and reflective aggregation of the phenomenological structure of lived experience. As van Manen (1990) states, "The insight into the essence of a phenomenon involves a process of reflectively appropriating, of clarifying, and of making explicit the structure of meaning of the lived experience" (p.77). Gadamer (1975) has important descriptions over questioning-answering dialogues to make interpretational analysis clear. Each time interviewee gives an answer to a question that is the topic, or notion, interpretation can be seen between the people who share conversational relations. Thus, conversations include hermeneutic stimulation. By the reason of this, the collaborative nature of the

conversation should be particularly well addressed to the task of reflecting on the themes of the notion or phenomenon being studied.

There is a big challenge in a phenomenological study analysis which is to differentiate between the essential themes that are forms of capturing the experience, the focus, the meaning, the point one tries to understand than the themes that are more incidentally occurred under the study (van Manen, 1990). To determine essential quality themes of phenomenon that is wanted to learn what it is and discover its aspects, phenomenologists uses the method of free imaginative variation. Basically, the decision over whether it is essential or not relies on the answers of these questions: "Is this phenomenon still the same if we imaginatively change or delete this theme from the phenomenon?", "Does the phenomenon without this theme lose its fundamental meaning?" (van Manen, 1990). Since this study was trying to discover what may remained unknown in regard of high-quality PD, I tried to include any emerged theme as much as possible.

In addition to thematic analysis, VS Coding standards was applied separately to clarify some repeated controversial dichotomies. Even though this was not planned at first, during the interviews I realized that there are some controversial issues among study participants thereupon I added VS coding to my analysis. According to Saldana (2013), VS Coding does not necessarily mean taking sides between two dichotomies and declare one side as winner. On contrary, it aims to provide readers to two or more sides and their multiple perspectives in a discourse. He explains its necessity on some occasions as "Moieties exist in many facets of social life, and there is generally an asymmetrical power balance between them, a duality that manifests itself as an X VS" (p.115).

Together with what is mentioned earlier, it is worthy to repeatedly underline that the aim of this research was not to use the predetermined effective PD characteristics as an analysis framework. Even though, there is a chance to reach many commonalities with the

related literature, it also pursues to explore undiscovered sides of different perspectives. In this way, this study is open to construct new themes through the study (Saldana, 2013).

5.6. The Role of the Researcher

To make it clear for readers to what experiences the researcher had with the phenomenon before the study has started will be explained first. Therefore, also Moustakas' (1994) one of the most underlined characteristics of phenomenological study – bracketing – is dealt with.

I may say my experience with the effective PD characteristics regardless of its content based on two roots: (1) final project assignment for the course called Teacher Learning and (2) my personal interest was PD itself since the first day of being a master's student. I took this course as an elective course during my master program. We were expected to design one professional development program with every aspect decided by the students of the course. To accomplish this assignment, my partner and I read the related literature and analyze many PD projects. Also, during the time I took master's courses, I specifically chose to work on effective characteristics of PD Programs, OPD, teacher learning, teacher education, and adult education for my assignments.

In practical manner, I had five months-long teaching experience as a teacher assistant in Westminster International School in Italy. While I worked there, we met once a month and reflect on what was done and what were the challenging objectives during that inquiry period. Each month one inquiry was specified for each age range and all the objectives and the activities were discussed and planned altogether including the principal of the school. These meetings may not be considered as PD but more like reflective teacher meetings and it was my only experience with PD at first-hand.

There is no doubt that, I always reminded myself to not implicate either my own experiences or the related literature with the data presented by the participants during the collection and analysis of the data. However, as it was mentioned before, it is almost impossible for the researcher to put aside all the pre-knowledge, beliefs, and thoughts aside (Moustakas, 1994). Moreover, since the nature of the conversations (Gadamer, 1976) and philosophies that relates description to the interpretation (van Manen, 1990), the researcher's interpretation will be part of the data analysis naturally. This does not mean that the researcher will decide every aspects of the data analysis by herself as an authority. With the use of member checking, rapport, and collaboration with the participants, I believe I stick with what data truly told. Besides, the interpretations shared by one other researcher's point of view over the data.

As a researcher, I started with watching the videos of Block Based Coding Applications in Mathematics Course twice. I took notes during watching and I got familiar with the content and the tendencies and attitudes of participants and the facilitator. Then, I wrote list of questions that makes me curious while watching the videos. This was my starting point for composing research questions of this study. I was already familiar with the literature because of my readings during the time I took my master's degree courses and later that time. However, I got deeper in the field and created the interview protocol for all the participants of this research separately, PD based on videos, the related literature, and the interviews itself. All interviews are conducted in participants' native language – Turkish – and recorded after getting consent form from the participants of the research.

Before the interviews, I tried participants to get informed about the study, their responsibilities and right as a participant as much as possible. The convenience of timing and place was arranged according to participants' schedule. During the interviews, probing questions added through the protocol when it was needed and if some issue remained unclear, either question was paraphrased or what I understood was explained to the participant. So that they can correct my interpretation. Also, I took notes during the interviews, since it is not possible to audio recording participants' mimics or gestures. If

there were more underlined issues or some noticeable facial or vocal changes such as excitement or resentment, while participants were talking was noted during the interviews.

After the interviews, member checking was done with each participant of the study so that there was no inconsistency between the interviewer and the interviewee. All the interviews were conducted and transcribed from recordings to the Word files verbatim by the researcher. Each transcription took more or less single spaced 35 pages.

5.7. Trustworthiness

Variety of words were established for referring to sustain the quality of qualitative research like "trustworthiness," "credibility," "dependability," "conformability," "validation," "reliability," and so on. Regardless of which terminology was used, it is important to confirm each steps' trustworthiness of the study for study's own worth (Creswell, 2007). It means to check the consistency and accuracy of the findings and strengthen the research's credibility through several methods. Angen (2000) proposed that validation refers to "a judgment of the trustworthiness or goodness of a piece of research" (p.387).

Creswell (2007) presented eight procedures to maintain trustworthiness of the study and suggested at least two of them should be engaged in any qualitative study. Figure 5.3. represents the elements of trustworthiness of this study: (a) prolonged interviews, (b) peer review, (c) member check, (d) audit, (e) researcher reflexibility and (f) rich description.

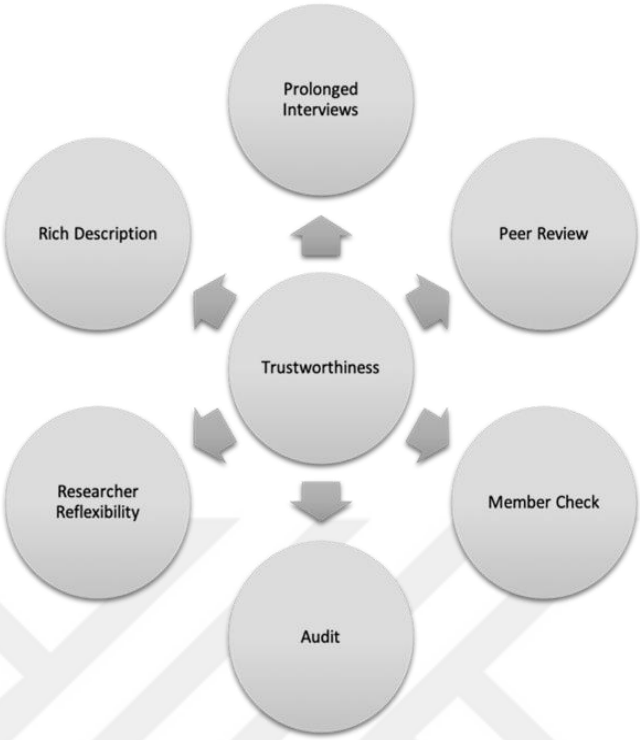


Figure 5.3. Elements of trustworthiness.

It is significant to underline that prolonged interviews are conducted for the research to get the essence of the participant's experience with the phenomenon better and most probably with different statements. All the protocols of the interviews were checked by two different experts to make sure there is no missing points to explore. Each interview taken at least one and half hour long. As well as audio recording, the researcher took notes during the interviews, to capture the unique statements or unusual change of facial or vocal expressions to make sure seizing all the recursive and underlined points.

As a second element, peer debriefing was used to check the research process. Lincoln and Guba (1985) identified the role of the peer debriefer as a *devil's advocate,* that someone who keeps the researcher honest, who is in every aspect the inquirer's peer, who asks reflective questions about methods and interpretations, and who sometimes simply listens the researcher's feelings (Lincoln & Guba, 1985). The researcher asked another graduate

student from the same department who took qualitative research course at graduate education and had experience in regard of qualitative data collection and analysis by working in research project, to be the peer-debriefer of the research.

Member check is considered by Lincoln and Guba (1985) as "the most critical technique for establishing credibility" (p.314). Member check process helps the researcher to incorporate participants' views into findings and interpretations of the study. In this manner, Creswell (2007) shared his experiences as taking participants' view into his analysis process including consisting of description or themes. During the interviews, as an informal member check, the researcher made small summaries after some points and asked from participants to confirm if her interpretation is accurate. For formal member check, it was sent a *thank you letter* including the review of the interview. It was requested from participants to clarify the review or fix possible misunderstandings. Each participant confirmed the truth of understanding during member check process thereupon it increased the dependability of the study's findings.

External audit provides opportunity for examining the accuracy of both process and product of the research (Lincoln & Guba, 1985; Miles &Huberman, 1994). This person was someone who interested in the context of the study and who was knowledgeable about the subject matter but, at the same time have no connection to the study to ensure confirmability (Lincoln & Guba, 1985). As a second opinion, this person assessed the product and evaluated if findings, interpretation, and the conclusion of the research is substantiated by the data.

Researcher reflexivity refers to detailed information about what was done specifying its time, place, and with whom. The researcher keeps a reflexive journal which she can write about research process, schedules with the participants, timeline, descriptions of the participants, in short, every aspect of the research. In this way, the researcher can increase the trustworthiness of the data and also assess the research design by reflecting on what was

written for data analysis and interpretation of the results (Gonzalez, 2004 as cited in Niğdelioğlu, 2014).

Rich description was final element for trustworthiness. It enables readers to decide on if findings of this study can be transferrable to other settings because of common features (Creswell, 2007). When the researcher describes the participants and the research setting in detail, it gives chance for readers to transfer information or findings into different contexts (Lincoln & Guba, 1985). For this research, the PD setting was explained in every aspect of one big project that PD was linked to. Application requirements for PD participants gave away clues for the educational demographics of the participants.

6. FINDINGS

In this chapter, findings of the study are presented. First, central research question is answered from the perspectives of PD participants, coordinator, and facilitator, respectively. Table 6.1 represents all themes that were found according to whom they were expressed. So that common themes that were underlined by every agent with different roles can be seen.

Table 6.1. Common themes that emerged among study participants.

PD PARTICIPANTS	PD COORDINATOR	PD FACILITATOR
Content	Content	Content
Duration	Duration	Duration
Teaching Philosophy	Scope as Purpose	Scope as Purpose
PD Venue	PD Venue	PD Venue
Cognitive Load		Cognitive Load
	Iterative Process	Iterative Process
Interactivity		Interactivity
Assessment		
	Sustainability	

Then, to understand PD reflections over PD participants' practices, after PD-regarded findings are presented. During interviews, I realized that some PD characteristics discussed among participants controversially. To present opposite opinions objectively, VS coding was also used during data analysis. Finally, everybody that was included in the study mentioned about high-quality PD facilitator characteristics thereupon these findings are presented, and related emergent research question is added as well.

6.1. Effective PD Characteristics According to PD Participants

In this section of the findings, perspectives of PD participants over high-quality PD characteristics is presented. Seven themes emerged after data analysis process: (a) content, (b) cognitive load, (c) duration, (d) teaching philosophy, (e) interactivity, (f) assessment, and (g) PD venue. Each theme is composed different categories. Furthermore, to be insightful for further studies and more meaningful for readers, most underlined codes are shared under these categories. Table 6.2. presents all the themes, categories, and codes that were found from interviews with PD participants.

Table 6.2. Review of effective PD characteristics according to PD participants.

THEMES	CATEGORIES	*CODES*
CONTENT	Syllabus	*Clearly stated syllabus*
		Consistency between syllabus and its implementation
	Diversity of Content	*Differentiated and interesting examples (e.g., art-related)*
		English resources
	Coherence	*Adaptable and practical examples*
		21st century educational needs
	Depth in the Field	*Enhancing pedagogical content knowledge*
COGNITIVE LOAD	Prior Knowledge	*Disciplinary content knowledge*
		Background with the PD content
	Learning Curve for New Technologies	*Hard at first but applicable at last*
	Amount of Content	*Balance between duration and amount of PD content*
	Recording PD Sessions	*Re-watching videos*
DURATION	Multiple Doses	*Application time for what is learned*
		Time is needed to gain expertise
		Time is needed to get comfortable for getting interactive
	Workload	*Workload*
	Logistics	*Not breaking out teachers' work routines*
		Adjusting best hours for teachers
	Scope	*Scope of the PD*

Table 6.2. Review of effective PD characteristics according to PD participants (cont.).

THEMES	CATEGORIES	*CODES*
TEACHING PHILOSOPHY	Sincerity toward Teaching	*Sincerity toward teaching and sharing*
	Selective Inclusiveness	*Motivation letter as chance for self-reflection*
		Reaching eager to learn teachers
	Road Map /Teaching How to Learn	*Getting a vision for going further on the topic*
		Accessible various resources for lifetime
INTERACTIVITY	Familiar Faces	*Sharing experience with colleagues who have something in common (e.g., grade, school, etc.),*
		Knowing facilitator beforehand
	Comfortable and Safe Environment	*Personal and cultural characteristics*
		Peer learning and sharing environment
		PD facilitator should create safe space
	Readiness for the Content	*Background with the PD content*
ASSESSMENT	Certification	*Necessity of certification*
		Meaning of the certificate for PD participants
	Lesson Plan as PD Output	*Producing something from what you learned*
		Producing something that can be used in the classroom
		Getting feedback over what was created
	Assessment Criteria	*Clearly presented rubric*
		Document as prototype
	Inclusion of Assessment Process in PD Duration	*Getting instant feedbacks*
		Peer learning
		As alternative small homework
PD VENUE	Noticeability and Respectability in the Literature	*Being student in rigorous learning*
		Positive reputation of the institution
		Previous experience with the institution
	One Structured Platform for OPD	*Various communication tools*
		Synchronized
		User friendly layout for sharing environment
		Accessible resources
	Optimum Number of Participants	*Optimum Number of Participants*

6.1.1. Content

Under this theme, categories called (a) syllabus, (b) diversity of content, (c) coherence, and (d) depth in the field is presented.

6.1.1.1. Syllabus. Exemplary codes for this category were *clearly stated syllabus* and *consistency between syllabus and its implementation*.

All participants emphasized the importance of the syllabus of the PD. First of all, since the main source that forms an opinion about PD in the first place is the syllabus, its clarity played a crucial role for participants. So, syllabus of the PD should be proposed clearly and explicitly. Secondly, while PD continues, participants expected to follow syllabus as it was presented. This means that consistency between syllabus and its implementation was highly important for participants.

During the interviews, it was discovered that participants usually did a web search to find a PD. In their search for a PD, the first thing they encountered was the syllabus. This is probably why, they all mentioned importance of syllabus is being clearly and explicitly presented. Eva shared her experience as "When I read the syllabus, it was saying that both math-based and coding. They used that two most important words at the same sentence. This is why, I chose this PD". On the other hand, Nora shared that she had hard times during PD, because she was expecting different content after reading the syllabus. Nora was expecting that learning more about different coding applications and not moving forward with mostly Scratch-based examples. According to Nora, even though other coding applications were basically presented, the main focus was Scratch, and the syllabus did not state this would be the case. She stated that this situation highly affected her motivation toward the PD.

> Nora: If it was written that we would go directly through Scratch, I would look for a little bit of Scratch. Then, I would decide it. But there was a more general definition about the content of the course.

During the interviews, the question of "What were the objectives to be achieved at the beginning of this course?" was asked. All the participants except Nora agreed on that learning objectives to be achieved during this PD was the ones that was presented in the syllabus.

> Eva: I mean the weekly schedule was actually written on the web site [syllabus], and Hayes tried to keep up with the schedule. He explained the weekly plan in detail in each week. So, I can list those learning objectives because we really learned those objectives. Frankly, I don't think anything left missing.

All the participants except Nora stated that since syllabus and its implementation were highly consistent, they actually achieved the learning objectives that they were supposed to. In this regard, they stated that PD facilitator followed the syllabus as it is supposed to be without any missing parts. According to participants, after covering each learning objective of the syllabus, Hayes even managed to go beyond this syllabus by sharing various resources that was not even included in the syllabus.

6.1.1.2. Diversity of Content. Exemplary codes for this category were *differentiated and interesting examples (e.g., art-related)* and *English resources*.

The most appreciated feature of the content among participants was its diversity. Participants found the syllabus very interesting and differentiated because it was involving different kinds of examples from various projects and experts. The chosen examples were not only composed by national experts in the field of coding integration into mathematics lessons but also Hayes was be able to reach through international experts' projects. Each week they went through different mathematical concepts by using different examples from different topics. They agreed on that these diverse examples and various sources help them to be aware of different paths to follow according to their different needs.

During the interviews, most of the participants repeatedly defined syllabus as *interesting*. The dialogue over syllabus with Daisy was the gist idea for all participants.

> R: How do you consider the syllabus when you consider your learning process?
>
> Daisy: … Syllabus was interesting. I mean especially the prime number algorithm, etc. I guess it is one of the catchiest examples, that is why I always mention about it. When I look at the syllabus, I got excited. [I said] are we going to do that too, how do we do that?
>
> R: Why do you think the prime numbers was the catchiest example for you?
>
> Daisy: … Hayes done such a colorful example [excitedly telling]. I liked it that week. I said myself I should show this in my classroom, it seemed so artistic. Mathematics, coding, and art are all intertwined. So, I think I was very interested. It stuck on my mind.
>
> R: Especially visual and artistic examples stick in your mind. Is it correct?
>
> Daisy: Yes. Yes.

During the interviews, while participants giving examples from PD, they always remembered the visually charming and catchy examples. They considered the content of this PD as *interesting* because they were amazed by what they see as examples. They all noticed the connection between mathematics and art within those examples. For example, Eva chose to do her project based on one of the art-related examples.

> R: Could you tell me about the effect of this PD on your project?
>
> Eva: Sure. For example, we learned to create shapes in examples. There was one example prepared by Sam. As the teacher showed us with the ballerina girls [example name], I actually prepared my own project with such example … So, I prepared something about shaping. It was something like the image that two planets form in the circle while rotating in their orbit. I mean, it's all about visualization, but I could never think about it before. [I realized] in mathematics, visualization is important and because the visual representations draw attention, you can bring it closer to mathematics. Frankly, I used this in my project.

To sum up, the most memorable examples were the ones that have interdisciplinary approaches and visually worth to remember. This shows that proposing interdisciplinary examples, in this instance art integrated into mathematics, increases participants' interest toward PD content.

As another point of diversity, all the participants except Nora was very appreciated that Hayes was able to share resources in English with them. Being able to reach though examples from all around the world was very beneficial for participants to widen their visions on the PD content. Luna stated her gratitude as follows.

> They [PD facilitators in this institution] are really good teachers in their schools. Knowing English and being able to give examples from resources in English. Turkish literature on this content is limited and they are replications of one another.

On the other hand, Nora was neutral about documents in English as diversity since she could not benefit from these resources because of the language barrier. So, it is very important for PD facilitators to know their audience because it may be very effective for choice of sharing in the related content. In Nora's context, language barrier was the problem.

Eva also shared that she sometimes had hard time to integrate international examples or documents into her context because of curricular differences among countries in K-12 levels. So, in Eva's context problem was the lack of experience – reminding that Eva had no teaching experience – in adapting examples from other countries in the Turkish curriculum. In addition to giving examples in English language, discussions about their implications over local classrooms should be added to these shares.

> Eva: When I look at foreign sources, maybe there are too many lesson plans, but it seemed to me that it doesn't fit. Sometimes they make their curriculum lighter or their coding lessons are given at early age.

These two circumstances showed that being able to share international resources may be useful, but it came with its problematic views. Even though sharing international resources could be very beneficial for some of the participants, it may not be very meaningful for others, if PD facilitator was not careful. PD facilitators should both be able to know their audience and explain practical issues of adopting foreign-origin resources into local classrooms to make these shares worthwhile for each participant.

6.1.1.3. Coherence. Exemplary codes for this category were *adaptable and practical examples* and *21st century educational needs*.

Each participant agreed on the importance of parallelism with PD content and teachers' classroom needs. All of the participants had the aim of learning how to integrate coding applications into their mathematics classes. According to participants, 21st century came with its special necessities such as having computing skills, being digital citizen and so on. By attending this PD, they aimed take a step towards meeting 21st century educational needs. In this sense, in the nature of attending a PD, each participant sought to get information that they can use in their classrooms.

Throughout this PD, participants stated that they had no problem with understanding the relevancy between what they learn from this PD and transforming it into classroom. In this sense, Eva expressed her gratitude as follows.

> R: How do you consider the syllabus when you consider your learning process?
>
> Eva: I think it was quite full, for example, sometimes there were examples on certain mathematics topics. There were Euclidean algorithm, GCD and LCM… In other words, the fact that it was explained as a whole with mathematics affected me very much … The content of the PD was already nested with mathematics. There were as many examples as possible in all fields, from geometry to mathematics. Maybe it couldn't be more because of the time but it may be the best it can be.

Luna was very contented about Hayes was being aware of current learning objectives and facilitating PD accordingly.

> R: How do you interpret the course when you evaluate its suitability for your classroom needs?
>
> Luna: …I was able to apply the codes we learned every week, even only little by little [in the classroom].… examples that were done in the PD was based on our current learning objectives [at school]. He often asked us whether there is an integral or not, is this still in the curriculum…[I did not feel like] 'You know Hayes, you do this here, but we don't have this at school or I can't do it in class. You are saying this my teacher, but this topic is removed from the curriculum, and I will not use it'.

As one of the reasons for this, participants proposed that since Hayes had previous experience in the classroom setting while integrating coding into mathematics, he was be able to ask probing questions to discover the relation between the coding application and the mathematical concepts. He was be able to present participants' possible challenges of implementation or reflect on what they might go through in practice. Luna stated that if she took this PD from one PD facilitator whose profession was engineer, s/he would give more technical information than practical pedagogical knowledge. In this situation, it would not be as beneficial as their version.

As one of the coherence related worries, Nora stated that possibly not all teachers had facilities like she had (e.g., pc, smartboard, etc.) Therefore, more convenient examples that suits for different contexts better might have chosen for the PD content. On the other hand, since participants of this PD was aware that this PD was directly related to computer-based technology, all the participants had already facilities in their schools to use these applications. Therefore, this might be why nobody mentioned facilitative deficiencies. On contrary to Nora's worries, Luna shared her Scratch implication experience as follows.

> R: You mentioned positive, did anything negative happen in your experience?
>
> Luna: …In private school, it happens like this. You know, computer labs are not always available. But we turned it into positive. It can be overcome by teamwork.

It shows that even though Luna had hard time for getting available hours for computer lab, with collaboration with her colleagues, she overcame these kinds of obstacles. So, participants who were volunteer to take technology integration-based PD were already prepared for the facilities that was to be needed.

6.1.1.4. Depth in the Field. Exemplary codes for this category was *enhancing pedagogical content knowledge.*

Participants, specifically, Eva, Luna, and Steve emphasized the importance of getting information about their pedagogical disciplinary needs. According to them, they chose this PD because it was directly related with their fields – mathematics. They proposed that it would be meaningless to have some general pedagogical knowledge without any specification about mathematics. Therefore, as Steve explained in the following quote, it is safe to present that Pedagogical Content Knowledge (PCK) was a priority among participants.

> Steve: For me, any education gains meaning only with mathematics. So, I'm not only an educator but also math teacher. So, when I go to a conference, I look at things related to mathematics and my discipline. Indeed, people are like that. The most ridiculous PD were independent from the discipline, and they were the types that tell us about psychology and children… But, instead, let a math education professor-not a math professor, a math education professor-come. I always wanted to find something that can directly help me in my class, I have always been after them.

As its in essence, teachers followed pragmatist approach while they are attending a PD. During the interviews, all the participants underlined that they are aiming to learn new instructional methods that they can directly or adaptably use their classrooms as one of their reasons for attending this PD. Naturally, they wanted to learn new methods that they can apply it in their classrooms.

On the other hand, as a different perspective, Daisy highlighted not only specialization in the classroom environment but also having depth in the field was an important motive for her to attend PD. She considered every knowledge that she is going to learn in her field is a chance for her to gain depth in the field. So that, PD is not only about meeting educational needs but also getting more advanced in the teaching profession.

> Daisy: To be honest, I would want to learn this even though, I won't use it in my classroom ... I mean I wish I can use it in my classroom. However, even though I won't use it, I am sure that it will be useful at some point. It is a good thing even only knowing this.… I think I should know as a mathematics teacher even if I am not going to use this in my class. So, my aim is to improve myself. If I improve then, my lesson will improve as well. You know, not thinking about the lesson in the first place, but if I improve, the lesson will develop automatically.

6.1.2. Cognitive Load

Under this theme categories called (a) prior knowledge, (b) learning curve for new technologies, (c) amount of content, and (d) recording sessions are presented.

6.1.2.1. Prior Knowledge. Exemplary codes for this category were *disciplinary content knowledge* and *background with the PD content.*

During the interviews, all the participants shared that they considered mathematics as very intertwined with coding. In other words, they believed that since coding is highly related to mathematics, they can use it in their classrooms to teach mathematical concepts more efficiently. This means that they all had very strong connections in their minds about this PD is being fruitful for their profession.

In one example with Nora, I asked her first motivation about coding:

> Nora: I always tried to support my education during the summer holidays, that is, during the university period, with a summer course or with private courses from the outside. Firstly, I went to a course where I could learn the basic functions of the computer. Then, as a next step, a computer programming course was opened. Then I continued this course. I also think that coding has a lot to do with mathematics. So, it is a field that requires some analytical thinking about mathematics. So, I continued. The reason I continued was because I like coding and associating it with mathematics, and analytical thinking. I continued like that. Of course, this is an education I received during this university period, but I still keep my notes.
>
> R: You said that I think mathematics is very related to coding. Could you please elaborate on this part a little more?

> Nora: I felt it the most, while I was learning to Scratch. Yes, maybe a non-math teacher can use Scratch too. But I think the coding is already language of mathematics. Everyone who deals with coding absolutely knows and accepts this fact. In other words, with a little knowledge of mathematics, you can make it much faster and think more analytically. So that's why I think it's about mathematics.

In another example with Steve I asked his reasons to focus on coding and programming:

> R: As a mathematics teacher, what were the reasons for you to focus on coding, programming etc.?
>
> Steve: Because I think one of the best things that we can connect mathematics with real life, where we can teach mathematical thinking, and show its direct application is algorithmic thinking. Plus, this is the way of where we can see real life application directly from encryption technology, to make any object smart. In fact, it provides an environment where many mathematical skills are used. Coding provides us, more precisely computational thinking, so we're not just coding. We want to do more. It provides a very unique opportunity for it [computational thinking].
>
> R: What was your first motivation?
>
> Steve: The computer is, of course, I am a child of the 80s. We grew up with a PC. PC technology is always a wonder for us, so I would write code to play games. In other words, I wrote my own code on the pc because it was saved on other diskettes and they were really expensive. It came out later that floppy things. I wonder from the beginning for writing my own code for it. We also grew up with this in popular culture, … Imagine that you can enter every pc and do anything, it's such a dream age. Think it is the first time that PCs are coming out. Therefore, coding was always a wonder. When the internet came to Turkey, I had just started university… This is a very humanly curiosity. Maybe not as a teacher, but teaching is a way of life. I bring this into what I am teaching in my life, of course. If I'm interested in pc, I do my lessons closer to pc. The reason I use technology well is that children learn better, but first of all, I am interested in it.

Therefore, before participants attended this PD, they all had the connection between coding and math in their minds. For some, this interest came from college years while they are taking computer-based elective courses. For some, it came from even earlier ages, because of growing in 80s generation which means that they witnessed the creation of digital age. Therefore, since they associated the content with their profession, they felt necessity to learn about it more and transforming into their classrooms. Whether they attended PD that was related this content before or not, they all made sense the theme of the PD first. They all believed that this relationship could help them and also their students to grasp mathematical concepts and enjoy math classes better. In a sense, mindfully, they all felt readiness for the content.

While some of the participants are totally new at PD content, some of the participants stated that they had *on purpose curiosity* toward the PD since, they had background on the topic, but they expected to learn some new technology that they do not know about. Steve explained his experience as "I had a background in integrating technology inside the classroom. I mean I had high self-efficacy on the content. I believe that I can do it…what I had was *on purpose curiosity*". It showed that having previous experience with the PD content, comes with high self-efficacy for participants.

Participants who had previous knowledge and education on related PD content proposed that they saw the benefit of their previous knowledge and their archive that was saved from previous PD programs. They claimed that if they did not have this previous experience, it would be harder for their learning through PD. So, previous knowledge was a big advantage for participants to reduce the cognitive load.

> Nora: If I didn't have basic knowledge [about coding], I think I would have a hard time with Scratch… Yes, the codes are ready, but when you combine them, you could have a hard time, I think that having some basic knowledge has a positive effect on this … You know, I had to go back and look at my previous notes while we were learning to Scratch because I need to know a little bit about the basics of coding. So, you can't just say that 'I'm learning Scratch' and learn.

Not only prior knowledge on the PD content but also disciplinary knowledge was very effective on cognitive load for participants. It required extra effort to work on brand new PD content and integrating it into discipline by using disciplinary content knowledge. As Steve and Eva explained in the following:

> Steve: I think it was a little bit fast. This was first experience of Hayes' as well. I couldn't follow many things. In other words, as one of the things I said during the PD exceeded my expectation was that algorithms which require a very good mathematics thinking were made. There was not much time to follow.

> Eva: Writing code does not happen very fast. You have to think on why that code happened. You know, in some of that session, for example, there were some mathematical problems on my mind. I had a mathematical problem in my own project, and it might have been a little longer for us to solve this problem.

This showed that even though participants associated the PD content with their classroom needs and feel necessity for learning about it, their previous experiences on the PD content and disciplinary content knowledge affected their cognitive load for the PD. So that, PD designers should have the information of participants' prior knowledge on the matter.

6.1.2.2. Learning Curve for New Technologies. Exemplary code for this category was *hard at first but applicable at last*.

All of the participants underlined that learning new technologies took time for them adopt the process. They mentioned that dealing with codes, mathematics that lies behind codes, and being novice for technicalities of coding application at the same time was very challenging.

All the participants have agreed on PD facilitator was very fast because he was expert on technicalities of the Scratch. Luna expressed her experience as "While doing the codes, Hayes went a little fast. Since he knows himself very well, I sometimes missed things while combining the codes". This means that PD designers and facilitators should consider learning curve for new technologies because it takes time for participants to get used to. It is an extra cognitive load for participants. Steve explained this situation as follows.

> The teacher was explaining the lesson, explaining, explaining, and suddenly asking a question, okay? I am 10 minutes late already. I'm just trying to follow the previous example, that code. So, I need to understand the question then, I need to answer it. It was not easy. Because he is still using it very fast on that board. I mean he was using the program like crazy. When he says, "Take this code", I try to find where it was, I try to find talk button or something else simultaneously. So, my learning is much slower than the speed of the teacher. Hayes was not very aware of this.

Nora was one of the most struggled participants on technicalities of the PD. She shared her experience as follows.

> At first, there were times when I had difficulty. While I was listening to the teacher, I was working on two PCs and at the same time, I was trying to practice what my teacher did. And then you are falling behind, you may have a little trouble using the mouse, etc… It really wasn't as easy as it looked, to take the codes from one place and paste them to one another…. Our teacher was recording that lesson. When you applied it four or five times, you could only do that session swiftly. Frankly, I had difficulty at first. Later, but as I saw that I can do it and watched the recorded lessons a few times, it started to wrap my head around it. Then, when I felt enough, I started using it in my classes.

It took time for them to get used to use the buttons, figure out the interface of the application, and following the PD facilitator at the same time. In time, by repeating the videos and getting used to the layout of the application, they stated that it got easier.

6.1.2.3. Amount of Content. Exemplary code for this category was *balance between duration and amount of PD content.*

Even though diversity of content was appreciated by the participants, they all shared that they had hard time with dealing with cognitive load of the PD. As a suggestion for excessive cognitive load, some participants suggested to focus on less content so that they had enough time to understand and process all the knowledge that they had. On the other hand, some participants suggested to prolong the PD. Either way, they agreed on the since cognitive load was beyond its limit for participants, they needed less condensed PD. This showed that it is very essential to achieve the balance between duration and amount of the PD. As a justification of this finding, Luna's experience as follows.

> While I was applying the examples on Scratch at the same time with Hayes was showing us, I couldn't understand some codes and missed them. I couldn't understand during the session ... It is really a very important issue because each learning objective was very important. I understand it is important for us to see each objective but for example, we are missing the buttons in Scratch. There were some missing parts because we are not very good at it. I always had to watch it again afterwards. For example, instead of fitting the code of two objectives into a lesson or saying that you can quickly choose that button, that button, it could be one very large code or a wider course hour, such as two hours rather than one hour.

6.1.2.4. Recording Sessions. Exemplary code for this category was *re-watching videos.*

Participants agreed on having recorded videos of the sessions and being able to watch these videos over and over again helped them more than anything. It significantly helped to deal with cognitive load of the PD. For example, according to them, some parts that were perceived as difficult and complicated during the session. However, when they re-watch the videos, these parts easily comprehended. Thanks to recording sessions, some briefly mentioned points during PD were completely understood afterwards. It was the main source for participants to watch their own experiences in the PD, whenever they need it.

For example, Nora was expecting different content relating this PD thereupon at first, she experienced bias toward PD.

> Nora: At first, I had a hard time with the first one or two sessions. Later on, I watched the sessions that our teacher recorded. Maybe if you watched video recordings, I did not attend in the first sessions. There was section on the right [in the screen] where conversation progresses. Our conversations. Of course, I was panicked since this was the application [Scratch] that I don't know anything about it. But as I said, I overcame this bias by watching the sessions that is taught by the teacher.
>
> ….
>
> R: How do you consider the issue of recording these videos?
>
> Nora: I find it very useful. If I don't have this chance, I don't think I can learn Scratch because as I said, you have to watch the teacher very carefully at that moment because he moves fast … If I hadn't watched them again afterwards, I would have missed a lot. I think it was definitely the right decision, in that regard.

Luna also pointed some additional points in regard of having chance to watch recorded videos.

> R: How do you consider the recording of the videos in order to offer you the opportunity to be watched again?
>
> Luna: Very good, great, great.
>
> R: In what ways? Shall we open up a little?
>
> Luna: Because I can see what colleagues wrote all the time. So, for example, you don't just listen to the teacher. There is another brain elsewhere who has applied and done something new that is really good,

> and s/he tells and shares it. So, for example I could watch the entire session. This was really good. Also, there is a friend who shared an activity, sent a file, and remembers what the teacher said. This creates network among teachers.

6.1. 3. Duration

Under this theme categories called (a) multiple doses, (b) workload, (c) logistics, and (d) scope were presented.

6.1.3.1. Multiple Doses. Exemplary codes for this category were application time for what is learned, time is needed to gain expertise, and time is needed to get comfortable for getting *interactive*.

All participants were very satisfied with having PD sessions once in every week because they claimed that they needed time to think about that weeks' session, to watch the video of the session, and to apply what they learn. If this would be one-session PD, they would not have this chance. So, it is an obvious fact that time was needed to gain expertise. During our interview with Eva, she expressed her duration-related ideas as follows.

> R: What do you think about the duration of the course? What I mean by duration is that it's a one-hour PD sessions for six weeks.
>
> Eva: It was good to have six weeks but one hour seemed too little to us. Yeah.
>
> R: So, six weeks was fine. In what way it was good? What did you think of when you said good?
>
> Eva: six hours means six weeks. All of this can be done in one day, or in two days. But when you have six weeks, you can use the information you learned next week. You can improve it until the week. Even if you can do something yourself or do nothing, you can do research in that area, you are developing more and more in that area. So, it's good to have six weeks.

Additionally, participants agreed that it was not easy thing to be interactive at first glance. Some time was needed to feel free for sharing. As gaining expertise took time, also becoming participative and interactive took some time.

> Steve: Asking questions is not welcome in our Turkish culture anyway. As a student, the teacher asks us questions … it takes time to establish an atmosphere of trust among colleagues. [It is like this] even in the classroom, even among students. Even more among the teachers … It takes courage to ask that question. The classroom environment must be created very safely by the teacher in order to be less for that courage, so that less is required.

6.1.3.2. Workload. Participants stated that the workload of PD required much more effort than the PD sessions. According to their experiences, they had to watch the videos at least four or five more times to be able to apply it. So, it means that they spent at least four or five more hours than they spent in the PD. It is important to keep in mind workload of the PD for participants was not only limited to PD sessions. As a matter fact, it took a lot more time and effort than they spent on PD sessions. Thus, PD duration should be decided by considering workload of the PD for participants.

> Nora: I can say that our learning process was a bit difficult. Because after I attended that online session at that moment, I turned back and watched it four or five times. I was aiming to do it on my own, that is, without the direction of the teacher. But it was not limited to one hour. I had to watch that lesson four or five times over and over again. Obviously, it was a little difficult process. Or rather it was a tiring and troublesome process for me. You know, it wasn't limited to one hour, yes, it was six weeks, we could say six hours, but I watched each lesson four or five times over and over. So, at least for me to be able to reach the level that I can do it on my own, apply it on my own.

6.1.3.3. Logistics. Exemplary codes for this category were *not breaking out teachers' work routines* and *adjusting best hours for teachers*.

First of all, since all the participants except Eva were in-service teachers, they tended to find PD that suits their working schedule. Especially, accessibility of OPD provided quite convenience for most of the participants. So, while designing PD, taking not breaking out participants' work routine into consideration is should be one of the essential principles.

> Daisy: In general, I think the people who take this PD, are already in-service teachers and we are already doing this in the evening. So, I think one hour or maybe maximum one and a half hours it should be… I think that the duration of the PD should not bother us to gather our concentration and not divide our routine too much.

In this regard, especially Steve and in-service teachers except Nora was very appreciated finding OPD. Luna shared her gratitude as "I work in private school and since I am math teacher, I am working on Saturday as well. So, it would be so hard for me to get permission from work [if it would be face-to-face PD]". As in the following Daisy also confirmed this statement.

> If I had to go and take this PD there for six weeks, something could happen in the last minute. However, for example, on occasion, I started part of that session, on the road while I went back home. Being online made a huge contribution to me.

Timing of the PD should be decided with participants and the priority should be not breaking out their daily work routines. Since most of the participants were actively working as teachers or professors, timing of the PD was discussed especially in regard of which hours of the day is the most suitable. For example, Nora was not happy about the choice of day and time since she was feeling the tiredness of the day in that particular time.

> Nora: In fact, one-hour is not a short time but since we were so tired at that time, it felt so long. I mean it is from eight to nine, but we were stretching 21 to 21.30. Since it was such an exhausted period of the day, we were wishing that no one will ask any questions so that PD will end as soon as possible…However, when I watch the videos when I was convenient, one-hour was not enough.

On the other hand, some participants were so satisfied with the timing. For example, Daisy proposed that "Hours of the PD was so convenient for me. I mean in the evening time; the time was like when I can attend the PD after I come home. It was not that long". Steve also confirmed as saying "[Having OPD during working days] was great because I don't have to spend my weekend to this. In the evening, one-hour and one-day was ideal timing. I mean I attend this PD instead of watching TV-series.

6.1.3.4. Scope. It is important to inform that this category was emerged only based on Daisy's interview. Even though only Daisy made point of scope in relation to duration, it was acknowledged that it is directly related to *Road Map* category under *Teaching*

Philosophy theme. She claimed that teaching philosophy and scope of PD has a significant effect on requisite duration.

> Daisy: As I said, I think the purpose of this online course is, in all, guidance for the teacher. You can teach this PD for two years as well, you can find something to tell for two years, but I think it is important to guide the teacher.

6.1.4. Teaching Philosophy

Under this theme, categories called (a) sincerity toward teaching, (b) selective inclusiveness, and (c) road map/ teaching how to learn are presented.

6.1.4.1. Sincerity toward Teaching. Exemplary code for this category was *sincerity toward teaching and sharing.*

All participants believed in Hayes's and institution's sincerity toward teaching and sharing. They defined Hayes as eager to teach as many sources as possible. Participants were convinced that as an institution, they conducted this PD to provide quality education for everybody not for just one community. The institution or Hayes did not seek after money. This was important principle for PD because participants were very concerned about if PD have more financial priority than giving an education. So, it is very important for participants to be convinced that institution or PD facilitator have honest purposes toward education.

Participants shared several experiences that they had with other PD that has sincerity toward teaching problem.

> Luna: When I got there, I only realized that the product is being advertised. There was a lack of material and there was a very limited time. For example, we were constantly recorded. It was kept short because it was free. It was only for advertising purposes. I don't even remember the name of the education. It was not very useful for me…Most of the free educations are like this.

> Eva: Many PD facilitator or institution does it [PD] just for the money. They think 'There is money in this business.' After they develop themselves just a little bit, they open PD. I see many places like that. However, this PD does not pursue profit-making. I witnessed that they are sincere about sharing their education and their priority is taking education forward. … After I received the second PD program from this institution, I started to understand their philosophy slowly. Because the lesson plans were shared on this platform, and frankly, I do not know your academic background, but even sharing a lesson plan among my friends at my own university is often a problem. Because while preparing the lesson plan, you spend a lot of time and energy on it. You put your own activities …and I was very surprised that the teachers shared their lesson plans here.

6.1.4.2. Selective Inclusiveness. Exemplary codes for this category were *motivation letter as chance for self-reflection* and *reaching eager to learn teachers*.

Participants agreed on that PD should involve people who are willing to learn and each teacher who has motivation toward learning and later on applying that PD content should be entitled to participate any PD they want. For this reason, prerequisite for participation should base on motivation of participants. Even though people do not have background on the PD content, if they are willing to learn and apply it in their classrooms, then it should be available for everyone. Eva pointed out different aspects of attending inclusive PD with motivated participants.

> R: What was the purpose of this PD for you? What was the purpose of six weeks-long the block-based coding applications PD you took?
>
> Eva: I think this platform is not only a platform open to its own [private] school. So, as I can participate, it is not only for the teachers at that university. I think the teachers who opened it think like this: We should not only teach our own teachers. We should give all teachers this education, this quality, maybe this awareness. So that, as a country, maybe we can go a little further … If I only bring this to my own school and I do not bring this awareness to other schools in any way, if prevent it then, for example, you cannot do anything in the country. There is no competition, activity, or environment. I think the teachers honestly thought that they wanted this to be more developed, not as a competition, but to increase this awareness.

She expressed that this PD as being available not only for the teachers of this private institution, but for all teachers who are eager to learn. According to Eva, in this way, building community around people who have same interests and enthusiasm is possible. As one of the options for determining participants' motives for participating PD, asking them to write motivation letter was highly recommended. Participants claimed that writing a motivation

letter as prerequire for participation aimed to reach teachers who are sincere toward learning not the ones who only pursue after certificates or some written proof to show for it.

> R: How do you interpret the participation requirements for Advanced STEM Courses?
>
> Daisy: … Especially that 200-word article is very impressive. Because the purpose of putting the prerequisite of participation in the program is not to choose the one that is very knowledgeable. It is about the thoughts, the purpose of participation, what I am waiting for, what I want. I do not say elimination, I think every teacher should be entitled to join. But at least it's a question for teachers to asked themselves before … Why do I actually want this? It is like questioning yourself. So, I think it's beautiful.
>
> R: You think teachers actually offer an opportunity for self-assessment.
>
> Daisy: Yeah. Exactly.

6.1.4.3. Road Map/ Teaching How to Learn. Exemplary codes for this category were *getting a vision for going further on the topic* and *accessible various resources for lifetime.*

Participants claimed that having extensive knowledge about how to proceed in the PD content individually after PD was very positive for their learning. In addition to content of the syllabus, it was very useful for participants to get knowledge about many webpages, names of the experts in the field, and projects. For example, participants except Nora were very contented learning about not only Scratch but also other coding applications that are possibly can be used in the classroom.

> Steve: Hayes mentioned other coding applications as well so that we do not stick into Scratch only. Besides, the name of the PD was not Scratch, it was 'Block-based Coding Applications in Mathematics Course'. I mean I am not even sure if the name of the PD mentions about Scratch.

On the other hand, Nora was not agreed PD was explaining not only Scratch but also other block-based coding applications. However, she was not sure if she wanted to learn more than one application at the same time since it would be so complicated.

> Nora: For example, I thought how I could enrich my lesson with different programs, not only Scratch. But we just went on Scratch. Maybe it was good. It is because Scratch is a difficult program itself, a

> difficult game. If we were divided, maybe it would be harder to learn about different games or different applications.

During the interviews, it was asked what reasons could be why so many resources were shared with them, in addition to PD content itself. Participants including Nora all agreed that Hayes tried to show how far they can go and how they can move forward in this field even after this PD. Luna explained as "He says 'Okay, our PD can be over here, but see what they do'". Thus, according to participants, Hayes tried to make everyone find their ways by showing as many examples as possible. Participants were very satisfied with having lifetime resources like recommended names, websites, and most importantly video recordings of their PD sessions. Specifically, this category is highly consistent with *Diversity of Content* category of *Content* theme.

> R: As you just said, 'Hayes shared many applications and projects so that we can always look and learn. I took many notes and made a list.' For what purpose do you think these resources were shared with you?
>
> Eva: He wanted to show that this wasn't just as much of the field as the teacher could show us, but that it could be improved.
>
> …
>
> R: I wonder if these sharing were useful for you.
>
> Eva: Of course, I did not know most of the websites that the teacher here told us. Moreover, so many other resources were not recommended to us in other PD that I attended. So, it has helped me a lot.
>
> R: What purpose do you think these sharing was made with you?
>
> Luna: [Hayes thought] 'OK we are making codes here, but you can also examine different codes or even you can even apply.' I think it was shared to fully expand our literature.

Eva, Luna, and Daisy specifically highlighted that even though they did not take a step further right after PD for many reasons, they were very contented about having this archive in their hands. Eva stated that "If I decided to be a teacher one day at school, I always use these web sites". Besides, Nora was very happy that Scratch had big network that includes many accessible sources. It means that if they are willing to use it, it is easy to find prepared related sources, since there is a big community who works on making projects for integrating Scratch into mathematics already.

Thanks to these additional resources, participants claimed that they got a vision for going further on the topic. Daisy defined this process as guiding participants with *road map*.

> R: What was the aim of this PD?
>
> Daisy: I can tell what the aim was not. It was not teaching Scratch. It was not making participants Scratch experts. In my opinion, the aim of this PD was seeing what we can do via Scratch. I mean Scratch is a big network. You can create so many things, it is like big ocean…the aim was giving us awareness on the content and understanding what we can do with it…not by memorizing the codes but by teaching us learning method of Scratch. I mean he [PD facilitator] taught us how to learn it and what kind of sources we can use while we learn it … [After PD] I could have gone on it and improve myself further. I did not do this. But I think this is something I can always do for now. Maybe I didn't do this year. I'll do it next year. I would like to do a different study on this, I continue like that. This is always in my hand; I think I am very well guided right now. Something in my hand. So maybe this sense of security was the reason…
>
> R: So, you feel safe because you learned how to learn this content.
>
> Daisy: I feel it, yes.
>
> R: So, whenever I want to go back to this, you say I know where to start.
>
> Daisy: Exactly. I know where to start, so besides of that, of course I have a base knowledge about this content. You know, there are only parts that needs to be improved. It can be improved, I know what to do to improve it, so this PD was a good guide for me.

6.1.5. Interactivity

Under this theme, categories called (a) familiar faces, (b) comfortable and safe environment, and (c) readiness for the PD content are presented.

6.1.5.1. Familiar Faces. Exemplary codes for this category were *sharing experience with colleagues who have something in common (e.g., grade, school, discipline etc.),* and *knowing facilitator beforehand.*

Most of participants had the feeling of need for more interaction with either PD facilitator or their peers. To do so, participants proposed different suggestions. For example, according to Eva, knowing facilitator beforehand could have increase participants' interactivity.

> R: What did you write to the question of recommendations for a more effective experience in the next PD?
>
> Eva: More communication should be done. I wrote that there should be more interaction with the facilitator. I do not know how much other teachers are in contact with the teacher or because of his acquaintance. Yes, I remembered now. It was already in the lesson that those who had previously become acquainted with the facilitator and they had more communication. Maybe this can be increased further to every teacher and facilitator.

Nora suggested to attend PD as group of teachers who knew each other beforehand, or who had something in common such as working in the same school. She claimed that they would have more interactive if they were from same school. Participants wanted to share PD experience with familiar faces.

> R: So how would you interpret your interaction with other participants, or what would be better if it were different? In respect of interaction among participants.
>
> Nora: It was including private school teachers, as well as teachers working in public schools, and teachers who entered different levels. Since we do not have much in common, I obviously could not get much interactive. Because why? If you have anything in common, you can share. [For example] If we all were secondary school teachers or we all were private school teachers … For example, I would like it very much, [with colleagues] from my institution. Because for example, we went to STEM Leader Teacher PD with different science teachers from my institution. For example, we received education in Diyarbakır. We went there four times. For example, when we went there, there were some topics that other teacher was more prone to, and there were subjects that were more of my interest. While we were preparing our homework, we received a lot of support from each other. For example, while I was helping to integrate math discipline to science, I was able to get support from science objectives. In that way, we had less difficulty because our interaction was easier. For example, it was very difficult to get support here because I did not know anyone and because it is online. But as I said, if we were getting PD with people in the same institution, … we could support each other when we meet again at school. You know, it could be a lot better. I think we could go deeper … The fact that Steve was a participant in this PD also motivated me because she is someone I know.

6.1.5.2. Comfortable and safe environment. Exemplary codes for this category were *personal and cultural characteristics*, *peer learning and sharing environment* and *PD facilitator should create safe space.*

Participants emphasized the importance of comfortable sharing environment for their learning. Nora and Steve specifically stated that most of the participants chose to be passive

during this PD. Even so, they were aware that this does not mean they did not need it. On contrary, they needed more interaction but because of some reservations, they could not.

First of all, as a reason to abstain from interaction during PD sessions, personal characteristics were underlined by participants. For example, Eva and Nora chose to deal with every difficulty they encountered during PD by themselves, instead of asking for guidance from their colleagues or PD facilitator.

> Nora: I felt that I should have known it [what I am going to ask as a question]. I mean I need to handle it by myself. Maybe we can call it ego, I do not know. Maybe it is about self-confidence. I mean I felt that I should be able to do or apply this myself. I did by myself by watching the videos in parts four or five times.

> Eva: Because of personal characteristics. My communication with the teachers is not always good, so this maybe it. Even though I am a teacher myself.

Steve claimed that hesitation for sharing may stem from cultural reasons as well. For example, in this PD, there were some participants who lives all around the Anatolia. He proposed that "Turkey is a big country. It has many cultures inside. Eastern culture is already shy. We do not want others to see our mistakes. However, there are some places where his feeling is much more predominated in Turkey".

So, it is an obvious fact that participants had some personal reservations toward being participative. However, this was not because they did not need to be interactive, because they did not feel comfortable enough. For example, they specifically stated that they needed peer interaction more. Eva explained this situation as follows.

> Eva: We did not get in contact with other participants. I did not know them.
>
> R: Should it be?
>
> Eva: Yes, we should have got in contacted.
>
> R: How?
>
> Eva: I do not know. PD facilitator can create this environment.

R: How much communication are we talking about? Effective communication dose to be more effective.

Eva: I think it can be interacted as much as possible. Because everyone can tell how to use it. So, for example, I prepared the lesson plan, but I was wondering, for example, how the others did and which topic they chose. So, we don't even know it, because we sent it to the facilitator. But if we were in an interaction, maybe we would understand what subjects could be taught with coding. Because okay, we care about using mathematics when using coding, but maybe not every subject is suitable… For example, when one participant tells you a math subject, you can think about it and develop it more.

Therefore, it was suggested that comfortable and safe environment for sharing could be created by PD facilitator. Steve expressed same expectation from PD facilitator. According to Steve, even though Hayes encouraged participants to ask their questions in any time in any way, he could be better at creating interactive place among participants. He should be able to make everyone comfortable for ask, tell, and discuss anything without worrying about their hesitations. So, for participants to be interactive, natural sharing environment should be provided. Participants did not feel the environment exactly as organic to be interactive in this PD. Even though they had the chance for sharing by writing in comment section of PD or by writing an e-mail to PD facilitator, they needed something more because these options were not natural for them. They needed to be freed from every hesitation and anxiety of theirs.

Steve: Communication cannot be reached via mail. So, it happens, but it is also not very natural. Mail is used to complain about something to someone. Mail is used to report something. Mail is a very artificial method to ask natural questions, to say 'I didn't understand the teacher, how do we do that?'. This is why, WhatsApp is so popular.

R: Would you like to have WhatsApp group for this PD?

Steve: I definitely would.

R: Do you think this was the duty of the PD facilitator?

Steve: I think the institution organizing the PD would have made it mandatory in syllabus…

R: You think this would really increase naturalness.

Steve: Yes. Yes. Yes. In other words, online education is still far from natural. But we need to get closer to things that can interact as naturally as possible if we want it to be effective.

6.1.5.3. Readiness for The Content. Exemplary codes for this category was *background with the PD content.*

When it was asked reasons why they hesitate to share their questions or ideas at first, almost all participants mentioned difficulties of having first experience of PD content. Since first experience with the content causes hesitation, it takes for participants to feel free for sharing and being participative. Steve expressed that "[I was more responsive because] I felt that I was more ready for the content". He claimed that high self-efficacy and readiness for content of the PD causes higher interaction.

> Nora: Since we did not know what we encounter or some were seeing the content of the PD for the first time and some of us had no prior knowledge in this regard, we may have been anxious … When I started the PD, I had no idea about Scratch. The fact that I had no information actually triggered it. So, if I knew anything about it more or less, I would be more confident and ask my questions. But I also thought that something I ask remains very simple, I wonder if I'm asking something at a very simple level and in fact, I didn't want to ask it at that moment. Maybe our friends thought the same thing.

This shows that participants' prior knowledge on the PD content –as mentioned in the *Cognitive Load* theme – had serious effect on their participation. In other words, to be able to talk, participants needed some base knowledge. This is why, participants who felt more readiness toward content were more interactive. Steve explained this situation as follows.

> Steve: You cannot ask over what you don't understand. We usually consider that questions will be asked when you do not understand. Why would I ask what I did not understand? I should ask beyond what I understand. If I did not understand, then I can tell that I did not understand. However, I cannot ask what I did not understand. Asking questions comes with some level of understanding. This is a good point. For asking questions, you should understand something first.

6.1.6. Assessment

Under this theme, categories called (a) certification, (b) lesson plan as PD output, (c) assessment criteria, and (d) inclusion of assessment process into PD duration are presented.

6.1.6.1. Certification. Exemplary codes for this category were *necessity of certification* and *meaning of the certificate for PD participants.*

First of all, once this PD was successfully completed, participants would be eligible for certification. Successfully accomplished means that meeting the couple of instructions for the PD. For example, synchronically attending the PD was mandatory. Participants had only one session to miss the PD. Otherwise, they would count as ineligible for certification. As another criteria, participants had to complete one final project at the end of PD. Steve was the only participant who was ineligible for certification in this PD because he did not get the chance of produce final project.

Certificate was motivational factor for some of the participants to attend this PD. For example, Eva was the newly graduate participant and she believed that certificate may help to find job in good institutions. She expressed that "I tried to participate in certified PD at that time. Because I was thinking of working in private schools".

Besides, it was very important motive for Nora as well because during the interview, she was specifically pleased by getting certificate even though she did not get any feedback for her final project. In this regard, exceptionally, there was one misunderstanding between Nora and Hayes. Nora was the only participant who did not get any feedback from Hayes for her lesson plan, but Hayes thought he gave feedback for her. As long as Nora got her certificate after completing the final project, she did not put any effort to get feedback for it. She had to complete the final project for the certificate, and she did.

> R: Do you think you have received adequate and descriptive feedback on your lesson plan? How?
>
> Nora: No, we never received any feedback, so we just received a mail that our certificate would come, and our certificate has arrived.
>
> R: You have not?
>
> Nora: No, we did not receive any feedback. I received a mail in the form of my address information. So, only my certificate will come to my address. I sent the address information. We had the certificate within one or two weeks. But I did not receive anything positive or negative about my plan.

So, PD designers should determine the necessity of certification for their particular program and its reasons. What this certificate will stands for and what kind of opportunity it brings to its participants. If PD designers know their reasons for providing certificate for their participants, then they can also meaningfully question their participants' motivations toward PD.

6.1.6.2. Lesson Plan as PD Output. Exemplary codes for this category were *producing something from what you learned*, *producing something that can be used in the classroom*, and *getting feedback over what was created.*

Participants repeatedly underlined the importance of creating material based on what they learn in the PD. This gave chance for them to revise their thoughts and put it in action. Thus, participants were very satisfied with creating one project – in this case lesson plan –, at the end of the PD because in this way, they could be able to see that they can actually apply what they learn from the PD. It showed that they can transform what they learned during PD into preparing lesson plan that they can use in their classrooms. Especially, this result showed that teachers expect from PD to get knowledge that they can use in their classrooms as soon as possible. All the participants who were actively working as teachers applied their lesson plans in their classroom.

> R: How was your learning in this PD measured?
>
> Eva: They asked us to prepare a project… We were asked to write something with an explanation for how we would use this application. So, I think it's good as a benchmark because you see how much you can do. Our teacher said do what you can do by yourself. He didn't necessarily want anything too difficult or too complex. So, it is good that we prepare a project as a feedback.
>
> …
>
> R: What was the benefit of your lesson plan that you prepared within the scope of this PD?
>
> Eva: … For the first time, I prepared a lesson plan with coding. I may have prepared it in my previous lessons as well, but I have once again seen that I can really prepare a lesson with coding.

6.1.6.3. Assessment Criteria. Exemplary codes for this category were *clearly presented rubric* and *document as prototype.*

Preparing lesson plan was designed as assessment element because PD designers aimed to make participants believe in themselves as producers. So, the assessment criteria were not the passing or failing the project or grading it. The most essential part was making participants to create one lesson plan based on their understanding from this PD and then give feedbacks to their plans. So that, they can revise their plans. So, feedbacks were only for participants to develop their plans. This is why, preparing one final project was enough for participants to get their certificate.

Participants agreed that assessment criteria for the final project were not clear enough because all the participants had confusion over what procedure they will go through after sending their lesson plans to Hayes. Here, importance of rubric came into the view because participants needed clearance over how they supposed to create their projects. It was important for participants to have enough knowledge over what they will prepare as assessment and how their projects will be assessed. Otherwise, ambiguity can cause participants to feel anxiety toward their projects. Both Eva and Luna showed some anxiety toward their lesson plan as *not good enough*. This is why, they had hard time while they were preparing their final projects.

> R: How do you interpret the assessment and evaluation criteria of this course?
>
> Luna: I did not understand the assessment criteria. As I said, if we had a scoring every week. I was a little stressed out there, it was the area I had the most difficulty in because as I said, I send the project, but I felt like I send it in the space. Even if it was a feedback for me, I always said that the teacher will not like it. Because he was equipped in his field, do you understand me?

> R: So, did you get enough information about the lesson plans you prepared? Did you know exactly what to do? How?
>
> Eva: I understood what to do while preparing a project, but I could never figure out what we would write as a lesson plan. I did not even participate the lesson plan contest because I thought that I had prepared the lesson plan incorrectly. At that time, I thought I was doing my project incomplete. I believed that 'It is not good enough' so, I did not send it.

R: What made you think that?

Eva: I couldn't figure out exactly... so, maybe it is a habit that originates from my university years. I love preparing projects more after I understand what the teacher wants very well. I couldn't figure out what the teacher said there. So, I always thought I was preparing it wrong. But when I sent it to the teacher, I got a positive answer.

As suggestion for making assessment process clearer, Eva suggested that it would be better, if they could get some lesson plans as prototype to get some idea while they were preparing their own lesson plans. She stated that "A few, two or three lesson plans could be presented directly to us as an example… to give us a perspective". It was important for participants to clearly know that what assessment criteria will be implemented over their projects and what they should expect after sending their projects. For example, in this instance, it was essential for participants to know that they will get feedback over their projects so that they will know if they do not get any replies to their projects, there is something wrong.

The lesson plan process was different for each PD participant. Even though lesson plans are crucial parts of teachers' academic life, it was not always a case that a teacher prepare a lesson plan for their classes. Thus, lesson plan process was not a smooth process for all. However, because the institution Daisy was attending STEM Leader Teacher PD was affiliated with the institution where the current PD is originated from, she was accustomed to lesson planning process. Thus, expectations of institutions have an impact on participants' preparedness for a PD.

6.1.6.4. Inclusion of Assessment Process into PD Duration. Exemplary codes for this category were *getting instant feedbacks, peer learning, and small homework.*

Participants agreed on including assessment process into the PD sessions would be very beneficial for their learning because they needed some time to discuss over their projects and its implementation with their colleagues and their PD facilitator.

> Daisy: Perhaps, if the process of creating a lesson plan for the teachers was included in the weeks of the lesson, more beautiful things might appear. So, I think it could have been one or two weeks longer.
>
> R: In what ways could it be more beautiful?
>
> Daisy: Idea of exchange, I mean getting other teachers' opinions not only for my projects but also learning about their projects [would be better for us]. Contribute something to each other. Also, [it would have been better] for PD facilitator to give ideas. Of course, he gave his e-mail address for our questions …but it would have been better if we do this discussion almost immediately during PD time.
>
> R: Then you think that the evaluation process of these lesson plans will be more beneficial in terms of getting different ideas, both self-evaluation and others. Is it right?
>
> Daisy: Yes, so there are a lot of teachers there. I can give someone else a different idea, about his plan, or he can give me a different feedback. Hayes, for example, could guide and do something, some new things that could be done together might appear. You will develop each other, or you can come across each other. You know, things that can improve each other... I think there could be better lesson plans in this context.
>
> …
>
> R: What was the benefit of your lesson plan that you prepared within the scope of PD? Or what could be the alternative as an assessment for this PD? Have you ever thought? Or was this ideal? If so, what was the benefit to you?
>
> Daisy: What could be the alternative of assessment? I think more important than the lesson plan was its implementation. In other words, the more important part of the lesson plan was implementation. It would be better to talk about the application, for example, after sending the lesson plans. You know, not only when the teacher sees the plan, but in fact, during implementation of the lesson plans because the students use Scratch when applying this plan. Maybe it would be better to talk about what happened during this application.

As one of the suggestions to prolong the discussion process of projects, Luna stated that it would be better if they did little reflections over their learning after each session. In this way, they could be able to make self-reflections and get different views from peers as well. She also suggested to prepare small homework for each session, get feedbacks about it and discuss over it during the PD session. Either way, participants felt need for discussing about PD content with other participants and PD facilitator to widen their visions and get new ideas during PD hours.

> R: How did you interpret the fact that they made you prepare a lesson plan as a measurement and evaluation? Or could it be an alternative, for example, what could it be? Your first reaction.
>
> Luna: No, it was good for us to prepare a lesson plan in terms of preparation and knowing our material, applying it, we are already in learning process. But in terms of assessment, for example, we could have prepared lesson plan every week, not a lesson plan but small activity plan…. For example, after first lesson, in those four days, we could have prepared a little activity plan about the buttons he taught that week or about the things he taught that week. You know what I mean? Then again for Week Two. Then,

> I could have understood. I knew that I started using it … Teachers could have said, 'You learned it right here okay, but you couldn't use it well in this area'. Then, I will immediately [change it] again. In that sense, it would be better for us if we made small assessments every week and then switched it to the big lesson plan.

6.1.7. PD Venue

Under this theme, categories called (a) noticeability and respectability in the literature review, (b) one structured platform for OPD, and (c) optimum number of participants are presented.

6.1.7.1. Noticeability and Respectability in the Literature. Exemplary codes for this category were *being student in rigorous learning, positive reputation of the institution,* and *previous experience with the institution*.

Once participants decided on improving themselves in this content, they started to make research about the related educations. Daisy even tried to learn this specific content by herself through internet. However, she stated that it is always hard to find the primary resources for the content without guidance. She expressed that "It is much easier to learn from someone instead of dealing by yourself". Also, Eva confirmed that after this PD, she tried to proceed on the content by herself. However, if she finds out another PD as next level, she will attend it. She stated that "I had a hard time looking at the options [for PD] for what I could add more on this content. After some point, only I can improve myself. I couldn't find more PD as next level".

Rigorous and structured design was important for participants while they were deciding on which PD they are going to choose. Luna explained her motive as "I wanted to attend PD just like graduate or undergraduate course. I wanted to be student again". Steve has agreed on this idea and added that turning into student role again helped participants to be more reflective and to understand what their students go through.

When participants made a research about the PD, they also took reputation of the institution into consideration. They believed that in general, this reputation comes with a quality. It shows that institutions who have positive reputation possibly take their work seriously and put rigorous practice into action. Also, participants expected to work with experts they were respective in their fields if they took PD within these institutions. For this particular PD, all participants were very satisfied with their PD facilitator. Besides, Nora, Steve, and Daisy chose this PD because they had previous PD experience with the institution, and they counted on its quality. Daisy expressed that "I was interested in this PD because it is a platform I knew before".

> Steve: It is a non-profit business. I know the expertise of the teachers because I believe in this, I trust their sincerity. I see the man's CV. Syllabus is certain, where and what to do is appointed. It is rigorous as on similar platforms.

6.1.7.2. One Structured Platform for OPD. Exemplary codes for this category were *various communication tools, synchronized, user friendly layout for sharing environment*, and *accessible resources.*

During interviews, it was found that participants expect some technological infrastructure from the OPD. Specifically, participants underlined that having well-designed website for the PD, uninterrupted technology for synchronized education, and various communication tools for different needs were very essential for effective OPD.

Luna underlined specifically the importance of having well-developed website for the PD. She described this platform as "one common platform that we had our passwords for it to get into, we can see what others share, we can load our projects". So, it is one of the important characteristics for OPD to design website that includes user-friendly layout and well-thought sections for participants' sharing environment.

> Luna: We were meeting face to face [synchronically] here every week. On this platform, presentations remained in my hands. I have the documents. So, I can still enter and use them. I can still watch the videos by saying "Yes we did that". It's a wonderful thing.

It was underlined that, even in this era that is the technological advancement is as its peak, synchronous communication tools were not satisfactory. The main underlined point for OPD was that it was not suitable for interactive learning because people do not feel the same safe and comfortable environment as they find in face-to-face PD for sharing. So, better and well-thought websites, programs, or applications should be developed according to OPD needs.

> R: Well. How would you consider this PD's learning environment?
>
> Steve: The learning environment of the PD? You're asking Adobe Connect etc. right?
>
> R: Yes.
>
> Steve: It could be better. In other words, the fact that the teacher did this for the first time and that we were doing it for the first time as participant brought many troubles…We went through an adaptation process. But now I'm going to attend the PD second time this year…I think it will be easier. Adobe connect is obviously the best system possible. This is the best system I know.
>
> R: In what ways is the best?
>
> Steve: Synchronization, reduction of technological problems, I can share the application in screen as teacher. But if you are not a passive listener as a student, it is not so easy to attend the lesson. Unfortunately, in today's technology. But if you are a passive listener, then it is super. I think it's more designed for the teacher not for student.
>
> R: We're talking about Adobe Connect, right?
>
> Steve: Yeah. So, it was designed to make the job of the teacher easier. However, it should be designed to increase student participation. I think they couldn't do it too much. But there is no system that can do it anyway.
>
> R: I see. So, adobe connect could be better in terms of active participation. But this is still the best amongst its other options.
>
> Steve: Yes, so how do you do via Google hangout or any other application? … Adobe Connect is a highly respected system abroad… It is better when it is face-to-face. So, there are still many disadvantages compared to face-to-face PD programs. But it was still good.

For example, in regard of communication tools, some participants claimed it would be more interactive environment if the communication tool was talking because this content was so hard to explain by writing.

R: For example, the first lesson, the teacher tried to open the voices of the students during the lesson, and there was a glitch. What do you think would change the use of this feature? Or what wouldn't it change? Would you prefer talking?

Nora: In fact, I think it could have had a positive effect. If we were explaining what we want to tell by talking, we could be a little faster in terms of communication and we could express ourselves better. For example, because while I was giving the lesson, it would be more difficult for children to do explain themselves by writing rather than talking directly. I think it might have been more positive … Because it is a practical program, a PD, it can be a little difficult to explain via e-mail. It would be difficult for me to explain what I had in my mind. Maybe our teacher would understand a little bit better, but I would have a hard time explaining. Since it was a more visual course, it would be very difficult for me to explain it via mail. In fact, I can say that it was a little difficult to deal with that process. This is why, I preferred to deal with by myself [instead of asking by writing].

On the other hand, some claimed that writing as communication tool was as efficient as it should be because otherwise, the lesson would be divided so many times, and this would disturb the participants in many ways. For example, they claimed that they could lose their attention at that moment and they could have lost most of their times as it was already tight.

Luna: We could already write everything we wanted…

R: Well, Hayes tried to open the sound in the first session, and he encountered some troubles. It was not talked about again. What do you think would have changed if you could talk?

Luna: Nothing would change. It would not change in this PD… we completely had to follow the screen, we had to catch up. If content was based on more logical, based on our ideas and practices, it would be better to talk because writing would be more difficult in that content. But I do not think there is such a need in Hayes's PD.

R: As far as I understand, it changes depends on a content.

Luna: Yes, it changes according to the content. Abstract things should be more talkative. But in concrete things like this coding-based PD, the more we apply, the more we catch up, the more we complete, [it is better].

Daisy also agreed with Luna and expressed as follows.

I think it would not be so convenient. A lot of conversation, that is, could distract more…I think the situation I prefer is that only the teacher speaks about it. I wouldn't want everyone to speak. Of course, it is OK, if we had such a chance, when it is needed. But I think I wouldn't want to take OPD in a constantly spoken environment.

The main underlining point here was that OPD should provide different communication tools by considering everybody has different choice to express themselves.

As a final point, all participants except Nora agreed on being synchronized for OPD was very essential for their learning. Luna summarized it by saying "[Even though we got the chance of watching our videos again], it does not give the effect when applying at that moment. Daisy confirmed by saying that "Of course, watching also teaches a lot. It is also an effective method, but I think it is more effective if the teacher can say something about it".

> Eva: During our lesson with Hayes, I was a little scared at first. I thought that 'Probably we will be very passive on the internet and the lesson will be boring. I will listen in the form of sound recording, then I would listen one or two times more. But I think the lesson was fun and I was taking notes on the one hand, I was watching it on the one hand, and on the other hand, I was trying to code as Hayes was doing. Maybe if I were in the classroom, I couldn't even get so much attention. Maybe even in the classroom environment, I could not even pay so much attention as I did here.
>
> …
>
> I think it would be very difficult if it were not synchronized because the teacher would record the session in advance, and we would listen to the video later. We would never be active, for example, Hayes could have expressed one part in not clear way, and we couldn't make him explain it again. Hayes was repeating some points when we were synchronized. But if it weren't synchronized … Hayes might have thought of something complicated or different, and we could not have stated it at the time, and we wouldn't understand most places.

Also, Nora mentioned importance of being synchronized like her peers did. However, she told that if she would have to choose between having synchronized OPD and having videos of the sessions beforehand by not necessarily being synchronized, she would prefer not synchronized one. In this way, she claimed that she could watch videos when she was decent. Furthermore, since she had such hard time with over cognitive load by working with mathematical concepts, technical adaptation period of coding application, expressing herself by writing, and being tired at that time of the day, she considered it would be better if sessions were recorded beforehand or having this PD content face-to-face. On the other hand, she was aware like other participants were, she would not have chance to interfere and ask her instant questions without being synchronically online.

> Nora: It's a little difficult to follow in online. Why is that? Because I worked with two PCs. While watching how the teacher did it in 1 pc, my Scratch program was open on the next pc. I was trying to do the same that our teacher did. But for example, when I think of a classroom environment, I could work with only one PC in front of me while he is doing that application on the smart board. You know, I could try to practice right away and go slower, step by step. For example, I don't know, it would have made my learning process easier. I actually dreamed that my learning process would be the same as I do to my students. So maybe this is why.

R: Then how would you consider this PD in terms of active participation?

Nora: Active participation was mandatory anyway. Only one time I think we had the right to absenteeism… But our teacher was already recording that lesson. Later on, even though I did not actively participate in that lesson, I think I could watch it again and again, but we would not have the opportunity to ask questions at that moment. But it is not a huge loss. Because our teacher gave us opportunity to reach him via e-mail, if we have difficulty working by ourselves. I think it can be more useful when anyone opens and watches a recorded lesson not synchronized but in a time period where everyone feels more comfortable and more relaxed. It seems to me that the obligation to be synchronized is not necessary.

R: So, it doesn't seem like you were there, had any effect?

Nora: 60% actually I would prefer this. Yeah. I would have opened and watched a video recorded on my own and preferred it like this. But I think 40% it can be other way. I can reserve a 40% slice in the sense that we can immediately ask a question and get the answer at that moment. But the 60%, more dominant side may be to watch the recorded videos.

6.1.7.3. Optimum Number of Participants. Participants proposed that having small number of participants was very essential to be interactive. As the number of participants increases, it becomes harder to be participative.

Therefore, seven-people group was very happy with the number of participants. Specifically, Steve considered taking PD within a small group as they did by stating "In a team of 10 people, I felt that I could ask questions and get more personal help. Think, it is like a private lesson". In the following there are different participant justification in this matter.

R: What do you think would were different and what should have remained the same if this PD was to be reopened?

Daisy: I think the number of people should not change. The number of people should not increase.

R: For example, the limit is 10 people. Are we talking about seven people or ten people?

Daisy: I think this year, when it will be reopened, it will be 15. I think 10 is ideal. Even seven is very ideal. So, of course, there is a matter of reaching more people, but the more people, of course, the more problems I think in the OPD. In other words, even when there were seven people, there were pauses and disruptions. After all, the lesson also has a limited duration. The more we learn during this time, the better, I think. So, I prefer not to have too many people. I think the number of people is ideal.

Steve also compared this PD with massive open online courses in many ways especially in regard of having optimal number of participants and its efficiency on learning.

R: You said that “I normally did not take course from Udemy, I chose this place because it is interactive”.

Steve: Interaction. You are right. There is no such possibility in Udemy. First of all, somebody [PD facilitator] that I don't know about, I don't know if I will trust or not came there. But here I know the teacher. So, I know Hayes. Thirdly, thousands of people are taking the course. Here, this is not the case, only 10 or 15 people. I know that at least there will be learning in a small group. It was not as expected, sometimes because of technology, sometimes because I wasn't used to it. It could be better. But it was still much more interactive than Udemy. The important thing the teacher knew me. So, the teacher knew who he was talking to.

6.2. Effective PD Characteristics According to PD Coordinator

In this section of the findings, perspectives of PD coordinator over high-quality PD characteristics are presented. Six themes emerged after data analysis process: (a) scope as purpose, (b) sustainability, (c) iterative process, (d) content, (e) duration, and (f) PD venue. Each theme is composed different categories. Furthermore, to be insightful for further studies and more meaningful for readers, most underlined codes are shared under these categories.

As a remainder, Integrated Teaching was one big project and Block-based Coding Applications PD is just one of the PD programs that was conducted within the project. Steve was the coordinator of the whole project. During the interview, he explained PD design principles that they followed for whole project. So, it also included Block-based Coding Applications PD. However, since coordinator unit of the project gave the responsibility of designing each content-specific PD to PD facilitators as experts in the field, they were only involved in explaining Theoretical Framework of the project and proposing some flexible format to PD facilitators.

As a second reminder, Integrated Teaching Project had a theoretical framework. It was a big framework that was based on each step of PD design. It affected scope, sustainability, and content themes directly. PD coordinator believed that each PD should be based on academic studies as well as practical issues. Table 6.3. presents all the themes, categories, and codes that were found from interviews with PD coordinator.

Table 6.3. Review of effective PD characteristics according to PD coordinator.

THEMES	CATEGORIES	CODES
SCOPE AS PURPOSE	Joy of Teaching	*Giving teachers flexibility to find their own point of view*
		Teachers are competent as producing their own materials
		Preparing teachers to provide high-quality education for each student
	Selective Inclusiveness	*Reaching eager to learn teachers*
	21st Century Needs	*21st Century Needs*
SUSTAINABILITY	Teachers Teaching Teachers	*No top-down instruction*
		Going deeper into the profession
		Teach how you teach
	Documentation	*Flexible format to be consistent*
		Keeping record of any document as data for following years
ITERATIVE PROCESS	Preceding Research	*Coordinators' previous PD experience as teacher and academician*
		Pilot observations in classrooms
		Discussions with teachers
		Literature review
		Checking similar PD
	Each Year is Data for Next Year	*Collaboration between coordinator and facilitator*
		Documentation
CONTENT	Theoretical Framework	*Theoretical Framework*
	Diversity of Content	*Diversity of Content*
	Competent Person as PD Facilitator	*PD facilitator's expertise on the PD content*
		Having teaching experience in the same PD content
DURATION	Multiple Doses	*Time is needed to apply what is learned*
		Time is needed to gain expertise
		Time is needed to get comfortable for being interactive
	Logistics	*Adjusting best time for teachers*
PD VENUE	Technological Infrastructure for OPD	*Enough technology for participants to get interactive*
		Follow-up multimedia tools
		Synchronized
	Lesson Plan as PD Output	*Limited to number that allows anyone to get interactive*

6.2.1. Scope as Purpose

Firstly, PD coordinator highlighted that scope of PD should be based on teachers not students because the PD participants were teachers. If teachers will develop as person according to their professional interests, eventually, students will develop as well.

> The most important difference is that it [this project] does not do anything for the student. It tries to touch the teacher directly and aims for change through the teacher, targets change. What was generally seen in the projects carried out so far was the teaching material to be made bypassing the teacher. We do not want this. We want the teacher to develop certain competencies and develop his/her own student-specific activities and plans and even his/her own STEM understanding.

6.2.1.1. Joy of Teaching. Exemplary codes for this category were *giving teachers flexibility to find their own point of view, teachers are competent as producing their own materials,* and *preparing teachers to provide high-quality education for each student.*

As a scope of the PD, it was underlined by the PD coordinator that each PD should aims to increase teachers' engagement for their profession. The main goal should be not standardizing teachers. It was believed that otherwise, teachers will turn into people who apply the same examples or activities in every context without even thinking about it. This is why, one of the main aims of this project is to make teachers to enjoy their profession.

> I realized that teaching as profession has become robotic. It means that it was tried to determine centrally what the teachers should teach and how they should teach. This was around for a long time but has never been overrated. The central curriculum now decided what activities in the classroom will be, what teacher would say and even attempted to direct what was going on in the classroom… Teaching is a very unappealing profession when someone tells you what to do, it's an incredibly stressful job.

So, it was very essential for PD to make teachers to gain flexibility for enjoying their classes. It was important to make teachers realize that in fact each teacher can tailor PD content through their own situations. To increase the chance of adaptability of PD, this project aimed that making each teacher can find they are interested in or need by providing

in a wide range of PD content. So that, they can adopt PD content into their unique situations. If teachers become people who are competent as producing their own documents for their classrooms, they will be able to reflect what they learn according to their special needs. With this flexibility, it was expected to prepare teachers who provide high-quality education for each student not only the ones who are good at everything.

> Only the particular group of students was involved in all top-level activities at the school…It was as if in each grade five or six students in almost the whole school were only properly educated, and the rest were supposed to be educated by only doing tests.

After realizing these problems, he stated one of the goals of this project as follows.

> [At the end of this PD, we expect that] teachers who goes to classroom for teaching math enter classroom with joy. Let them do math with their students as part of the class community and do the math at the highest level. Let them teach math to students with the motivation to reach every student and teach every student with the motivation to maximize their potential.

Therefore, this PD programs were inclusive for every teacher and not only for one community. In this sense, Steve was appreciating the heterogeneity of the participants because there was a wide variety of participants in this PD. The aim was not to focus on only one group of people but focus on any teacher who has ambition to improve.

6.2.1.2. Selective Inclusiveness. Exemplary code for this category was *reaching eager to learn teachers.*

It was underlined that for PD to reach success, it is very essential to reach right participants for the PD. For example, even though this project was available for every teacher, coordinator unit of the project still put some preconditions for participation because according to Steve, there are also so many teachers who are only interested in collecting some certificates to find a job. However, this project sought to work with teachers who are purely eager to learn and develop professionally. Therefore, participants had the chance of

being part of only one OPD in progress, during one semester. Steve wanted to make sure participants work on one content with their all effort. Otherwise, they were worried about teachers got distracted since they do not have much time to meet workload of more than one PD in one term. So, having prerequisite to be part of one PD was about reaching the right person to accomplish scope of the PD.

6.2.1.3. 21st Century Needs. Steve specifically underlined the special needs of today's world. According to him, 21st century teachers and students have some special needs. He listed some of the 21st century skills as having scientific knowledge like experts use in the field, communicative skills, and learning the concepts in the form of life itself not just for the future. Therefore, it was important for PD to have instructional design that is based on needs of 21st century.

This PD project aimed to train teachers to be able to meet these needs. Steve explained this goal as "[to ensure that teachers] have competencies to develop a pedagogical approach to equip students with 21st century skills". In the following quotation, he explicitly explained what it means to have 21st century skills.

> People who do that profession at the highest level in every profession also use mathematics and science. If they do not use it, then those are the ones who do not do it at the highest level. If a photographer is doing the highest level of photography, he uses mathematics very well and has to understand it. He has to understand science very well, if he is photographer in the 21st century… The common characteristics of people who do any profession or occupation at the highest level are the community that has the skills we call those 21st century skills. We want students to already experience these skills in the classroom. We do not expect from teachers to prepare their students for the future, but we expect teachers to be able to transfer and model that 21st century highest level real life into the classroom.

6.2.2. Sustainability

Under this theme, categories called (a) teachers teaching teachers, and (b) documentation are presented.

6.2.2.1. Teachers Teaching Teachers. Exemplary codes for this category were *no top-down instruction, going deeper into the profession,* and *teach how you teach.*

Steve claimed that PD should provide sustainable platform for teachers that they can count on throughout their profession. That is why, PD should be able to sustain itself in time. He expressed their goals as "In fact, we are trying to establish a sustainable system that teachers learn from each other, examine each other and helps each other". He stated that in the first year of the project, most of the responsibilities was in his hand. However, with more people and by building community around the system, he transformed his duties through these people over the years.

The main expectation was that teachers teach teachers within the system. To do so, it was aimed to achieve that teachers who were once participants of this PD become new PD facilitators within the system.

> Participants who finished this PD successfully become one core team. They will have leading role in computational thinking and application of Scratch in classroom. I mean I was looking for some specific leaders. If participants show some potential to be leader, I would be happy with this lesson... Seeking for leaders here does not mean recruitment, it means an opportunity to identify people I could work with and for Turkey, more people will take the lead in this content.

In this way, participants will both be able to go deep into their professions and ensure continuity within the system. According to Steve, this is very helpful for participants because they will get PD from their colleagues not from some academician or just someone wo is theoretically knowledgeable on the content. This was important because PD facilitator will be someone who went through the same learning process before and this will affect his/her teaching. This person can be able to give more practical ideas based his/her classroom experiences. Besides, this person can be able to treat all the participants as their colleagues because they really will be their colleagues. To make sure, Steve also reminded PD facilitators to be careful with their attitude in regard of participants were being their colleagues.

6.2.2.2. Documentation. Exemplary codes for this category were *flexible format to be consistent* and *keeping record of any document as data for following years.*

As another point of sustainability, Steve underlined the importance of documentation within the system. Documentation means keeping record of everything that is produced within the system such as lesson plans, frequently encountered problems sheet, rubrics, formats for projects, and so on. Documentation provides to hand all the experiences down the future experiences. According to Steve, documentation will be resource and guidance for future participants and PD facilitators. It was expected that this will ease their teaching and learning process. For example, Steve explained the feedback cycle for lesson plans as documentation within the system.

> You know the feedback of the lesson plans that we do in every quarter of our eight-month cycled PD. I was writing feedback to all lesson plans at first. In the second year we printed it to our leaders, in the third year we printed it to the teams. In the fourth year, we now have our own expert feedback teams. We have a team of 40 people. We give each one 20 lesson plans. Rubrics are ready, they evaluate and give feedback to their colleagues. In return, we pay the fee and control the system because they do this as a business. We have a feedback pool on what kind of feedback can be given, so that the feedback is of a certain professionalism. So, the teacher looks at the lesson plan and doesn't pick anything random. We have developed a small program. He writes the name of the teacher in the program, looks at the lesson plan of the teacher to give feedback and chooses feedback from there.

Coordination unit of the project proposed flexible format for PD facilitators to be consistent through the years. Steve expressed this situation as “We want a continuity. The format is the same, the venue is the same”. This format was directly related to the documentation goal of the project to reach sustainable system.

> In order to be permanent, we determined the formats for such as the lesson plans or the course syllabuses. The next person will know what to do. We don't need to explain everything all again. For example, we have created a document of problems that have experienced very frequently… In this way, we carry the previous experiences to the future experiences with documentation.

6.2.3. Iterative Process

Under this theme, categories called (a) preceding research, and (b) each year is data for next year were presented.

6.2.3.1. Preceding Research. Exemplary codes for this category were *coordinators' previous PD experience as teacher and academician, pilot observations in classrooms, discussions with teachers, literature review*, and *checking similar PD.*

Steve underlined the importance of considering previous experiences as need assessment and later on moving forward iteratively. When this project was decided to be conducted, as first thing to do, he explained that they started with checking similar PD programs, observing classrooms, and taking teachers' opinions. Then, they checked the related literature for academic foundation and in this regard, he mentioned his academic background and previous PD experiences as designer or participant also helped and affected this process.

6.2.3.2. Each Year is Data for Next Year. Exemplary codes for this category were *collaboration between coordinator and facilitator,* and *documentation*.

Steve also underlined the importance of consideration each experience as data for better experience in the future. He stated that after first year, they always move forward by taking into consideration previous year's PD experiences and documentation. They always considered each experience as data to develop themselves in the future and they were still tailoring the PD based on these data. In this regard, he gave the example of how they started to make manual for technical support.

> Technologically, a technician was always ready to attend each lesson and was always on the phone. So, teachers should not complain to the PD facilitator. We asked for technical problems to reach our technical staff here from that helpline. It was used very much at the beginning… Now, in the second term, we were more prepared for these kinds of technical problems. So that we have prepared a manual for problems that may arise. We prepared a manual on how to enter the system. These were sent to the PD participants. Thus, those technical problems decreased in the second term. We have adapted ourselves.

During designing and implementation process of each PD, Steve stated that coordinator unit of the project and PD facilitators always stayed in touch and they collaborated all the time. Steve wanted from PD facilitators to consider coordination unit of the project as facilitator for their every need. Steve defined the role of coordination unit of the project as follows.

> Being there for PD facilitators, guiding them to reflect the principles of the STEM integrated teaching framework while planning the lesson, waiting for them as ready to consult continuously, waiting for a problem to solve, and constantly waiting in the center when there is a technology-related problem. We are a vigilant help unit … We shared certain experiences with PD facilitators. We told them about the specific difficulties in both planning and running the sessions. So that they could overcome these difficulties. In other words, we are trying to learn from the process and meanwhile, we try to be the person who provides this learning process.

Steve also proposed that same iterative process was applied for PD facilitators to tailor their PD design through the process. Like everybody else who were participated in the PD process, this was a learning process for PD facilitators as well.

> After [first year], we [him and PD facilitator] talked in evaluation meeting. Hayes was aware that points that are needed to be developed. This was such a positive thing. For example, there were so intense content. He was aware of this and he foresees that he may ease the content in the next year.

Besides, according to Steve, if PD facilitators had previous experiences in giving PD to teachers, then this experience affected their teaching as well. It is important to keep in mind that each experience was a data and chance for improving their PD design and implementation.

6.2.4. Content

Under this theme, categories called (a) theoretical framework, (b) diversity of content, and (c) competent person as PD facilitator are presented.

6.2.4.1. Theoretical Framework. Within Integrated Teaching Project, while choosing content of the PD programs, especially theoretical framework of the project was taken into account.

> We wanted [teachers] to deepen within the STEM integrated teaching framework. I mean our cognitive processes were four of them which are project-based learning, scientific inquiry, computational thinking, and mathematical modeling. We tried to create opportunities for teachers who want to deepen in each cognitive process method.

As it was explained before, theoretical framework of the project was very effective while framing the content of the PD programs in the project. Steve specifically mentioned Block-based Coding Applications PD was designed for teachers to develop computational thinking skills and meet their TPACK (Technological Pedagogical Content Knowledge) needs.

6.2.4.2. Diversity of Content. It was underlined by Steve that diversity increases the chance for relatability and adaptability of the PD for each teacher who has different backgrounds and interests. Steve stated that they tried to differentiate the content as much as possible. In this way, it could be possible to reach more people because everyone could find one content that possibly interests him/her. He expressed that "We tried to diversify as much as possible. For example, we opened four courses in the first semester. In the second semester, we wanted to have four different lessons than first semester but within the same cognitive processes [of the framework]".

6.2.4.3. Competent Person as PD Facilitator. Exemplary codes for this category were *PD facilitator's expertise on the PD content* and *having teaching experience in the same PD content.*

Steve insistently underlined that it was very essential to trust on PD facilitators' expertise on the content. Thus, the responsibility of designing their own PD was given to PD facilitators within this project. He expressed that "Designing the PD is primarily the task of PD facilitators". So, coordination unit let the PD facilitator flexible on the design of the PD.

Steve was aware of preparing syllabus for such a wide variety of participants was challenging work for PD facilitators because they had to be able to foresee needs of any participant may attend anywhere in Turkey, in every level of knowledge, and motivation, despite the motivation letter. This is why, coordination unit guided PD facilitators on what can be useful by giving constructive feedbacks because coordination unit had a lot of experience with teachers and PD programs.

While designing Block-based Coding Applications PD, it was specifically requested from PD facilitator to not focus on the technicalities of the PD content. In other words, it was asked from PD facilitator to make visible of how to integrate coding applications in classrooms not how to use menus of the application. After giving basic technical information for the application, showing the practicalities of the coding applications for mathematics concepts was wanted to be the main focus. Therefore, *teach how you taught before* was one of the most underlined suggestion for PD facilitators.

> We said that it will be more beneficial if you share as much practical examples as possible and teach how you teach in the classroom before – this is very important – if you teach these experiences and methods as you teach. Let it be interactive, not didactic. [Not teaching like] 'This is like this, like this, do it like this, not like that. [Teaching like] I did it like this, I saw the benefit of this as follows. So, how would you do it?'

It was also very essential that participants consider this PD as sharing environment not just as didactic course. This is why, it was asked from PD facilitators to not give any homework.

6.2.5. Duration

6.2.5.1. Multiple Doses. Exemplary codes for this category were *time is needed to apply what is learned, time is needed to gain expertise,* and *time is needed to get comfortable for being interactive.*

It was underlined by the PD coordinator that time is needed for participants to internalize and implement what they have learned from the PD, get expertise on the content, and also feel comfortable enough to get interactive. This is why, PD should be more than one session. In this way, teachers can think over their learning and discuss over their understanding of the PD with their colleagues. Therefore, coordination unit decided to set timing of the Advanced Stem Courses' each session as one hour and once a week.

> Why six weeks? To have some kind of interaction, sometime should pass. I mean this does not happen in 1 hour [in one dose]. It should proceed through the process. To have some kind of interaction, teachers should try something and share that experience in next week so that they have something to say… Another reason why we proceed for six weeks, it takes some time, before person can reach a certain specialization and produce something.

It was underlined that for participants time is needed to feel free for sharing. According to Steve, this cannot happen in one-shot or short-term PD. They need to feel safe for not getting judged or approached biasedly.

> A certain amount of time must pass before the interaction between the PD facilitator and the participants can take place. So, I can't talk to someone I don't know right away. Let there be a certain recognition process. My expectation was that interaction will start in week two or three. I did not expect everyone to speak right away from the first week because the PD facilitator who gave the PD is doing this for the first time. He should also be comfortable, and the participants should be comfortable as well.

6.2.5.2. Logistics. Exemplary code for this category was *adjusting best time for teachers.*

It is important to remember that *Iterative Process* theme is effective on decision making process of designing PD. Steve claimed that after spending so much time with teachers, they became people who are able to foresee teachers' needs and how much time teachers spend in their home. So that, they used their previous experiences with teachers as data to decide on duration of the PD.

Besides, according to Steve, PD designers should look after teachers' best hours to make PD more efficient for them. While deciding on which hours of the day was the most effective for in-service teachers, Steve expressed that they checked the time period that teachers spent mostly spent on social media. They realized that it was between seven and nine pm. They did not want to make it longer than 1 hour because they were worried about teachers may lose their attention in that hour of the day. After work, without taking teachers' weekends, the best time was chosen as around eight to nine pm.

> After teachers are working like a crazy, when they go home, we want them to relax and develop professionally in a very comfortable environment instead of watching a TV series. In fact, we want them to both learn and spend quality time after work.

6.2.6. PD Venue

Under this theme, categories called (a) technological infrastructure for OPD and (b) optimum number of participants are presented.

6.2.6.1. Technological Infrastructure for OPD. Exemplary codes for this category were *enough technology for participants to get interactive*, *follow-up multimedia tools*, and *synchronized.*

While designing this PD project, Steve specifically took interactivity into account because he believed that it is essential part of learning. They did not aim for one setting that only PD facilitator speaks and tells what should be done. Their goal was to create sharing environment among participants and PD facilitator. This is why, they searched for program as PD setting that enables as many opportunities as possible for participants to engage the PD in an active way. In this manner, he specifically underlined the importance of having synchronized OPD.

> We used a specific technology that allows interaction. We used Adobe connect. This technology enables interaction, so both the participant and the PD facilitator can speak… I mean we want it to be interactive. Within these interactions, there was assessment and evaluation process between the PD facilitator and the participants. Interaction is a must, and this happens only through conversation. Only by talking, the PD facilitator can notice if you understand something or not.

On the other hand, Steve was aware of interaction level of participants was very low. He stated that this may result from personal characteristics of the participants such as self-confidence, cultural background, technological knowledge and so on. But still, he anticipated these interactions will increase even more with the familiarity of OPD approach in the society.

Steve proposed that they tried to provide as much opportunities as possible. Even so, he was aware that this technological infrastructure was not enough to provide comfortable setting for participants to share. Since he thought this was not enough, they also suggested some follow-up multimedia tools to increase naturalness of the setting. Steve expressed this situation as “We wanted this because as follow-up of the sessions, WhatsApp group can be formed. Participants can ask their questions via WhatsApp”.

6.2.6.2. Optimum Number of Participants. Exemplary code for this category was *limited to number that allows anyone to get interactive.*

Steve stated that they kept the number of participants limited to make participants as active as possible. In this way, it was aimed that participants can build small community that everyone is comfortable inside to share. Additionally, it was aimed to each participant could have enough time for asking their questions or open discussion points to their colleagues. The maximum number for participants was ten and Block-based Coding Applications PD took place with seven participants.

6.3. Effective PD Characteristics According to PD Facilitator

In this section of the findings, perspectives of PD facilitator and two PD consultants over high-quality PD characteristics are presented. Seven themes emerged after data analysis process: (a) scope as purpose, (b) content, (c) cognitive load, (d) duration, (e) iterative process, (f) interactivity, and (g) PD venue. Each theme is composed different categories. Furthermore, to be insightful for further studies and more meaningful for readers, most underlined codes are shared under these categories.

It is important to remind here that Ray was consultant for this PD program's design. Ray and Hayes designed and conducted many PD programs before. Each time they got support from each other. This is why, within this study, interview was conducted also with Ray. Moreover, Hayes contacted with Sam over coding integration instructional design. I present Sam's and Ray's findings alongside with Hayes' because Hayes worked as a team with Ray and inspired by Sam's examples. Therefore, Sam and Ray were silent designers for this PD. Table 6.4. presents all the themes, categories, and codes that were found from interviews with PD facilitator and two PD consultants.

Table 6.4. Review of effective PD characteristics according to PD facilitator.

THEMES	CATEGORIES	CODES
SCOPE AS PURPOSE	Opening the Window	*More than PD content*
		Inspiring participants
		Community creation
		Responsible one's own learning
	High-quality Teaching	*High-quality Teaching*
CONTENT	Diversity of Content	*Drawing attention*
		Helping participants to find their own ways
	From Easy to Hard	*From Easy to Hard*
	Coherence	*Adaptable and practical examples*
COGNITIVE LOAD	Prior Knowledge	*Background with the PD content*
		Disciplinary content knowledge
	Amount of Content	*Amount of Content*
	Recording PD Sessions	*Recording PD Sessions*
DURATION	Scope of the PD	*Arranging duration according to scope of the PD*
	Multiple Doses	*Time is needed to gain expertise*
		Time is needed to get interactive
	Workload	*Workload*
	Logistics	*Not breaking out teachers' work-routine*
	Attention Span	*Attention Span*
ITERATIVE PROCESS	Preceding Research	*Experts in the field as resource*
		Similar PD as resource
		Experienced in the same learning process
		Collaboration with the PD coordinator
		Literature review
	Flexible through the Process	*Syllabus and implementation can be tailored during process*
INTERACTIVITY	Comfortable and Safe Environment	*Anxiety for doing wrong*
		Pressure of being math teacher
	Readiness for the Content	*Effect of content knowledge on confidence*
PD VENUE	0th Week	*Time to get to know each other*
		Need assessment
	Technological Infrastructure for OPD	*Enough technology for participants to get interactive*
		Follow-up multimedia tools
		Synchronized
		User-friendly layout for sharing environment

6.3.1. Scope as Purpose

Under this theme, categories called (a) opening the window and (b) high-quality teaching are presented.

While designing PD, Ray claimed that the first thing to do is that knowing what you want to do and setting your goals. Then, design process should shape around your goals. This is why, Ray and Hayes collaboratively designed this PD around the scope as their purpose.

6.3.1.1. Opening the Window. Exemplary codes for this category were *more than PD content, inspiring participants, community creation,* and *responsible one's own learning.*

Ray claimed that each PD should set long term goals before, structuring the syllabus. It means that even after 10 or 15 years, what participants will remember from the PD called as top of mind learning. Ray explained this terminology as "While we are designing any PD, you cannot create miracles in six weeks, but there are certain points you can take for life from every PD. These are at the core, so it's at the base".

When the goal of this PD was asked to Hayes, he underlined specifically two points. First one was inspiring teachers. The goal was more than just teaching some basic commands of coding applications, it was drawing some curiosity on different teaching methods. So, the broader goal of this PD was to open windows for teachers in the field of coding integration and drawing their attention. They wanted from participants to say "I can do great things if I work hard on it. If I work a little bit on this, everything is very clear, and I can now teach the concepts that I have never taught in math for students". So, the main goal was not making teachers Scratch experts, it was evoking some admiration among teachers.

Hayes explained his own adventure in this process. He wanted to open a window to other teachers, as this journey opened up for him. In this way, he aimed to raise the possible pioneers in the field. Therefore, he wanted to work with curious teachers. While he was reading motivation letters, he wanted to make sure if they are sincere toward learning this teaching method. He wanted to understand their motive toward attending this PD, either it was for certificate or improving their teaching. He wanted to work with teachers who sees promise in this field. According to Hayes, if they had bias toward applicability of the coding integration, six weeks would not be enough to deal with bias. He was specifically careful about this fact while he was reading motivation letters.

Target audience was the promising pioneers because according to Hayes, one teacher could change so many things and widen this learning circle. Thus, new visionary community can be built. Hayes claimed that since Scratch was easy to start and there was chance to go deeper if it is intended to, participants could proceed to improve themselves by being part of extensive network of Scratch. So, according to Hayes and Ray if participants are curious enough, they can figure out how to make it. In this manner, Ray claimed that "Today we are in such a period that if there is effort, if there is motivation, people can learn everything they want". Eventually, according to Ray, learning is the responsibility of people themselves. Since there are already so many projects and big network around the field, it is not hard for beginners of this field to get help and improve themselves.

6.3.1.2. High-quality Teaching. According to Hayes and Ray, second major goal of the PD was raising the quality of teaching. Hayes wanted to make sure that each teacher knows what he/she is teaching and why. According to him, block-based coding applications have huge impact on grasping the mathematical concepts comprehensively because either you are a student or a teacher, you need to fully understand one concept to explain it to the computer mathematically to make it work. Otherwise, it is just a machine, it cannot predict what you think or memorize. Hayes explained this process as "It does not happen without separating what is necessary. It has a more realistic approach in this regard. I think this is what makes

the child's level up and what interests them". This is why, he claimed that block-based coding applications help students to build real-life connections.

Sam claimed their goal while they were designing coding integration-based PD as "Our goal was to forge a link between a well-known and popular subject [mathematics] and a lesser known subject [coding]". In this way, they aimed to ease understanding mathematical concepts. Besides, when students really comprehend one concept, they can use it in many contexts even after many years.

Furthermore, Hayes wanted to make teachers to be able to produce their own lesson materials to integrate coding into mathematics classes at the end of this PD. Ray also suggested that make participants to create one project after each session or at the end of PD. He explained importance of production as "When participants create a product, while they work on one session, if they can take it towards the product, they become more motivated, they learn better, they do not forget what they have learned". So, they aimed that participants become people who are able to create lesson plan that they can integrate coding into mathematics. Thus, everybody can be able to create lesson plans that is suitable for their own situation.

During the interviews, it was asked that what points that they took into consideration, while rubric for lesson plans were planned. Ray stated that "There is no value for Hayes to evaluate the final project except that the person receives feedback". It means that rubric did not aim to give degree for participants to show their expertise on the field. The feedback that comes from rubric was important to show where the person should improve. While Hayes was reading the lesson plans, the main point that he was tried to check was if they were applicable or not in the mathematics classes. Since they wanted from teachers to be able to use these applications, in fact, they wanted to see lesson plans that is designed to use in the classroom.

6.3.2. Content

Under this theme, categories called (a) diversity of content, (b) from easy to hard, and (c) coherence are presented.

According to Hayes, the most challenging part was deciding on which examples will take place while he was designing this PD. He rewrote the syllabus three or four times. Hayes expressed this situation as "The most challenging thing was that deciding on which points were more important and can touch the majority, since there was a lot to be possibly mentioned". He made his content-based decisions based on his *scope as purpose*.

6.3.2.1. Diversity of Content. Exemplary codes for this category were *drawing attention* and *helping participants to find their own ways.*

It was underlined by the PD facilitator that content-related decisions should be made according to scope of the PD. Hayes stated that since his aim was to relate everybody into the PD content, diversifying the content was very essential. Since everybody has different professional needs and different ways of understandings, differentiated examples and works can help everybody to find something to relate with their classrooms. This is why, apart from the content shared during the PD, many other additional resources were shared. Hayes proposed that "The more diversity in content, the higher your chances of catching the audience. Maybe tomorrow, knowing these options can open other doors for them".

Diversifying the content was also useful for participants to find their own styles among variety of options to follow. Since there are many leading names in the field of coding integration into mathematics classes, knowing many options can higher participants' chance to relate themselves among one of them. Sam as one of the experts in the field also suggested Hayes to add various mathematics topics that can possibly connected with coding. Sam

advised Hayes to let participants to produce a lesson plan that is suitable for their own interests.

Additionally, Hayes was aiming to draw teachers' attention. To do so, Hayes and Ray underlined the effect of art on human-being repeatedly. Ray claimed that interest toward esthetics was always existed among people thereupon it was a big motive. Basically, relation between mathematics and art was highlighted to scope of this PD which was evoking admiration toward coding integration in classrooms. During PD, Hayes specifically underlined the relation between art and math by showing various examples and sharing names in the field.

> Hayes: An algorithm really has its beauty. In other words when someone sees it, they all say, "how beautiful". It may be discussed over why they call it beautiful and maybe there are many reasons for it. However, everybody has a sense of beauty. The same thing exists in coding. Coding easily highlights that beauty in mathematics… Actually, I can say [art is] unifying. A place where everyone can get along easier. It is interesting, you can think like something telepathic. In Turtle art, you drew something, and everybody says, "it is beautiful" … Everyone finds something from themselves…and everyone understands something else while looking.

Furthermore, while Sam was working as mathematics teacher, he noticed that relation between art and mathematics always made students excited and motivated. This is why, in his personal studies, he specifically worked on mathematics and art. Sam proposed that "Beauty [aesthetic and / or intellectual] has a stimulating effect on the human mind". Since one of the major aims of the Hayes was inspiring teachers to grow interest toward block-based coding applications, Sam specifically advised Hayes to choose visually and mentally interesting examples. So that, they can take an interest of participants and keep their motivation high.

6.3.2.2. From Easy to Hard. It was highlighted by whoever is involved in designing this PD that it is very essential to arrange the PD content from basic to complex. Sam underlined that working with coding applications can be challenging for both teachers and students because teachers are generally as new and shy as students in the field of coding. Hence, it is very

essential make teachers to believe in themselves. By experiencing same processes as their students do, teachers gain some empathy toward what their students go through while they are learning.

Therefore, Hayes tried to balance basic examples and interesting examples. Otherwise, visually and mentally interesting but too challenging examples may cause participants to decrease their motivation levels. He explained this situation as "There will be a boredom wherever there is difficulty". This is why, while Hayes was planning the syllabus, he started with simple activities to keep motivations high. He distributed the challenging but interesting examples among the sessions.

6.3.2.3. Coherence. Exemplary code for this category was *adaptable and practical examples.*

According to Hayes, it is important to keep in mind that teachers who attend PD basically wants to have some information that they can use it directly in their classrooms. This is why, he made an extra effort to include examples teachers can directly use in their classrooms or adapt according to their classroom contexts. He explained this pragmatist approach of teachers as follows.

> Hayes: Teacher thinks how [the knowledge I had] turns me in the short term, not in the long term … In every education, maybe in the good education, [according to the teacher] the most important thing is that I need fill my pocket when I finished the PD. So, not only my head is full, I should also throw something in my pocket. I should be able to spend it as soon as I go to my class.

Since one of Hayes' main aims was to raise quality of teaching, making sure that teachers were becoming people who are able to apply coding applications in mathematics classes was very significant. Therefore, while he was deciding on the content, he tried to keep in mind some principles.

> Hayes: I had a hard time planning the syllabus because I rewrote it four or five times. I erased it all over and wrote it again. The biggest problem is that there is a lot to be told, it is likely to be explained, but which one is more important and more relevant in general. Which is more interesting and useful, in fact, the most important thing in our syllabus here is this: Can the teacher turn this around and use it in his/her class. This is the first one. Second, the examples that s/he will use directly are also important, but will s/he be able to apply what s/he learned in some other context? So, will he be able to adapt? So, for example, we will explain 30 things here, but I will choose six out of 30, within six weeks of training. While doing these six weeks, which one is more important was a little difficult to determine, and we have to put them in a context. The things we pay attention is that first, can s/he adapt it and second, can s/he use directly.

6.3.3. Cognitive Load

Under this theme, categories called (a) prior knowledge, (b) amount of content, and (c) recording sessions are presented.

6.3.3.1. Prior Knowledge. Exemplary codes for this category were previous *background with the PD content* and *disciplinary content knowledge.*

It was underlined by PD facilitator that taking previous knowledge into consideration while designing PD is very important. According to both Ray and Hayes participants' previous experiences with PD content and disciplinary content knowledge has a direct effect on participants' cognitive load. This is why, while designing PD, it is very essential to know participants' background on the manner. Ray explained its importance as by giving example.

> Ray: If the participants were not familiar with Scratch and the computer, it would be quite hard. If they were are familiar with the computer but new learner on Scratch, it is relatively easier. If they spent some time on Scratch before, they would do wonderful work in one hour.

Additionally, according to Hayes, knowing mathematics concepts was very essential for this PD as well. While he was designing this PD, one of his biggest concern of his was the content knowledge difference between secondary school teachers and high school teachers. Hayes pointed out this is a big issue, especially in Turkey.

Hayes claimed that the most of the secondary school teachers do not know high school curriculum and most of the high school teachers do not know secondary school curriculum. Thus, teachers' motivations varied according to their knowledge on the concept during PD. They draw more interest if it was connected to their grade. This is a fact that is directly related to pragmatist approach of teachers, since they were mostly interested in what they can use in their classrooms. On the other hand, Hayes wanted to build an understanding among teachers that mathematics is a whole and it is always a rewarding thing to know mathematical concepts even though it is not in their curriculum. In this way, teachers can draw more emphatic and visional approaches toward their students. For example, according to Hayes, one high school teacher cannot understand what secondary school students can do or one secondary school teacher does not know what concepts their students will build on in high school. This is why, it is very essential to consider one discipline as whole.

6.3.3.2. Amount of Content. Hayes was aware that it was not easy thing to follow the sessions if participants had missing knowledge on the mathematical concept and had no knowledge on coding thereby, he tried to keep the amount of content under control even though he wanted to share as many examples as possible. He did not want that to make participants get lost in too much content. However, still he felt there were some problems with keeping up with participants. For next year, he planned to prepare small homework to be prepared for each following section. In this way, he aims to decrease cognitive load and increase the interaction over the content.

> Hayes: For example, there was something in the comments. Participants liked the examples, but they said that they had to watch the videos several times because they had problems while catching up. For example, if the participant has just heard of the concept of mathematics and does not know anything about coding, it is not so easy to learn both. You do two things at the same time. This is a problem. Maybe it is necessary to spread the time better. Next year, we will do it like this: We will do some homework outside of the lesson time, maybe we will discuss it in a group and talk about how to do it that week. But in this regard, we fell short this year.

6.3.3.3. Recording Sessions. According to Hayes, it was very useful to take a record of online sessions for participants to re-watch. He claimed it was very helpful for participants to reduce cognitive load of the PD. Also, he got very positive feedback about it from

participants. They shared that they watched the videos repeatedly and this is how they learned.

> Hayes: If we did this PD face-to-face and did not record the sessions, it would not be so effective because it is unfair to expect from participants to understand everything at once. Normally, I do not expect to understand myself at once. I did not understand those examples at once. You have to work on them several times. So, in this respect, I think it is important and effective that these sessions are online and on the record.

6.3.4. Duration

Under this theme, categories called (a) scope of the PD, (b) multiple doses, (c) workload (d) logistics, and (e) attention span are presented.

6.3.4.1. Scope of the PD. Exemplary code for this category was *arranging duration according to scope of the PD.*

According to Ray, duration of the PD is directly related to the goals you set for your PD. He claimed that if the aim to try to give people a specialization then, duration should take longer time than giving vision on the content and open window for participants.

> Ray: Normally, you determine the PD design and how many hours or weeks you will teach according to the scope and comprehensiveness of the frame you want to give. So, if you want your participants to gain deep expertise in Scratch, one hour wouldn't be enough. But if you want to raise awareness, one hour is enough. As Hayes fits his frame within one hour, there is no problem.

6.3.4.2. Multiple Doses. Exemplary codes for this category were *time is needed to gain expertise* and *time is needed to get interactive.*

According to Hayes, it is important to remember that learning does not happen all at once. It takes time to process thought, work on the content by yourself, and become to be

able to apply. So that, gaining even only some amount of expertise naturally takes time. This is why, it was suggested to conduct PD sessions multiple times at certain time intervals. In this regard, he stated that people need time to work on what they learned.

> Hayes: I think it is at least three hours and four hours to repeat and study the session again. If s/he wants to do it again, understands by her/himself and wants to practice well, it is hard to grasp that session less than three hours.

Besides, Hayes believed that it is so natural that it takes time to get interactive. According to him, in the first weeks, everybody was shier. They tried to get used to the environment. The more participants feel like it is conversational environment the more they get comfortable and participative. He commented about interactivity level of participants as follows "Maybe the first weeks were a little more hesitant. I mean in that getting used to period".

6.3.4.3. Workload. Hayes underlined the importance of workload of the PD. As it was mentioned before, participants spent too much time re-watching the sessions of the PD over and over again. Other than watching the videos, participants spent some time to internalize what was explained and how to integrate into classroom. This means that conceptualization process of PD was not limited to PD hours only. Hayes proposed that even though it seems like 1 hour in once a week, it may take at least three to four hours from teachers' other times in that week to revise and try to apply by themselves. Hayes explained it as "They are doing something nice now ... universities are now applying something called *workload*". So, your lesson may last four hours but the workload of that lesson can be 15 hours weekly".

6.3.4.4. Logistics. Exemplary code for this category was *not breaking out teachers' work-routine.*

Hayes stated that it was very essential to keep in mind that PD participants are mostly in-service teachers thereby their working hours and schedule should be taken into

consideration to arrange timing of the PD. This shows that it is very important to not break out teachers' work routines.

> Hayes: It should not exceed the limit. To do everything with due measure. So, maybe you shouldn't forget that we do these lessons during the season. I mean, the teacher comes home in the evening. The duration of the session should be like not exceeding the limits of tolerance. I am also teacher. I put myself in their shoes and empathized.

6.3.4.5. Attention Span. Ray pointed out that even adults have attention span. If duration of the PD goes up to its limits, participants may lose their attention. Additionally, timing of attention span may vary according to balance of being an active or passive during PD session. Both Hayes and Ray underlined that it was important to not exceed participants' toleration limits in the evening time of working day. Ray explained it as follows.

> Ray: The PD facilitator and participants should be equally active. Otherwise, you cannot listen one person for two hours anyway. Not even one hour, you don't listen exactly… So, if this active passive balance is maintained, duration can go up to 80 minutes. But I think you cannot take such a cognitively charged process for more than 80 minutes.

6.3.5. Iterative Process

Under this theme, categories called (a) preceding research, and (b) flexible through the process are presented.

While Hayes was designing and conducting this PD, he tried to move forward iteratively. It means that before PD started, he stated that he did a lot of research and collaborate various experts whose most effective ones are presented in this thesis. During PD process, he considered feedbacks and reactions from participants to tailor the syllabus and implementation. In addition, he evaluated this PD and determined some revising points for next year based on this first-year experience.

Sam also underlined the importance of moving forward iteratively while designing PD. He proposed that each step should maintain the next step and each experience should be data for upcoming design. Everybody that relates to PD should be included this iterative process such as academicians, PD facilitators, teachers, and students.

6.3.5.1. Preceding Research. Exemplary codes for this category were *experts in the field as resource, similar PD as resource, experienced in the same learning process, collaboration with the PD coordinator,* and *literature review.*

Hayes underlined the value of previous experiences that other PD designers and facilitators had. According to him this was an essential part of moving iteratively because it gave the grounded ideas for designing syllabus of the PD. He explained his design process as follows.

> R: Can you explain the process of design of the PD? From the very beginning.
>
> Hayes: Now let me tell you the first thing I did, a little research on the field. The first thing I did was I emailed several teachers working in this area I knew around me. Then I searched on Google, what are the studies in this field? By the way, there is an important person. We have a teacher named Sam. Currently working at MIT ... He was working at Berkeley at that time. At Berkeley University, there is a course on how to integrate programming into high school curriculum that is called beauty and joy of computing. The person who developed the mathematics part of this curriculum is Sam. Besides, he had teaching math experience in Turkey. Math teacher. His work at this point is very valuable for us. I asked him. Is there such a curriculum? Is there such a plan? He also talked about his own work.

Hayes also took advantage of being experienced in the same learning process. According to him, he could be able to foresee the possible needs and challenges participants could have. He designed this PD based on his experiences in the journey as well. “I can set off here based on myself. That experience brings that wisdom”.

Hayes was collaborated with PD coordinator as well, during PD design and implementation. He defined Steve’s role in the PD design as advisory. In other words, Steve was the first catalyzer for Hayes to understand the theoretical framework of PD. Hayes stated

that “Steve was my student after all”. This is why, he did not prefer to include Steve in each step of PD design.

> R: How would you define the role of PD coordinator on designing this PD?
>
> Hayes: Steve helped us only if there was a problem... I may have had one or two questions just to understand the overall framework of the project at the very beginning. Other than that, I can say that I did the design completely. So, let me give one name, Ray. He is also doing his doctorate in educational sciences. We actually designed this PD more with him. So, he doesn't know coding, but because he knows the pedagogical part. I proceeded by talking with him, by discussing some things.

6.3.5.2. Flexible through the Process. Exemplary code for this category was *syllabus and implementation can be tailored during process.*

After first session, Hayes wanted from participants to fill some open-ended questions to see if there were some suggestions. This is because he aimed to be flexible according to his audience. However, he said that he did not get any suggestion or comment.

> Hayes: Nobody said, let's add something, let's remove something. But I actually adjusted the ease or difficulty of examples according to the reactions I got. So, I did not deviate from the main subject. If I was going to tell fractal that week, I explained fractal, but when I explained the fractal with another example. I can say that I tailored my examples. I changed the depths. We went deeper in some parts. We stayed a little lighter in some parts.

6.3.6. Interactivity

Under this theme, categories called (a) comfortable and safe environment, and (b) readiness for the content are presented.

6.3.6.1. Comfortable and Safe Environment. Exemplary codes for this category were *anxiety for doing wrong* and *pressure of being math teacher.*

It was specifically highlighted by PD facilitator that participants need safe space for sharing. Otherwise, there are a lot of reservations that keep participants passive. For example, according to Hayes, interactivity was lower than his expectation because teachers were anxious about doing wrong. In this manner, he expressed that "It is necessary to capture the conversation environment and make people forget that they are in an educational environment". Otherwise, participants are worried about if they say something wrong and it will be considered as deficiency.

Besides, he mentioned specific situation to Turkey context. According to Hayes, mathematics teaches are considered as smartest people in the society and they are not to make any mistakes. So, this situation creates a pressure on teachers. On the other hand, according to Hayes, teachers should feel free for making any kind of mistakes. He explained what he expects from his participants to do as follows.

> Hayes: For example, it is not like this in the coding part. So, even good programmers [who works at google etc.] are less afraid to make mistakes. Because it is such an environment that you have to do wrong anyway. It is impossible for someone who writes a computer program to sit and write code without any error. And since this is well-accepted fact from the very beginning, I think programmer are much more comfortable. Everyone is writing wrong code anyway, no problem. Everyone is already writing code by looking at Google, so everything starts with copy pastes [ctrl c]. There is no problem here, and this is a very accepted thing. But mathematics isn't like that. A mathematician knows and does what s/he knows. They do not do much wrong either.

Hayes proposed that he could not notice any increase in participation rate as the weeks progressed. He claimed the reason as follows.

> Actually, we did a different topic every week … For example, if we choose only one subject in math, let's say we will make geometry after that and we make geometry with turtle art. If we do it for three or four weeks, the comments may arise gradually.

6.3.6.2. Readiness for the Content. Exemplary codes for this category were *effect of content knowledge on confidence.*

According to Hayes, participants should meet in a common stand to share their experiences, for this platform it was mathematics. In this way, participants can have something in common to discuss over it. However, Hayes claimed that to be able to discuss, participants should be confident about the mathematical concepts. Hayes noticed that participants were interactive when they were confident about their content knowledge. Ray also confirmed that the importance of having comprehensive content knowledge for being participative. The better mathematical concepts comprehended by teachers; the higher interactivity got during this PD.

> Hayes: Let me tell you, how deeply we know a concept or the more we know the concept, the more we were interested. So, let me say something here. For example, Steve was more interested. Why is that? The concepts I described were more familiar for him.

6.3.7. PD Venue

Under this theme, categories called (a) 0th week and (b) technological infrastructure for OPD are presented.

6.3.7.1. 0th week. Exemplary codes for this category were *time to get to know each other* and *need assessment.*

Hayes proposed some revision points based on his experiences during this PD. For example, even though he reminded that revisions can be made based on participants' suggestions, nobody proposed any suggestion. On the other hand, according to Hayes, it was impossible to match exactly what he designed and what participants expected. So, Hayes realized that before even starting to design PD, need analysis should be done with participants. He named it "0th week".

> First, participants should determine what they intend to get at the end of this PD. We tried to learn about this via motivation letters but maybe something else was needed. Maybe brainstorming, maybe it's not

> week 1 but week 0. We just need a session to do conversation. First, let's get it off our chest. Who is doing what? Who knows what? Who wants to do what? What will happen if they finish this PD? What happens when they get this certificate? What happens if they do not? … maybe we should talk about this a little bit. We need to create a comfortable environment [before we start].

6.3.7.2. Technological Infrastructure for OPD. Exemplary codes for this category were *enough technology for participants to get interactive*, *follow-up multimedia tools*, *synchronized*, and *user-friendly layout for sharing environment.*

Hayes underlined the importance of having well-developed platform to share documents, post forums and comments, and give feedbacks. For example, when he got final projects via e-mail, he had hard times to keep them under control. One time, he could not one participant's project and asked to send it again. He also did not keep the feedbacks that he gave in his achieve. He needed to control participant's documents in another structured web platform.

When it was asked to Hayes how he would consider their active participation during the PD, he expressed that they were lacking in creating active learning environment. He stated that mostly "I became a bit more narrator there, participants became the listeners".

Even though he tried keep the participants active by asking them questions, he expressed that "I did all the examples and did not let them to see if they can do it by themselves or not". He was aware of this problem. In an online platform he started to search for better ways to conduct PD in this content. Hayes gave the example of Beauty and Joy of Computing which is Sam's project. He expressed that he would want to do live coding sessions with participants.

> Hayes: They never explain coding in videos. The videos are about general concepts… They do the coding part as follows. There are online laboratory environments. You enter and read in the site. It asks you question or more precisely, it wants you to do one program. You are doing the program. When you click it, it tells you what is wrong. This is a great feedback. However, it is not easy to provide this environment, its infrastructure is a different infrastructure.

Based on this example, Hayes shared that he started to record videos on YouTube for next years' PD. In other words, he recorded and put the topics that he will tell the participants on YouTube. Then, he aimed to combine the videos with the topics he will tell because he believed that video content that is independent from the PD session content does not make any sense. For next year, he aims to give small assignments based on these recorded YouTube videos and then discuss over it during the PD session. In this way, he expects to create something to talk about each following week. Hayes got feedback from participants as "wish there were small assignments over the weekend because we can only be motivated in this way. Also, we can see our improvement when we do something". Hayes commented about this request as "Even though participants were adults, people tend to not study without homework".

Besides, Ray gave the suggestion that giving participants a reflection opportunity to evaluate themselves after each session is can be very useful because when they reflect on what they learned; it reinforces their comprehension. Either way, PD designers underlined importance of giving opportunity for participants to work on and reflect on based on what they learned during PD.

6.4. After PD Experiences of PD Participants

It is important to remind that the completion condition for this PD was preparing coding integrated lesson plan. All the participants that were interviewed except Steve completed this condition. Because of Steve's busy academic schedule at the university, he could not complete this condition and get the certificate. Moreover, even though Eva prepared her lesson plan, since she was not actively working at the school, she could not apply what she prepared. However, all the other participants were able to apply their lesson plans in their classrooms. This is why, implication of the PD in the classroom related interview questions was meaningful for participants to answer.

In this section of the findings, PD participants' after-PD experiences are presented. Four themes emerged after the data analysis process: (a) being able to do, (b) when participants used PD knowledge (c) what changed after PD, and (d) support from the workplace.

6.4.1. Being Able to Do

Exemplary code for this theme was *produce something from what you learned.*

According to PD participants, preparing a lesson plan based on what they learned during PD was very effective for their learning. Therefore, they were very satisfied with producing a lesson plan based on their PD content. After they created one product that they can actually use in their classrooms – lesson plan –, their understanding toward applicability of the PD content was strengthen. They specifically underlined that to be able to create products based on what they have learned had an important role in believing that what they have learned is feasible.

> R: How was your learning in this PD measured?
>
> Eva: They asked us to prepare a project… We were asked to write something with an explanation for how we would use this application. So, I think it's good as a benchmark because you see how much you can do. Our teacher said do what you can do by yourself. He didn't necessarily want anything too difficult or too complex. So, it is good that we prepare a project as a feedback.
>
> …
>
> R: What was the benefit of your lesson plan that you prepared within the scope of this PD?
>
> Eva: … For the first time, I prepared a lesson plan with coding. I may have prepared it in my previous lessons as well, but I have once again seen that I can really prepare a lesson with coding.

Luna also suggested if they had the chance for preparing small activities for each week, they would have more opportunity for experience-based discussions. As one of the biggest appreciations of this PD, participants stated that having each session of the PD once a week gave them time to internalize and apply what they have learned. Luna proposed that if they

would have small homework for each week, they could have more benefit from this situation. In this way, they could have got more feedbacks for more than one context and discuss with not only PD facilitator but also their colleagues. This suggestion was given in a different form by Daisy as including feedback sessions of lesson plans into the PD process instead of sending it to PD facilitator and got feedback via e-mail.

> R: How did you interpret the fact that they made you prepare a lesson plan as a measurement and evaluation? Or could it be an alternative, for example, what could it be? Your first reaction.
>
> Luna: No, it was good for us to prepare a lesson plan in terms of preparation and knowing our material, applying it, we are already in learning process. But in terms of assessment, for example, we could have prepared lesson plan every week, not a lesson plan but small activity plan…. For example, after first lesson, in those four days, we could have prepared a little activity plan about the buttons he taught that week or about the things he taught that week. You know what I mean? Then again for Week Two. Then, I could have understood. I knew that I started using it … Teachers could have said, 'You learned it right here okay, but you couldn't use it well in this area'. Then, I will immediately [change it] again. In that sense, it would be better for us if we made small assessments every week and then switched it to the big lesson plan.

6.4.2. When PD Participants Used PD Knowledge?

Exemplary codes for this theme were *used when I need it, applied what is really internalized,* and *used after totally comprehended.*

Since interviews were conducted months after PD was ended, teachers also shared their experiences other than application of lesson plans that they prepared as PD assessment. Participants specifically underlined three important conditions they chose to use what they have learned from this PD.

Firstly, they stated that they preferred to use coding applications-based lessons when they needed it. It means that they should feel necessity to use what they have learned in the PD. Otherwise, they tend not to use the knowledge that they had during PD. Steve explained it as "Of course these are shaped by need. So, if I am not going to apply it, because my chance of application is low, so my interest is accordingly". This was directly linked to

participants' motivation toward attendance for PD. For example, as one of the main motivations for attending this PD, participants stated that they had hard time to explain some concepts for students. They thought that coding-based applications may help them in this sense so, they participated this PD. After the PD, participants specifically preferred to use coding application-based lessons for such occasions. For example, Daisy used while she was teaching *logic* and Luna used while she was teaching *great common divisor* (GCD) and *least common multiple* (LCM).

> Daisy: When I needed to, I tried to remember different things that I learned, and I did different things… For example, 9th grade started directly with logic subject. I used the STEM lesson plan that I made almost every lesson. [I said] Look, I did this, so here are the conjunctions. They are having a lot of difficulties while they are learning 'then' or 'truth tables'. [They say] What is this, what am I going to do with it, when am I going to use this, etc. I showed what I prepared several times in this term.

Second, participants proposed that they preferred to use what they really internalized. It means that whichever example they had in their mind the most during PD, they taught that example in their classrooms. This shows that chosen examples for PD plays very essential role for PD's credibility for teachers. Moreover, participants need to be convinced by the advantages that PD content offers. In other words, primarily teachers should fully grasp the concepts, then understand why and how these concepts can be explained better by using coding-based applications. So, this shows that participants tend to use coding-based applications in the topic they had a solid grasp of.

> Daisy: The heart wants to know more, show more, but let me say as much as I can. I think there is something I can do in every subject with Scratch. But time, workload, life conditions, rush, of course I can't do it in everything, but I love to show the things I learned to children.
>
> R: But still, you do your priority to do the things that you associate the most, by putting them in the front row.
>
> Daisy: By putting them in my priority, of course. Of course, absolutely.

Finally, they expressed that they prepared coding applications-based lessons once they felt fully confident about it. Teachers stated that they want to be prepared any occasions in the classroom. Since they wanted to feel sufficient while they are teaching one concept, they

only used these applications once they really understood it. Nora explained this situation very explicitly.

> Nora: I wouldn't want to apply it to my class if I do not fully grasp of that topic, that program, that game because I would like to be fully prepared in the lesson. There could be students who don't know what Scratch really is like me or a student who knows very well. Both are actually disadvantaged situations for me. I should have sufficient for the student who knew very well. I should have known at least as much as they do. I should have had enough information to convey it to the student who does not know anything about it.

Additionally, participants felt need for more time to sustain their expertise over PD content. For example, Nora expressed that "Maybe if our lesson time was a little longer, I think I would have achieved this qualification [preparing more original lesson plan]". They were all intended to move forward on coding-based applications by taking additional education. For example, Eva suggested to longer the one-hour duration since she wanted to see more examples. Afterwards, she searched for additional PD to go further on the topic, but she could not find anything more advanced. Similar situation happened for Daisy. She claimed that it is always easier to learn someone so that she would want to take advanced level of this PD to move forward.

6.4.3. What Changed After PD?

Under this theme, categories called (a) changing perspective, (b) positive effects on students, and (c) higher confidence are presented.

6.4.3.1. Changing Perspective. Exemplary codes for this theme were *potential of related coding application* and *exaggerating the content.*

Once PD participants became to be able apply what they have learned, they underlined that their insights and preconceptions changed. For example, as one of the main preconceptions, specifically Steve and Daisy, who worked as high school teachers before,

believed that what they could do with Scratch will be limited. However, after attending the PD, their preconceptions completely changed because they were convinced by examples throughout the PD sessions. Examples were highly challenging even for their cognition. So, they realized that there was no upper limit for these kinds of applications if they were willing to use it.

> R: Do you remember your first feelings and thoughts before starting this PD?
>
> Steve: I think it will be easy. So, what is Scratch. Kids playing with it. He can show us couple of codes at most. How hard it can be. Frankly, I trust the PD facilitator very much. But it seemed to me that he was going to do something more at middle school level. That's what I thought. So, I might be somewhat belittled about what Scratch can do.
>
> …
>
> R: What has changed in your life after participating this PD?
>
> Steve: …I realized that Scratch is not a program to be underestimated. If I were interested and specialized, I felt I could do math like this, do rigorous math in the classroom with it as well. This is also a good thing.

As another preconception, most of the participants stated that their expectations were very high because they were intimidated by the name of *coding*. Luna specifically mentioned her anxiety toward *coding* because when it comes to coding, she felt like she must do something huge and complicated. However, once she was able to use coding applications by herself in her classrooms, she changed her mind. They noticed it is something that they can use even for very earlier grades to explain some concepts.

> Luna: I always have thought that I have to do very big things for children, until I get this PD and talk to Hayes. In other words, I was thinking that I really had to design something that would find a solution to a world problem.

As an additional point, it was discovered that for teachers, gratitude of creating learning environments for their students outweighs to win an award or gain appreciation by others. In other words, the ability of the teachers to apply what they learned from the PD and to make a difference on their students with it causes the attitudinal change of teachers. Luna shared her attitudinal change over process as follows.

> Luna: At the beginning, what I want was maybe a project or a project that will receive an award. I mean it happens for every teacher, but then I saw children were actually learning. That was the real reward. I discovered this.

6.4.3.2. Positive Effects on Students. As it was mentioned before, all the participants who were actively working as teachers have applied their lesson plans in their classrooms and they shared their experiences. During the interviews, participants all shared positive experiences in many ways that they had with their students.

For example, Nora shared that as positive effect on her students that they started to enjoy the mathematics lesson when she started to use these applications. Nora noticed that she started reaching the students whom she thought could not reach at all before. She claimed that she enriched the content through coding-based applications and made the lessons more enjoyable. In this way, her students' motivation toward mathematics lesson increased. She considered her own situation as "I think that [this PD] has reached its goal [for me] because I could apply it later in my class".

By using different teaching strategies and taking interest of students, participants aimed to make mathematics classrooms more enjoyable. Luna specifically expressed her goal as "I mean I wanted to enjoy the lesson and I wanted to make my students to enjoy the lesson". They believed that if they can draw attention of students, they can initiate interest toward mathematics. According to participants, since mathematics is a discipline that most of the students have prejudice about, they wanted to turn it into more applicable and understandable discipline by using coding integrated applications. Participants believed that coding integrated applications have potential to reach through all these goals. These were the classroom needs for teachers and they aimed to meet these needs by attending this PD.

As an example, Daisy realized that in her classroom coding-based applications always raise students' motivation toward mathematics lesson and open new insights for them. Daisy expressed that while she was applying her lesson plan, she was so happy about working with

excited and interested students toward coding-based applications. She cared a lot about creating awareness in students' world from different aspects. She stated that "The important thing is how much we make contribution to students". She shared one specific example with one of her students.

> Daisy: I had a very curious student about coding. He was working with mostly Ardunio because he was thinking Scratch is for children. This student was in high school level… I showed very different examples from Scratch. I specifically liked the algorithms about the prime numbers that Hayes taught us, and I showed these examples in the classroom. For example, this boy engaged a lot of attention [towards it]. Actually, this is not something that only appeals to middle school children. [He realized that] We could do a lot of things [via Scratch] … He is in the robotic team of the school. [Afterwards] They developed a project with Scratch. They used Scratch in their projects. I can say maybe I may have contributed to it a little bit.

On the other hand, Luna focused on more cognition-based effects, while she was sharing her experiences.

> Luna: Children had a little difficulty in the first lesson. [They said] I can't draw, I can' do etc. but then, when they were designing that box, I realized that they learned rectangle. I did not have to say much. They looked at their own characters while drawing the rectangle and they learned the angle. They learned the angle of rotation. It is not even within their curriculum. It happened so naturally, and I realized that they did not forget them later. In other words, children were actually in the live environment and they love the computer. They did not forget. I have experienced this. This was exactly what I wanted.

6.4.3.3. Higher Confidence. Exemplary codes for this theme were *more computer-based teaching, high confidence in related concepts, affecting professional surrounding, meeting in common points with some students,* and *believe in teachers' enthusiasm for learning has changed.*

When it was asked to participants "What has changed in your life after this PD?", they all shared positive examples from their personal experiences. Some common points like preparing more technology-based instructions, gaining more confidence in their profession, meeting in more common grounds with their students, and thinking more multidisciplinary were presented by participants.

First of all, even though Steve was not working as a teacher, he shared his experience about giving calculus lectures at the university. He said that "It [This PD] may help me to plan my lectures more technology-based". Same claim was raised by Luna as this PD induced her to prepare more technology-based instructions because she was convinced by its positive effects on her students and lessons.

Once participants become more knowledgeable in their fields, their confidence has risen. Daisy expressed that "I have more confidence in sharing interdisciplinary knowledge about concepts because I always have answers for questions like *what is the use of knowing this concept?*". So, before students, if teachers grasp the concepts with their reflections on real life, they become more comfortable to discuss over concepts with their students or colleagues.

Besides, once participants become more knowledgeable in their fields, they become more extravert people to share their own experiences with their colleagues. Through this process, their collaborative skills with their colleagues developed. Specifically, Luna, Nora, and Daisy shared that after attending the PD, they tended to share what they learned from it with their colleagues. They worked with teachers from multiple disciplines while they were applying their lesson plans. For example, Nora pointed out that her implications created curiosity among her professional surrounding to seek for knowledge and PD programs like she attended. In this regard, Luna expressed that "It is much more effective for people to talk, suggest, and share with each other rather than advertising".

As another main impacts of this PD on teachers' daily lives, they expressed that they had more in common to talk about with their students. Because of today's students were so interested in digital technology and they grow up with it, participants stated that most of the times, before they even mentioned, students were already familiar with different kinds of applications. In this regard, Nora shared that "Students had already foundation [on Scratch and Minecraft]. I mean they learned it before I do". Naturally, teachers wanted to meet in

more common points with their students. When students realized their teachers were also aware of different applications and be able to use it, they developed more interest toward both teacher and the discipline. It was very mutually rewarding for teachers and students to meet in common points as many as possible. Daisy expressed her gratitude as "I can talk about Scratch with my students now". This was one of the important motivational factors for teachers to attend PD.

Specifically, participants who were graduated from the STEM Leader Teacher PD program, in other words participants who were familiar with Integrated Teaching approach, stated that after this PD, their multidisciplinary thinking skills have improved. For example, both Daisy and Luna collaborated with teachers from other disciplines to prepare integrated lesson plans. They proposed that they did not learn something new, but they learned how to connect what they already knew with other disciplines and making many concepts more meaningful for students.

As an additional point, Steve stated that after this PD, his faith in teachers has risen. He proposed that if proper content and conditions are presented for teachers, there are many eager to learn teachers who are willing to make reforms in their instructions out there. Since he shared this PD platform with highly motivated teachers for learning, his preconception has changed.

> Steve: My faith in my colleagues and my profession has increased [after this PD]. There is no image of a teacher who does not want to learn anything in my mind anymore. People want to learn something when proper content was provided for them.

6.4.4. Support from the Workplace

As a negative reflection of participants' classroom experiences, participants generally suffered from not getting enough support from their schools as an institution. Teachers' implications in their schools varied according to whether they got support from where they

work or not. As one of the reasons for not getting support from the administration, participants proposed that dealing with high stakes national exam. For example, Daisy proposed that each lesson that she used these kinds of applications considered as falling behind the other teachers. Since they had to catch up the curriculum and proposed schedule, she only found the opportunity to use these applications only occasionally.

> Daisy: I work in private school that is very exam oriented. We do a lot of exam-related things in our lessons, so it is not possible to use this kind of applications in many lessons. I think how the school treats the teacher in this regard is the most important thing, that is, because it is the authority for permission. Because there is a curriculum and you have to follow it. Another person ... other teachers are going through the same curriculum. Every activity you make or every video you watch and everything you do takes you one step back from them. This caused me a little difficulty in our system, so I can't use too much, of course, not every lesson. Because then I get behind the curriculum that I need to implement. But I hope our education system in the future will be very suitable for this and I can work in such a place in the future.
>
> R: Then, aside from getting the necessary support from the school administration, you say that they caused difficulties.
>
> Daisy: We can say yes.

Daisy was not the only participant that underlined the importance of institutions' support. Even though Luna did not have that much of hard time implying what she learned from PD in her classroom, her institution did not tolerate and ease her process for attendance of these PD programs.

> Luna: Because there is a situation like this; Implementing the lesson plan is a little difficult. Because what the university wants, and the working environments of the teachers do not fit very much. In this sense, I think that universities always ignore this, while doing and planning their PD programs, or I think that they took the plan of only very big schools into consideration. Because frankly going to these PD for me is a serious time. Even my institution applies serious mobbing on me.

As a counterpoint, Eva who was the only participant that was not actively working as teacher claimed that teachers who are working as teachers got support from their schools. As it turns out that private school teachers had hard time to get support for using different instructional methods. This shows that participants tend to think of the difficulty of their situation and that those are not like them have the advantage even though they do not.

6.5. Controversial Issues in regard of PD

In this section of the findings, some controversial issues of PD are presented; thereupon, it is aimed to give different opinions over PD dichotomies. Four themes emerged after the data analysis process: (a) online vs face-to-face, (b) secondary school vs high school teachers (c) traditional vs modern instruction, and (d) paid vs free.

6.5.1. Online Vs Face-to-face

Exemplary controversial stances for this theme were *accessibility, documents for lifetime, educational environment management, interactivity,* and *content.*

6.5.1.1. Accessibility. First of all, the most striking point of OPD was that it provided accessibility to everyone without time and place constraints. As one of the core scopes of this PD, reaching through all teachers who had motivation toward professionally develop themselves, OPD offered accessibility for them. In this regard, OPD provided so many opportunities for participants. For example, regardless of which region of Turkey that they resided, participants were able to attend this PD. This is an important feature especially in countries that had enormous inequalities among its regions.

> Ray: Both our industry and our education opportunities are concentrated in a certain region. Almost all our conferences are enacted in Istanbul. Now this is a handicap. Let's say I don't have money and I am a public school [teacher], do I really have to come to Istanbul?

The fact that OPD provides logistics convenience was an important motive for participants who were located in Istanbul as well. It is important to inform that Istanbul is worlds' one of the largest cities. Over crowdedness and traffic are well-known problems of Istanbul. Since teachers had busy working schedules and it was very hard to transport from one region to another in Istanbul, they were specifically searching for OPD. Some

participants shared that they could not find time even for going their homes in that time, they just attended the PD from their schools or some café.

> Daisy: If I had to go and take this PD there for six weeks, something could happen in the last minute. However, for example, on occasion, I started part of that session, on the road while I went back home. Being online made a huge contribution to me. Because on the one hand, everyone has a rush, we all work, on the other hand, this does not require anything extra. It does not require effort, for example, one day we had a branch teacher meeting at school. I had to watch the lesson at the end of that meeting, and I stayed at school and attended that session, that week. I mean, I didn't have time to go to my house, but I probably wouldn't have had time to go to that session if it was normally somewhere else. But I could have stayed at school, attended PD, and then went back to my house. I think online platform is where everyone can participate more.

6.5.1.2. Documents for Lifetime. Participants and also Hayes was very satisfied with having documents for lifetime especially, recorded videos of each session. According to participants, especially being able to watch their own videos gave them the chance of remembering what they did or what they think at the moment and be able to watch and catch up whatever they missed during the PD. Not only recorded videos but also high variety of resources were very appreciated. Since many resources could be easily shared online and participants could easily save it in their archives, they were very contented about having OPD.

> R: May I ask why you prefer especially this platform? For example, have you researched its alternatives? There were other options, and did you choose this PD among them or what? Was there any special reason?
>
> Luna: Because here, we were meeting face to face on the platform, and the presentations were in my hands. I have the documents. So, I can still enter and use them. I can still watch the videos by saying "yes we did that". It's a wonderful thing. So, this is really good. This is a situation that I constantly use. I also thought I was taking lessons from really qualified instructors… and as I said, I'm connecting from the house instantly. I learn, I forget, I open it again, I look. Frankly, that's why I chose it.

6.5.1.3. Educational Environment Management. In regard of management of educational environment, Luna underlined that online platform had its advantages. She was so satisfied that in this PD, they followed the syllabus that was presented to them in an exact same weekly order as it was as planned. On the other hand, Luna claimed about face-to-face PD that "I have never seen it was completed as they planned in the face-to-face educations I

went to". It means that there was always something that keep them busy and they could not complete the syllabus that they supposed to follow. This is why, according to Luna, educational environment management was more effective in OPD.

6.5.1.4. Interactivity. As a drawback of having OPD, everybody that was involved in this PD agreed that even in today's technology, interactive tools were not fulfilling real-life counterparts. In other words, it is still far from what is natural. Steve explained this situation as follows.

> Steve: Also, as a participant, I don't know what my peers were doing. So, I saw only names there and I saw the teacher. However, learning is social. I would like to know what X was doing. I would like to ask something to X… In other words, this online education is still far from natural. I think if we want it to be effective, we need to get environment as naturally as possible to be interactive.

For active participation, participants prefer to attend face-to-face PD. They claimed that it is much easier to get participative in face-to-face PD. For example, Eva was one of the participants that were satisfied with having OPD in many other aspects except interactivity.

> Eva: If it was face to face, it would be better because we would have had the opportunity to meet the PD facilitator more. We would interact more with each other [as peers] in the classroom. We would have the opportunity to speak one-on-one with the PD facilitator.

This study's participants proposed that OPD should be more interactive, and better technological infrastructure was needed. For example, for some, it was not comfortable expressing themselves by writing in this content, and for some it would not be very effective if they would talk because it may get chaotic and they would lose their focus and time. As PD facilitator, Hayes stated that he had difficulties to let participants to talk because everybody's voiced get mixed up. Steve was one of the people who stated that better infrastructure is needed for OPD around the world. He proposed that "[Adobe Connect] was designed make the job of the PD facilitator easier. However, it should have been designed

to increase student participation… If you are not a passive listener as a participant, it is not that easy to attend the PD".

In this regard, Ray summarized everybody's opinion in the following statement. "The biggest advantage of the face-to-face PD is to connect with the facilitator, the second is to allow peer interaction and cooperation". According to Ray, bonding is very important for learning. People learn only from the person they are connected with. This is why, all the possibilities of the online sources must be used to reduce the drawback of OPD. Ray specifically underlined the importance of forums as follow-up for OPD to create sharing environment.

6.5.1.5. Content. Even though Nora was one of the participants who attended this PD outside of Istanbul, she was very critical about having this PD online. She insistently claimed that she would have learned better if this PD conducted face-to-face because this content was not proper for OPD. Besides, she would have more interactive with her peers and PD facilitator. According to Nora, since this was one application-based content, it was very hard for her to follow and apply at the same time by using two computers. So, it is important to inform participants how PD will be enacted and what kind of technical tools they may need during the process to ease their experiences.

6.5.2. Secondary School Vs High School Teachers

Exemplary controversial stances for this theme were *ideal option is to open PD as specific as possible* and *different sessions for different grade teachers.*

During the interviews, what amount content knowledge that participants should have was discussed a lot. In this PD, there were both secondary school mathematics teachers and high school mathematics teachers. While Hayes was preparing the syllabus, he considered

both levels and chose examples accordingly because he believed that teachers should have content knowledge in both levels. They should be able to tell what comes in secondary school curriculum or otherwise. According to Hayes, when teachers consider mathematics as whole, they can foresee what their students can possibly do, if enough opportunities are provided to them. Besides, Hayes wanted to make PD syllabus inclusive for each participant.

Among the participants, only Nora disagreed with this opinion. Nora was not satisfied with taking this PD with high school mathematics teachers because PD facilitator should have share examples for both level and she got bored while they were talking about high school topics. She expressed that since she would not use it in her classroom, she lost her attention. Therefore, she would have preferred different sections for secondary school teachers and high school teachers.

> Nora: For example, in our group there were secondary school teachers and high school teachers. For example, in my opinion, it could be taken into consideration while forming the groups. Since there is a subject difference between these two levels, our teacher had to plan one weeks' session for a middle school, and next week's session for high school mathematics topics. For example, it was a bit boring to me. Why? Since I worked in secondary school, I could not apply it in my class. It could be noted that, for example, the groups can be formed among teachers who attend classes in the same level. Or at least it could have consisted of teachers attending secondary school level or high school level only. I can criticize this.

Other participants stated that since mathematics is a whole and it cannot be separated very sharply, it is always useful to proceed in your profession regardless of which grade it concerns.

> Eva: [This was how it should happen] because some students want to learn more math. If we explain advanced level mathematics to them, when they are still in middle school without even seeing the subjects in high school, I cannot even imagine the joy of that child.

Daisy considered knowing about secondary school topics as well as high school as depth in the field.

> Daisy: To be honest, I would want to learn this even though, I won't use it in my classroom… I mean I wish I can use it in my classroom. However, even though I won't use it, I am sure that it will be useful at some point. It is a good thing even only knowing this.

As another standpoint, Steve underlined the importance of having content knowledge in both levels. He stated that "I think a high school teacher should be able to teach secondary school subjects when necessary. Secondary school teacher should also be able to teach in high school. I think that such distinctions should not be for teachers". However, for better and more specific learning, he would prefer opening PD for each level separately, if they had that luxury. He believed that PD would be more effective if content will be as specific as possible. But still, he would expect from both level's teachers to attend these content-specific PDs. In other words, content should be presented specifically but teachers should be eager to learn all of them to develop professionally.

6.5.3. Traditional Vs Modern Instruction

Exemplary controversial stances for this theme were *misunderstanding of different teaching methods, quality standards for popular concepts (e.g., STEM), up-to-date teaching methods, up-to-date learning objectives,* and *importance of block-based coding application.*

This study's participants discussed the issue of what considered as modern or traditional instruction because according to them there is a big misunderstanding in this manner. According to Hayes, there is big difference between explaining mathematics by visual aids or games and explaining concepts by embedding them in digital technology. He explained this situation with one example.

> Hayes: In fact, what we can provide mathematical modeling, that is, simulation environment, is computer, in other words, we refer to real life in this way. Otherwise, the relationship with real life sounds funny to me. For example, it does not seem very real to me that the child divides one apple by two. My two-year-old child also understands this… But you can actually do something through computers so that the half is abstracted and used. This is how, it takes students' understanding to a higher level.

In other words, it does not mean teachers are using new teaching methods by making activities more colorful or using computer aids. It does not necessarily mean that teachers updating their teaching methods just because they used some games or clicked some buttons. In fact, this can be done by pencil and paper. On the other hand, what Hayes aimed was not to teach concepts like gamifying them, but to teach math concepts little deeper. Eva supported Hayes' claim by stating as follows.

> Eva: [They always told us while we were taking courses in the university] 'we should not be a traditional teacher'. But I do not think that the solution for differentiating our teaching methods is to gamify all mathematics concepts because you cannot explain everything with games…[For example] we were actually trying to teach how students can use mathematics while we were preparing our final projects in this PD.

On the other hand, most of the participants presented their motives to attend this PD just as how Hayes was worried. They were associating the coding with mathematics. However, their first proposition for their motive toward this PD was that they were in search of different teaching methods because the new generation does not listen the lesson if classic methods were used. For example, Luna and Nora expressed their motives as follows.

> Luna: New generation kids no longer like tangible things. They want everything digital. It is also very difficult to satisfy them in that sense. When it comes to a very entertaining interface such as Scratch, I wanted to join this PD. So, I wanted to enjoy in the class myself, and I wanted my students to enjoy in the class as well. That's why I attended.

> Nora: Unfortunately, it does not draw any attention of today's students when we apply a traditional education model. I realized that we should associate it with a little more technology and thereby draw more attention of students. That's why, I felt the need to choose this PD.

Therefore, Hayes's point was right on the spot. He wanted to make sure that teachers find new teaching methods useful for their needs, not interested in just because they are new and popular. This is why, he tried to show in what ways block-based coding applications can be useful and improve their teaching.

According to Steve, coding was tried to be involved in mathematics curriculum throughout the history but especially in high school or university level. However, for earlier grades it was almost impossible to encounter any instructional examples before block-based coding applications. Thanks to these block-based codes teachers and students are be able to focus on mathematical concepts not on coding. It is important to keep in mind that here, coding was not a focus, it was a tool for better teaching and learning. It means that the main aim was not become students who are be able to write their own codes like software engineer, it was to make students to be able to express mathematical concepts by using block-based codes. So, it is a way for students to express their own mathematics language and develop their creativity. The fundamental focus is to promote better understanding for abstract concepts that are confusing for students. In this way, students use their computational thinking skills because basically, they use a data processing tool to solve their own problem.

Hayes presented the necessity of coding in current curricula by starting to explain the inconsistencies between current learning objectives and needs of today's world. He stated this inconsistency as "The most of the current mathematics objectives are actually ancient. However, the objectives that you have given by computer are incompatible with the current ones". Thus, in the curriculum, a serious update is required both for the old concepts and for the concepts that have just arrived and are now at the center of modern life. According to Hayes, this PD's syllabus was just the baby step for this huge change.

6.5.4. Paid Vs Free

Although financial issue of PD was not one of the points asked on behalf this PD, it was frequently uttered by Steve and some of the participants.

First of all, both Eva and Luna noticed that free PD programs do not seek the aim of quality education in the first place. They claimed that most of these PDs only advertise products or provide demo lessons. Even some of the paid PD programs also were not

faithfully rigorous. Eva shared that there were so many PD programs provided to earn money because some content was popular at that time. So, there was some reservations among participants, if this would be the case for this PD as well. However, they were very satisfied in this sense because they believed that especially Hayes was very eager to teach.

Besides, all the participants were agreed on they would prefer this PD longer because of the excessive cognitive load of the PD. On the other hand, it was noticed that participants were not aware the cost of each session. In other words, the more sessions mean more expenses. As the PD coordinator, Steve, explained the optimal balance between financial limitations and PD duration issue as follows.

> Duration could have been longer. However, if it goes longer then expenses will go higher. I think if we take time and expense into consideration, this was ideal. I mean I can understand that if we talk three hours [it will be better] but this time the expense will be three times more and it will become unaffordable.

It was realized that participants were not actually aware of what kind of expenses made for conducting one PD. They only take their personal variables into consideration. For example, Luna was very ambitious toward improving herself professionally but, she specifically stated that she would prefer attending PD programs for free.

6.6. PD Facilitator Characteristics

Even though the main research question for this research was not focused on PD facilitator characteristics, the common theme has come up among study participants. As it was presented earlier, ideal PD facilitator perceptions of the study participants who had different roles are be presented according to each role separately.

6.6.1. According to PD Participants

In this section of the findings, perspectives of PD participants over ideal PD facilitator characteristics are presented. Seven themes emerged after the data analysis: (a) competent person, (b) adaptability in the PD process, (c) accessibility, (d) giving high-quality feedback, (e) having classroom experience, (f) creating sharing environment, and (g) eagerness to teaching.

6.6.1.1. Competent Person. Exemplary code for this theme was *being able to reach various resources.*

Without any exception, PD participants defined Hayes as competent PD facilitator. According to participants' overall definition, having extensive PD and discipline-specific content knowledge, being able to reach through various resources, being familiar with the names in the field, and being one of the respected names in the field were the main indicators of being competent PD facilitator. In other words, being well-equipped in the field and being able to open different windows for participants were considered as competency as an PD facilitator. This is why, participants preferred to rely on the expertise of the facilitator, even if they were offered the option to change PD syllabus according to their suggestions. In the following, Eva and Luna's opinion of being competent facilitator in the field is given.

> R: What does it mean to be competent to you? So, when would you say I am competent?
>
> Eva: For example, Hayes is good in this field because he loves what he does so much. He's also doing research. As he conducts research, he learns field more as he meets people. So, these are the competency criteria actually.
>
> Luna: I thought I got PD from highly qualified instructors. I mean, they all have English, they can give examples from foreign sources and they can share international sources.

6.6.1.2. Adaptability. As another characteristic of being qualified PD facilitator, participants proposed that being adaptable through the process was very essential. Even

though participants did not suggest any change in the syllabus, they shared instant feedbacks such as asking for slow down a bit. As one of the main drawbacks of Hayes as PD facilitator, participants expressed that since he was expert on both technicalities and the content of the PD, he processed the PD swiftly in some cases. After participants warned him on that instant, he was be able to alter the speed.

According to participants, not only speed but also syllabus and implementation of the PD was tailored by PD facilitator according to participants' knowledge, interest, and skills over the PD process.

> Steve: I think the teacher personalized his lesson according to our knowledge and interest. He made it personalized and differentiated. He listened to our feedback and talked about it the next week. I think it was very positive in this respect.

Moreover, participants were aware that this PD process was learning process also for Hayes as PD facilitator since this PD was enacted for the first time. For example, Eva expressed that "I think this PD was practiced with us for the first time … I mean, the experience of the first year and the experience of the second year will not be the same for PD facilitator". Eva also claimed that since this PD was also first for Hayes, it cannot be expected to make everything perfect at once. She expects to attend tailored PD based on first years' experience and she is willing to take this PD again in the next year. Steve confirmed this situation as follows.

> Both Hayes was giving this PD for the first time and we are taking PD in this context for the first time caused some troubles … [but] Every teacher knows that if you give a lesson for the first time, you do a lot of things wrong. Let say you have 20 years of teaching experience, if you enter the 6th grade for the first time or give the geometry class for the first time [it will be hard]. These are hard work, not easy.

As a different standpoint, Nora proposed that lesson plans that they prepared as PD assessment material were the main feedback resources for PD facilitator's learning process as well. She considered PD process as learning opportunity for PD facilitator. Therefore, lesson plans were evaluation opportunity for not only participants but also PD facilitator.

She explained this situation as “In fact, he [Hayes] also evaluated himself while taking final projects from us”.

6.6.1.3. Accessibility. Exemplary codes for this theme were *asked what is not understood* and *getting instant response from the PD facilitator*.

Participants agreed on that Hayes made them feel accessible. It means that participants felt that whenever they had questions or encountered a problem, they knew they could reach Hayes. For example, Eva was one of the participants who hesitated the ask any kind of questions to PD facilitator. Even so, she repeatedly shared that “[If I had asked him], I am sure he would have answered”.

Similar statement was expressed by Daisy. She was one of the participants who did not feel any discomfort for asking questions or sharing her opinions. She proposed that since she shared everything that she had in her mind during PD and she had the opportunity to watch videos afterwards, she did not feel any need for getting contact with Hayes. However, she expressed her gratitude toward Hayes’ attitude as “I think the feeling that it could help with any problem and be constantly accessible was enough. If I had a problem, I would have sent an e-mail or reached him”. Also, Nora wanted some additional time for her final project, and she got instant and positive response from Hayes. This shows that it is very important for participants to give them a sense of accessibility.

6.6.1.4. Giving High-quality Feedback. According to participants, getting high-quality feedback was essential part of making assessment worthwhile. All the participants that sent lesson plans to Hayes except Nora got feedback from Hayes. Specifically, Luna and Daisy highlighted that what Hayes gave them as feedback was very clear, specific, and productive. They stated that they did not get only the knowledge of pass or fail on contrary, they got very authentic and practical feedbacks that it may help their instructional implications. This

shows that PD facilitator is responsible from not only conducting assessment but also providing sustainable feedback through participants' assessments.

> Luna: Our progress was also tracked, and we received quality feedback. After he received my project, he did not just tell me if I pass or I got the certificate. Such a feedback came to me: I find it really creative and useful that you have designed a material by using Scratch. Also, it was good that there was a clear and specific feedback.

6.6.1.5. Having Classroom Experience. Exemplary codes for this theme were *PD facilitator as colleague who lived same learning process before* and *probing questions to be coherent.*

In regard of consistency between PD implementation and teachers' classroom needs, all the participants were very satisfied with how Hayes conducted PD sessions. When it was asked the possible reasons for his success in this regard and can it be possibly him having a teaching experience, participants stated that since he was also teacher and had his own classroom experiences with exact same PD content, he could easily share very practical, on topic and coherent examples to make teachers' implications easier. Luna explained this situation as "He evaluated the student approaches in a more pedagogical sense due to his teaching background. In this sense, I find it good. If he were an engineer, maybe there would be more technical information".

Nora underlined that Hayes was able to ask probing questions to make connections between mathematical concepts and coding examples. She expressed her gratitude as "In fact, he was someone who met the exact criteria, that is, the profile I would like to see. So, I think it was a great advantage [for us] him being a teacher and apply such a thing". Also, Steve and Daisy were appreciated taking this PD from someone had teaching experience and colleague as teacher instead of taking it from some academician. Daisy stated that "Week by week, while Hayes was planning content of the PD, he prepared PD content in a very good way how we can integrate it in the subject".

6.6.1.6. Creating Sharing Environment. Exemplary code for this theme was *PD facilitator should encourage to ask questions.*

According to participants, PD facilitator is responsible from creating safe sharing environment during PD. For example, as one of the main deficiencies for this PD, Eva repeatedly stated that she would want to get interaction with her colleagues.

> Eva: We did not get in contact with other participants. I did not know them.
> R: Should it be?
> Eva: Yes, we should have got in contacted.
> R: How?
> Eva: I do not know. PD facilitator can create this environment.

Nora and Daisy proposed that Hayes encouraged them to ask their questions and tried to activate participants. In this regard, according to Nora, participants chose to be passive. According to Daisy, since everybody was trying to catch up with what was done and deal with the technicalities of coding applications, participants could not find time to get interacted. Low interaction level stem from cognitive load of the PD not because of Hayes.

On the other hand, according to Steve, even though Hayes asked probing questions and triggered them to share, he could have done this more elegantly.

> Steve: I have to be encouraged. I think it was one of the shortcomings of the teacher. Encouraging us to ask questions, he did though ... I don't know. I feel like he could do more. For example, the teacher was teaching, speaking, speaking, and suddenly asking one question, okay? On the other hand, I was 10 minutes late. I was just trying to follow the previous example, that code. So, I need to understand the question first, then answer. It was very difficult. Because he was using the buttons very fast… I mean my learning was happening much slower than the speed of the teacher. Hayes was not very aware of this…. Perhaps the teacher could encourage us a little more, he could let us talk more.

6.6.1.7. Eagerness for Teaching. In general, participants were very convinced by Hayes' attitude toward teaching. They repeatedly implied that how much he was trying to teach

them everything in the field. This is because, the content of the PD was very intense. They were very satisfied with Hayes' sincerity toward teaching and learning. Daisy specifically stated in her written feedback that "I wrote how much Hayes was willing to teach. I always talked about the lessons passing by him wanting to teach us more". This shows that teachers' willingness toward learning and teaching also reflects on participants' attitude. Thus, it is essential for PD facilitators to really want and like what they do.

6.6.2. According to PD Coordinator

In this section of the findings, perspectives of PD coordinator over ideal PD facilitator characteristics are presented. Five themes emerged after the data analysis process: (a) keeping it open mind, (b) authority in the field, (c) authenticity, (d) iterative process for PD facilitator, and (e) adaptability through the PD process.

As starting point, Steve thought that being PD facilitator should be regarded as separate profession because it necessitates many skills. As an authority on deciding on PD facilitators of the Advanced STEM courses, Steve mentioned some underlining points for which characteristics were taken into account. Obviously, these characteristics were the key criteria for reaching through successful PD facilitators.

6.6.2.1. Open-minded. Exemplary code for this theme was *understanding theoretical framework.*

First of all, since these OPD programs including Block-based Coding Applications PD were carried out under one big project which is Integrated Teaching, Steve wanted to find openminded and approachable PD facilitators who were ready to learn something new. Steve explained this process as "Firstly, in two or three separate meetings with Hayes, we talked about what kind of group of teachers he will encounter, who will take this PD and what they

will know about STEM teacher integrated teaching framework". After these meetings, Steve aimed to understand if they are conceptually in the same page or not. Basically, Steve wanted to work with PD facilitators who had collaborative skills and did not possess strong prejudices.

6.6.2.2. Authority in the Field. Exemplary codes for this theme were *sincerity toward sharing* and *available for the workload.*

As another criteria, Steve highlighted that PD facilitator should be respected in his/her field. In other words, this person must have authority in the subject matter. In this respect, both Steve and participants could be able to count on his knowledge on the content. Steve gave some examples in specific to Hayes' situation as follows.

> For example, Hayes was a completely outsider about the project, but he had 3 or 4 books on Scratch ... He is already accepted as an authority. When the participants searched for his name on the internet, they will see that he had written five books about.

Additionally, Steve underlined that PD facilitators' priority should be their participants not their career. In this respect, Steve considered Hayes very sincere toward teaching and sharing his professional experience with his participants. Steve underlined that Hayes's priority was always being helpful for his participants in any respect. Besides, since planning PD and allocate time for participants requires serious amount of time, being able to reach who is ready and available for the workload of the PD was very essential. Hence, PD facilitators' attitude and work schedule were one of the main regarded points while deciding on PD facilitator.

6.6.2.3. Authenticity. Exemplary codes for this theme were *having classroom experience, teach how you teach,* and *treat as colleagues.*

As one of the most important characteristics of successful PD facilitator, having the similar classroom experiences on the content and being able to share these experiences with the participants were underlined by PD coordinator.

> Virtually everyone involved in the project is made up of people who have smell of the class and have teaching experience. In this way, we think that we can speak the language of the teacher and we can reach the teacher better.

This statement underlines specifically two important points. Firstly, Steve believed that if PD facilitator has a classroom experience then, s/he be able to give specific examples that directly relates to practical issues of the PD content. In this way, coherence of the PD can be raised. Steve explained this thought as follows.

> We believe that it will be more beneficial if you [PD facilitator] share with practical examples as much as you can in the way of how you teach in the classroom – this is very important – if you teach these experiences and methods as you teach.

Secondly, Steve believed that choosing PD facilitators among teachers who have classroom experiences will decrease the top-down instruction. PD become more empathetic and practical.

> We reminded that your participants are not your students but your colleagues. I think this contributed to be a friendly and sharing environment. There has never been a conversation from the top. We have paid particular attention to the PD facilitators who will not be so while we were choosing these PD facilitators.

6.6.2.4. Iterative Process for PD Facilitator. Exemplary codes for this theme were *experience as teacher facilitator* and *OPD needs multitask expertise.*

Steve repeatedly underlined during the interview that PD process was learning process for PD facilitator as well as participants. Since this was the first experience for everybody, he claimed that there are many things to learn for everybody. This is why, he considered PD

as iterative process for PD facilitator. In this regard, Steve expressed that "We think it [PD] will be much better as they [PD facilitators] learn from their experience".

Additionally, according to Steve, giving OPD requires multitask expertise. This also takes time for to get used to. For example, since this was Hayes' first time to give OPD, naturally some flaws came up. However, according to Steve, like any other drawbacks, with time and expertise, these flaws will cease to exist. Steve explained this situation as follows.

> Project the slide. Take a note on it. Let the student see it instantly. Let the student speak. These are nice. It requires certain expertise though because you need to look at many things at the same time … So, he had to concentrate on three or four things. However, in the classroom, the teacher only concentrates on the subject. When the teacher looks at the student's eye, s/he can understand whether the student understands or not.

6.6.2.5. Adaptability. Steve was very appreciated Hayes was being adaptable through the PD process. It means that Hayes was be able to be flexible about PD syllabus, implementation, and chosen examples. Before PD, as PD coordinator, Steve asked from PD facilitators to prepare syllabus for the PD but not very strict. In other words, this syllabus should be able to be adopted and modified according to participants requests' and needs. Steve used the words "principled" and "flexibility" to explain this case. As it turns out, according to Steve, Hayes succeeded this suggestion.

6.6.3. According to PD Facilitator Himself

In this section of the findings, perspectives of PD facilitator himself over how to become PD facilitator are presented. When he was asked about the advice for the PD facilitators who will provide PD in this content, he mentioned some important points to consider. Three themes emerged after data analysis process: (a) becoming competent person in the field, (b) experienced in the same process, and (c) sincerity toward teaching.

6.6.3.1. Becoming Competent Person in the Field. First of all, in his journey of becoming a PD facilitator on the content of block-based coding applications, he underlined 3 important steps which are noticing the need for learning, being responsible from his own learning and continue through the learning process for a lifetime. Firstly, he internalized the importance of the content for the educational contexts.

> R: How did your process of being interested in with block-based coding practices begin? Can I learn this process?
>
> Hayes: For example, you explain the student the concept of fraction, or very simply, that is, you will explain the additions of integers. But beautify as much as you want is still a conventional teaching. So even if you beatify it with activities, your way of telling, your way of explaining can be more fun, but it is no different. And what you are going to explain is only, I am saying 'only' because students encountered the minus concept since fourth grade. For example, in sixth grade, even though the child is familiar with the concept for two years, s/he cannot move forward. There is a problem we all share. Let say the child in seventh grade. The child will operate in integers, s/he cannot… Or we start a fraction in elementary school, in second grade, if I know it right, but we can't teach it. The child can't add fractions because s/he didn't actually understand what fraction is. I wondered what we can do a little differently in this process. Are there any other examples in the world? What can they do? I had an interest in programming in my childhood. I saw this platform called Scratch.

After embracing its necessity for classrooms, he became the person who was responsible from his own learning process. He stated that he learned everything from the internet by attending online courses, following lead names in the field, and revising existed projects. In this way, he learned how to make existed studies, later find his own path, and started to create original work. In this way, he became competent in the content of integration of block-based coding applications into mathematics lesson. He even started to write books on the topic.

> R: Did you attend any PD on this content? Besides of your own interests and pursuits.
>
> Hayes: I have gone to small things like, when I saw the education of ÖRAV [Teachers Academy Foundation], for example, I have gone to that, but I can say that I got the real knowledge on the internet. I follow on the internet. So, I'm still following YouTube. I am still following the lessons in Edx. I follow Coursera. I'm moving forward over there.

Furthermore, he stated that learning process for him never stopped. So that, he still follows the current trends, news, and respected names in education and continues to improve

himself. In fact, he considers this PD process as learning opportunity for not only participants but also for himself. He stated that "I, Myself, learned with this PD as well. With this PD, I entered the sites I have never been entered to. I did a research with this PD. So, in this regard, we had a learning adventure together [with participants]".

6.6.3.2. Experienced in the Same Process. As one of the main factors that helped him during his being PD facilitator, he highlighted the statement of "I went through the same journey". It means that since he went through exact same learning process by himself and then applied in his classrooms, he had many experiences to share with his PD participants. In this way, according to Hayes, he was be able to approach more empathetically, and more considerate. Also, he was be able to share more practical and on-purpose examples with his participants. He was hoping that these sharing will ease teachers' implementation processes. So, he advices for PD facilitators to share the experience that their PD participants will go through beforehand.

6.6.3.3. Sincerity toward Teaching. Since one of Hayes's main goals was to increase teaching and thereupon teachers' quality, he claimed that he tried his best effort to be useful for them. This was one of the most appreciated characteristics of him as PD facilitator by both participants and the PD coordinator. Hayes explained his process of joining this PD project as follows.

> Hayes: I did not know Steve beforehand. I met with him through this PD… He mentioned this integrated teaching project there. He explained its goals. At that point, because it seemed reasonable to me, because I foresee that this might have effects in the long term… [this is] why I gave this PD. [I felt] there might be something here, in the long term, these teachers can contribute to education. That's why, I have volunteered to be part of the project.

This statement was very consistent with what PD participants claimed about Hayes was being sincere toward his sharing and teaching approach.

7. DISCUSSION

This study aimed to discover high-quality PD characteristics from perspectives of one particular PD's coordinator, facilitator, and participants. It might be good to remember that this study had the qualitative nature thereupon its implications work better for in this study's PD context or similar contexts. Since it had limitations for generalizability, it might be more helpful if findings of this study would be considered with its context.

This section of the study deliberates the data which was focused on what constitutes as effective PD characteristics for people with different roles involved in a PD. In this regard, it intended to determine in what ways their perspectives corresponded to the previous studies. Furthermore, it aimed to discover to what extent it supported or extended the literature. For example, each element of *consensus view* – content, duration, collective participation, active learning, and coherence – was confirmed by this study's findings. Other than *consensus view* PD characteristics, this study discovered some new insights in regard of effective PD characteristics. Even though, these findings might be specific to this PD context, still they may contribute new approaches to the field.

The outline of this section was structured according to commonality of themes that were asserted by different PD roles. First, themes that were asserted by every PD role – content, duration, teaching philosophy and scope as purpose, and PD venue – are presented. Second, themes were asserted by two of the PD roles – interactivity, cognitive load, sustainability, and iterative process – are presented. Finally, assessment theme that was only discussed among PD participants is speculated.

Other than discussing high-quality PD characteristics, comparison of online and face-to-face PD was investigated and lead to new findings. In a nutshell, this section provides the examination of high-quality PD characteristics and online and face-to-face PD dichotomies.

7.1. Content (Participants-Coordinator-Facilitator)

Everybody who was involved in this study underlined the importance of *content-focused* decisions. This implies that in this context, PDs might be more efficient if decisions about a PD would be shaped around content. This finding may be considered as consistent with the existed literature of learning theories (Ball & Cohen, 1999; NRC, 2000; Putnam & Borko, 1997) and effective PD characteristics (Borko et al., 2010; Darling-Hammond et al., 2017; Desimone et al., 2002; Desimone, 2009; Garet et al., 2001; Yoon et al., 2007). Because what will be learned is the content of the PD, it is suggested that it might be viewed as essential to design PD that is focused on subject matter (Bransford et al., 2007; Darling-Hammond et al., 2017; Desimone, 2009; Garet et al., 2001; Guskey, 2003; Kennedy, 1998; 2016; Yoon et al., 2007).

This study's participants highlighted two important aspects of content: (a) being coherent with classroom needs and (b) being informed by diverse sources and examples about PD content. As one addition, PD participants mentioned about the importance of syllabus for the content. They proposed that it was useful to be notified what to expect from PD by having syllabus of the PD beforehand. Furthermore, being consistent and following the syllabus as it should be were considered as useful. This shows that under this context of PD, syllabus helped PD participants to foresee their learning process and reduce the uncertainty.

This study's PD participants, and many studies in the literature suggested to set clear learning goals (Cheawjindakar et al., 2012; Guskey, 2000; Loucks-Horsley et al., 2009). In the regulation of learners' knowledge, the first step is considered as planning (Brown, 1987; Kirbulut et al., 2016). Planning mainly refers deciding on goals and how to reach them. Therefore, it would be reasonable for PD participants to expect to know what they will encounter in the PD.

Aside from viewing syllabus as foresight over what to learn, PD participants gave some clues over which activities from syllabus worked better for their classroom activities. They claimed that they tended to use examples that they really internalized and comprehended. In addition to internalization, they also shared that they used what they learned when they needed it. Therefore, these findings may represent that if the syllabus would be prepared according to teachers' classroom needs and if participants would be well-convinced over the benefit of what was thought with its reasons, they may tend to use the knowledge more. Thompson and Zeuli (1999) calls it as *cognitive dissonance*. It means that creating curiosity in teachers' existed practices and later on turn participants into active practitioners of what was thought which is called *dissonance-resolving*. In this context, even though PD participants had some level of curiosity and need for learning toward PD content, it was also considered essential to make them satisfied with their learning. This finding might be viewed as relatable to existed learning theories as well.

It is important to remember that if learning concepts with understanding would be accomplished contextually, this knowledge might probably be transformable into new situations, help learners to build meaningful connections, and lead to solve unfamiliar problems (Carpenter & Lehrer, 1999; Crain, 2005; Fishman et al., 2005; NRC, 2000; Putnam & Borko, 2000). Once learners become able to organize their knowledge and make them well-structured, they may easily retrieve this knowledge whenever it is needed (Carpenter & Lehrer, 1999). Therefore, other than feeling necessity for learning, it could be better if learners would be convinced by the value of what is learned. If teachers would be convinced and well prepared, positive results might possibly be obtained from students as well. Just as expected, the PD participants of this study stated that they saw the positive effects of block-based coding applications on their students in many ways in their contexts.

According to PD participants, not only their students but also, they professionally improved with the usage of block-based coding applications. It was claimed that once PD participants became to be able to use block-based coding applications smoothly and move forward in their field, their confidence toward their field and profession has risen. With more

confidence, it was proposed that they started to affect their colleagues in the way of possibility of using different teaching methods. However, it is important to remember that this finding may emerge only within this context.

Within this PD's context, one of the PD coordinators' and facilitators' goal was to raise teachers to become new pioneers in the field even though this goal was not stated or written anywhere. Then, PD participants confirmed this goal was turning into reality by expressing how they started to change their surroundings. This finding might be intertwined with Loucks-Horsley et al., (2009)'s idea that suggests that effective PD might promote teachers to become agents of change and reform. This idea implies that teachers' transformation from being a learner to playing leadership role for their colleagues.

Furthermore, PD participants claimed that some of their prejudices have changed along with they became to be able to use what they learned. For example, it was claimed that they started to stop exaggerating the coding as a field. Now, almost all PD participants believe that coding could be applied most of the levels of curriculum. Along with these improvements in their lives, they were very contented about having more common things to talk about with their students since this PD's content was highly consistent with using digitalization. In similar contexts of PDs, teachers might share similar interests with their students that could ended up with stronger bonding opportunities with their students.

In regard of content is being *coherent* with classroom and real-life needs, the literature brings many strong arguments. It was well-suggested to give content as consistent with curricular learning objectives, current educational reform movements, and classroom needs of teachers and students (Borko et al., 2010; Desimone, 2009; van Driel et al., 2012; Garet et al., 2001; Hawley & Valli, 1999). It is considered essential to embedding PD content in PD participants' situations (Thompson & Zeuli, 1999). It is one of the most emphasized aspect that by the literature (Desimone, 2009; van Driel et al., 2012; Garet et al., 2001; Hawley & Valli, 1999) and this study's participants, PD participants might possibly be more engaged if they would believe what they learned could be adaptable or practicable into their own situations. Besides, this claim shares commonalities with learning theories as given the

content in a related context may lead to construct connected concepts. Therefore, coherent knowledge or learning within context could be one of the key factors for better learning (Cheawjindakar et al., 2012; Fishman, et al., 2005; NRC, 2000; Sawyer, 2005). At this point, all the PD participants were highly satisfied about their PD in their contexts. One of the possible reasons for this may be caused by PD facilitator having classroom experience with the exact same PD content and being able to relatable examples with PD participants.

In regard of content is being as diverse as possible, this study found that it was very helpful for PD participants to find their own paths on the PD content. From very beginning, PD coordinator aimed to provide high range of diversity for PD participants as PD content because he believed that everybody has different need and interests. So, within this context of the PD or in similar contexts, it would be one suggestion to provide everybody what they are interested in and need as much as possible. As the person in the second step of the PD design, PD facilitator also aimed to provide high range of subjects in mathematics and different kinds of examples to increase the relatability of the PD content for everybody. PD participants as those who were in the final stage of PD confirmed the positivity of what the PD coordinator and facilitator aimed to achieve. They claimed that diversity of the content widened their vision over PD content. Also, it was stated that it helped PD participants to have an overall idea over PD content and find their particular interests among all the options. In this way, they claimed that they learned how to move forward in the PD content even after the PD.

7.2. Duration (Participants-Coordinator-Facilitator)

Duration of the PD was one of the main underlining points of effective PD characteristics both in the literature (van Driel et al., 2012; Garet et al. 2001; Loucks-Horsley et al., 2009; Wayne et al., 2008; Yoon et al., 2007) and among this study's findings. Everybody that was involved in PD process highlighted some key points in regard of PD

duration. These aspects can be listed as PD duration as having multiple doses, logistically acceptable, balanced workload, and arranged according to the PD scope.

Having PD more than one session, in other words, abstaining from one-shot PD programs is one of the main emphasized aspects of the duration in the existed literature (van Driel et al., 2012; Garet et al. 2001; Loucks-Horsley et al., 2009; Wayne et al., 2008; Yoon et al., 2007). It was asserted that providing some time would be very useful for PD participants to form their thoughts, apply what they learned, and discuss over it with their colleagues (Borko et al., 2010; Darling-Hammond et al., 2017; Desimone, 2009; van Driel et al., 2012; Garet et al., 2001; Guskey, 2003; Hawley & Valli, 1999; Penuel et al., 2007; Thompson & Zeuli, 1999). Some scholars believe that it would be more on-point learning process, if learners could be responsible from their own learning and have enough metacognitive awareness about what they already know and what knowledge they acquire later on (Brown, 1987; Carpenter & Lehrer, 1999; Hammerness et al., 2007; Kirbulut et al., 2016). To do so, it was suggested that regarded *sustained duration* should be provided.

The same suggestion made by this study's participants. PD coordinator, PD facilitator, and PD participants agreed on that learning could be a process not something magically happens in couple of hours. They claimed that all learners may need some time to get comfortable to be participative, process and work on what was learned during PD sessions and apply what was learned. They repeatedly highlighted that gaining expertise and being able to apply what was learned might take time for everybody. In their special circumstances of the PD, PD participants even suggested to add the assessment process into PD process itself.

The second underlining was that duration is being logistically acceptable. It means that taking in-service teachers' busy schedules might be essential part of deciding on timing. According to PD facilitator and participants, timing could be decided with the PD participants. According to PD coordinator, this PD's timing was arranged by considering in-

service teachers' best hours. He claimed that it was decided according to existed literature, social media usage statistics, and PD coordinator's previous PD experiences. Either way within this context, it was well-suggested to arrange timing and duration of the PD according to PD participants' logistical circumstances.

The third emphasized aspect of the timing was that arranging timing of the PD according to balancing workload of the PD. It means that it might be essential to be aware of learning of the PD content does not remain limited to PD sessions only. Specifically, PD facilitator and participants underlined that it could be better if the duration of PD sessions and the time given for internalizing what was learned during PD sessions were balanced.

The final aspect of duration of the PD which is link between scope and duration of the PD is underlined by one of the PD design consultants and one of the PD participants. However, it could be reasonable explanation to understand why the literature is having hard time to define one standard perfect duration for PDs (van Driel et al., 2012). According to Ray, Daisy, and van Driel et al. (2012), PD duration may vary according to what was aimed to given PD participants in other words scope of the PD. For example, if the aim of training is making everybody to become experts in the PD content then it would take quite a time. However, if the aim is to open a window and teach how to learn and move forward in the PD content then couple of weeks might be enough. Either way, this claim does not propose to conduct one-shot PD, but it says that duration of the PD may vary according its scope.

7.3. Teaching Philosophy & Scope as Purpose (Participants-Coordinator-Facilitator)

Everybody that was involved in this PD mentioned about intellectual, philosophical, and visionary aspects of PD. In other words, from PD participants' point of view this intellectual stance could be called as teaching philosophy of PD facilitator or PD itself. In PD facilitator and coordinator's point of view, this philosophical stance could be called as

PD scope as purpose or vision. It was claimed that this intellectual aspect of PD had an effect of anybody that was involved PD process in its context.

For example, PD coordinator claimed one of his purpose from ITP as meeting 21st century needs, and PD facilitator claimed his purposes from this PD as raising quality of teaching and opening a window for teachers in the field of coding integration into mathematics lessons. These were the purposes that was not written on the syllabus; however, somehow PD participants felt it from PD coordinator's and facilitators' attitudes. Eventually, they confirmed this teaching philosophy as being sincere toward teaching and doing his best to teach them as diversified examples as possible to widen their visions. This might imply that if PD developers would have broad purpose and vision that lies under any decision or action, other than just teaching one content, PD participants may tend to sense that aim and approach PD more positively and profoundly.

As another example, PD facilitator aimed to inspire participants about coding integration into math lessons. So that more teachers could be interested in the field and may become the new pioneers of the coding integration into math lessons. It was claimed that he aimed to reach this goal by providing various sources from various topics and experts and sharing art-related and visually charming examples. PD facilitators' goal was not directly told to PD participants or shared via syllabus. Meanwhile, PD coordinator had the purpose of training teachers to become new PD facilitators of the project. So that ITP as a PD design might sustain itself over time. Later on, during the interviews it was discovered that PD participants confirmed PD facilitators' and PD coordinators' goals were reached. They shared that the catchiest examples for them to remember were the art-related ones. Furthermore, they were very contented about having so many different resources for this PD content. They considered this content diversity as having the road map in their hands in the journey of moving forward in this PD content whenever they want. Even though there is a possibility that this findings may only imply in this context, it may also possible that if PD developers would be sincere toward their goals and take it into action, the audience might sense the sincerity and they work on the PD content as PD developers expect them to.

In the literature, it is possible to encounter some similar arguments as this finding. However, it has never been listed as high-quality PD characteristic instead, it was underlined as something to take into account. For example, Loucks-Horsley et al. (2009) proposed that PD design mostly begins with commitment to a vision to scale up teaching quality thereupon student achievement. So, it may be considered as essential to have philosophical or visionary stance behind setting the learning goals for one PD content or designing the PD itself. Similarly, Guskey (2000) pointed out that intended change could be achieved if it would base on visionary goals behind it. Therefore, this might enable everybody that is involved in the PD process to be aware of reason for taking any action and being committed to it.

As another aspect of philosophical aspect of high-quality PD, PD participants and coordinator proposed that everybody should have opportunity to develop themselves as long as they are sincere toward learning. It was claimed that this was the reason for this PD was having prerequisite for participation which was a writing a motivation letter or being a STEM Leader Teacher – the title that is given after completing eight months long PD over integrated teaching philosophy. It aimed to reach through teachers who were eager to learn. This prerequisite was mostly regarded as positive by PD participants. They were appreciated having prerequisite because they claimed that in this way, every teacher had to chance to move forward in the field they are interested. It might be one suggestion within this context that PD programs could propose selective inclusiveness policy to reach through highly motivated and eager to improve participants.

7.4. PD Venue (Participants-Coordinator-Facilitator)

Venue of the PD is one of the main findings for this particular study. As it was suggested in Cheawjindakar et al. (2012)'s study, OPD would be more successful if they cover five fundamental factors which are (a) institutional management, (b) learning environment, (c) instructional design, (d) services support and (e) course evaluation.

Learning environment factor was the direct refer of OPD Venue that was suggested by everybody that was involved in this PD.

First of all, PD participants proposed that OPD venue would be better if it provides access by using personal account. So that, everybody would have the opportunity for accessing PD sources from there, make a comment and share from there. Since one of the most appreciated features of this particular PD was being able to reach PD materials such as recorded PD videos even after PD, PD participants claimed that having one well-structured platform for OPD may ease the accessibility and usage of the PD sources. Just as participants of this study, also Parsons et al., (2019) proposed that keeping everything under record might be one of the most appreciated features of having OPD. Additionally, according to PD participants and Elliot (2017), OPD venue could be better if it would provide user-friendly and well-thought interface so that everybody could adopt to use it quickly.

As another important characteristic of OPD venue, everybody that was involved in this PD claimed that technological infrastructure of the OPD venue would be better if it provides various communication tools (Cheawjindakar et al., 2012; Elliot, 2017) and continuous synchronized communication. So that, it was claimed that everybody could make contribution in the way of they prefer in that instant moment. Providing various communication tools was also considered as essential to maintain active learning environment (Cheawjindakar et al., 2012; Collins & Liang, 2015; Ginsburg et al., 2004). In regard of synchronous education, the literature mostly proses it as one option for having OPD and its instructional necessities (Bates et al., 2016; Elliot, 2017; Parsons et al., 2019). However, according to everybody that was involved in this PD except one of the PD participants were highly satisfied with having synchronous education because it was proposed that it gave them chance to be more on the moment and active. Otherwise, they suggested that it would become just sit and listen without having chance of stopping the facilitator when there is something unclear. However, again this claim might be only implied to this context or similar contexts of this PD since this was only one PD instance that was investigated.

Additionally, PD coordinator and facilitator proposed that OPD venue could be better if it provides follow-up communication tools such as forums, comment and feedback tools, and discussion panels. In other words, it was suggested that OPD venue as providing any possible interaction tool that exists in today's world to reduce the lack of interactivity which is mentioned as the biggest disadvantage of online education. It was discussed in the literature that combining more than one online format under one course management system, so that it might be take advantage of each format kind (Cheawjindakar et al., 2012; Elliot, 2017; Ginsburg et al., 2004). According to PD coordinator and one of the PD participants, even creating WhatsApp group could be tool to increase the communicative tools and reduce the unnaturalistic side of OPD environment. It was claimed by PD coordinator and facilitator, even today's world of technology, the existed venues that are possibly used for PD were not considered as covering needs of conducting effective OPD.

Final aspect of OPD venue was having optimum number of participants. This finding was suggested by PD coordinator and PD participants. They claimed that in an overcrowded environment this PD could have failed. It would not be realistic to give specific number of participants but, for this particular PD the limit was 10 people and it had seven participants after all, and everybody was quite satisfied about it. According to PD coordinator, number of PD participants, financial optimization of the PD and infrastructure of the learning environment should be balanced. Even though finance issue of PD often disregarded by the PD participants, it was underlined by PD coordinator and Wayne et al. (2008) that increasing the PD hours might come with its expenses. In the same way, reducing the number of participants might affect the budget of the PD design as well. Besides, Cheawjindakar et al. (2012) suggested PD designers to make optimized financial plan to maintain cost effectiveness, in the stage of institutional management while everything was in the stage of planning.

7.5. Cognitive Load (Participants-Facilitator)

As one of the high-quality PD characteristic themes of this study's findings, PD participants and facilitator underlined the importance of balancing cognitive load. Prior knowledge on the PD content is often considered as one of the most effective factors on participants' learning processes and even their interaction levels. Almost all the efforts on understanding learning process leads to one important factor which is pre-existing knowledge (Ball & Cohen, 1999; Loucks-Horsley et al., 2009; Putnam & Borko, 1997;2000). Since it is claimed that all the incoming new knowledge builds on existing ones, pre-existing knowledge is considered as one of the key factors to take into account when learning is considered (Carpenter & Lehrer, 1999; Hammerness et al., 2007; NRC, 2000; Putnam & Borko, 1997; Sawyer, 2005). So, it might be helpful for PD facilitator or PD designers to consider their audiences' backgrounds while they are framing the PD content.

It is suggested that almost every learner comes with different knowledge, beliefs (Desimone, 2009; Fishman et al., 2007; Putnam & Borko, 1997), attitudes, self-efficacies, and motivations toward their learning processes (Bransford et al., 2007; Clarke & Hollingsworth, 2002; Guskey, 1986, 2002; Opfer & Pedder, 2011; Richardson, 1990) or getting education in an online setting (Collins & Liang, 2015; Parsons et al., 2019; Redmond, 2011; Vu et al., 2014). For example, for this particular PD, there was a new technology that most of the PD participants were not familiar with. According to Collins and Liang (2015), this might be one of the most basic obstacles for PD participants. Besides, some participants expressed their prejudice toward learning coding because they believed it would be too complicated. This is because it took time for them to get adapt to use tools of the application and comprehend the mathematical aspects of coding like PD facilitator did.

However, according to PD participants' observations, PD facilitator was not much aware of this effect on PD participants' cognition. Thus, PD participants sometimes could not catch up what was taught on the screen and they had to watch recorded sessions over

and over again. As another case, there was also one participant who had high-self efficacy because of his background with coding implications in mathematics lessons and he was the one who participated actively. This finding may only imply into this particular PD, there is also possibility for occurring in other settings.

In conjunction with prior knowledge, arranging amount of content was considered as essential side of cognitive load. If the prior knowledge on the PD content manner would be low, then amount of content is suggested to be balanced accordingly. At his point, recording sessions played a key role for this particular PD. Since PD participants had to chance watch their own recordings over and over again, according to PD participants' claims, missing some part of the PD content did not become a big problem. This is why, all the PD participants without any exception, claimed that they could not have learned this much if the PD sessions would not be recorded.

7.6. Interactivity (Participants- Facilitator)

Another important characteristic of high-quality PD was indicated as inducing interaction level as high as possible among people who were part of PD. It means that the person is either PD facilitator or PD participant, it was viewed as essential for PD participants to get interactive to reinforce their learning. To do so, PD participants claimed that attending PD with they were already familiar with could be helpful. Since they would have already something in common it is either branch, school, or same students, they could have more chance to get interactive with each other and have more common points to discuss about. This exact finding was already asserted in the existed literature as it is called *Collective Participation* (Borko, 2004; Desimone, 2009; Garet et al. 2001). They proposed that most probably the more teachers have common strands, the more their participative level increases. This is why, it might be better if they would be encouraged to attend PD as teachers who have something in common (Borko et al., 2010; Darling-Hammond et al.,

2017; Guskey, 2003; Little, 1993; Loucks-Horsley et al., 2009; Penuel et al., 2007; Wayne et al., 2008).

PD participants claimed that same condition was valid for familiarity with the PD facilitator as well. One of the PD participants specifically stated that participants who knew PD facilitator beforehand were more interactive because they were more comfortable to share. At this point, PD facilitators' 0th week suggestion came into view. In this way, it was suggested to make possible for participants get to know each other and PD facilitator. Besides, they might have the chance of reflecting their motivations toward attending the PD and giving information about their backgrounds for the PD content.

Another important aspect of increasing interaction level was suggested as creating safe and comfortable environment for PD participants. This finding was also very underlined point of existed literature as it is called *Active Learning* (Desimone, 2009; Garet et al., 2001). It is important to keep in mind that PD facilitator mostly had the key role to encourage participants to open sharing by asking probing questions, starting leading discussions, and approaching empathetically based on their experiences (Desimone, 2009; Garet et al., 2001; Loucks-Horsley et al., 2009). Specifically, two of the PD participants asserted that creating safe and comfortable environment is essentially PD facilitators' duty.

In addition to all, it was claimed that readiness for the PD content was another effective factor for PD participants' interactivity levels. This observation was made by PD facilitator as the more participants were familiar with the concepts, the more their interactivity rise. PD participants, on the other hand confirmed this observation as mentioning one of the possible reasons for their hesitations to become participative was that being completely new at the PD content. Here, the importance of prior knowledge was highlighted again (NRC, 2000; Putnam & Borko, 1997). PD participants' background might an immense effect on their level of active participation.

7.7. Iterative Process & Sustainability (Coordinator-Facilitator)

It was discovered that PD design should progress iteratively. It means that every single experience and source should be valued for further endeavors. For this particular PD, PD coordinator started his project and PD facilitator started his PD design by making research over existed works, literature and discussing with the experts in the field. PD coordinator even observed classrooms and made discussions with teachers. PD facilitator on the other hand, proposed that for next year, he wants to conduct 0th week so that he can make brainstorms with PD participants first. This is the first step of what was meant to be explained from moving iteratively. This is also the first step of what was referred as Instructional Management in Cheawjindakar et al. (2012)'s study. It includes making need assessment, forming the scope of the PD, and finally making operational plan that is embedded in overall teaching framework.

According to both PD coordinator and facilitator, it is very significant to give value of previous experiences that other people had. After designing and while conducting PD, same iterative process should maintain by being flexible through the process based on audience reactions and keeping record of documents to create documentation. As one example of preparing documentation for sustainability, as it was suggested in Cheawjindakar et al. (2012) and Vu et al. (2014)'s study, the frequently encountered problems sheet was prepared in regard of getting PD in an online format and PD management system which is Adobe Connect.

In the literature giving value to teachers' opinions was specified as well (Hawley & Valli, 1999). Since they are the learners of the PD, their needs, opinions, and expectations quite worthwhile. This is highly consistent with what PD facilitator aims from 0th week implication. This is why, it is highly important to determine scope of the PD as a vision or goal should be primarily based on learners (Guskey, 2000; Loucks-Horsley et al., 2009). However, it was also notified in this study's results that collaboration with experts in the

field and being aware of past and current PD activities is important to be able to progress by making count of previously gained experiences.

According to PD coordinator, this whole process will induce sustainability through time. Making count of every little data was collected during PD design and implementation will lead designing better ones. In this manner, PD coordinator claimed that having structured but flexible format will ease moving forward based on previous experiences process. Besides, any documentation that will be passed on to future generations will help them to design and conduct evolved PD programs.

In the literature, *sustainability* often mentioned with duration of the PD (Darlin-Hammond et al., 2017; van Driel et al., 2012). It was preferred in this study to open new discussion title because it is not limited only the durational aspects. It is a well-accepted fact that PD should be a sustained and ongoing process (Borko et al., 2010, Darlin-Hammond et al., 2017; van Driel et al., 2012; Garet et al., 2001; Guskey, 2000; Wayne et al., 2008). So that participants can internalize the whole process mentally and practically. However, there is also visionary stance of the sustainability and maintaining iterative process. At this point, Loucks-Horsley et al. (2009)'s approach toward sustainability is similar with this study's findings.

This aspect of sustainability is highly regarded with following discussion title which is teaching philosophy and scope as purpose and vision. It is a well-accepted fact that making an educational reform or changing a vision does not happen so quickly. On the way of accomplishing the change, participants need constant guidance and support (Guskey, 2000; 2003; Hawley & Valli, 1999; Loucks-Horsley et al., 2009; Thompson & Zeuli, 1999) because only the continuous learning and improvement results in change (Clarke & Hollingsworth, 2002; Guskey, 1986; Loucks-Horsley et al., 2009; Richardson, 1990). To maintain this support, it is very essential to provide learning environment that participants can count on and get a sustainable education or help. Therefore, the main idea is to maintain

ongoing and sustainable PD system until broader scope or vision of the PD will be accomplished. To provide such an environment, it is suggested to save documentation for upcoming PD designs and moving iteratively.

7.8. Assessment (Participants)

As one of the characteristics of high-quality PD, PD participants highlighted different aspects of value of assessment. First of all, they asserted that preparing lesson plan as PD assessment output gave them chance to apply what they learned and get a reflection over it. It is important to remember that as a final step of regulation of learners' knowledge, evaluating includes making judgments on their own learning (Brown, 1987; Kirbulut et al., 2016). Being aware of their own learning stages and reflecting on them might turn learners into more active and this leads their construction of knowledge process sustainable (Kirbulut et al., 2016). In this manner, according to PD participants, preparing lesson plans worked very good for their learning to regulate in their PD context.

Using lesson plan as assessment output might also be consistent with the *Modelling of Instructional Strategies* effective PD characteristic that was proposed in the literature. In this particular occasion, instead of providing the instructional strategy model as a concrete material, it was asked from PD participants to create one. In this way, they might have the chance of visualize some of their abstract thoughts based on what they learned in the PD (Borko et al., 2010; Darlin-Hammond et al., 2017; Yoon et al., 2007). In this context of the PD, it was asserted that since it was asked from PD participants to prepare a lesson plan that would be applicable in their situations, teachers even could get to apply what they prepared. This finding might imply what was suggested by some studies in the literature (Borko et al., 2010; Penuel et al., 2007; Thompson & Zeuli, 1999).

However, while maintaining assessment process, PD participants expressed that they sometimes had difficulty to understand what exactly was expected from them, even though

it was told. They proposed that they would prefer having rubric under their hands. In this way, they claimed that they could be clearer about what was expected from them. It was discovered that in this context of PD, the PD participants prefer to be open and clear toward them in every manner. It might be better reducing the ambiguity toward PD participants.

As another important underlining aspect of assessment, most of the PD participants asserted that PD could have much more effective if assessment process was included in PD duration. In this way, they claimed that they could have chance to give feedbacks other participants' lesson plans, get feedback for theirs, get more creative ideas from their colleagues and PD facilitator, and discuss over their assessment materials during synchronized PD session. So, according to PD participants, it would be more beneficial for reinforcing their learning processes. The same suggestion was made by some studies in the literature (Darling-Hammond et al., 2017; Guskey, 2003) as *Inclusion of Evaluation*. These studies claimed that discussions over what was made by PD participants as an assessment output could be more beneficial for their learning processes than just receiving feedbacks by their PD facilitators. It could be important to underline that forming metacognitive activity might require being critical about themselves and also others (Kirbulut et al., 2016).

7.9. Online Vs Face-to-face

One of the most controversial issue on this study among study participants was OPD versus face-to-face PD discussions. Even though interview questions were not including anything specific for comparing these two types of PD, study participants tended to discuss over OPD programs' advantages and disadvantages. This is why, this particular PD dichotomy element added into discussion as well.

Alongside the current literature, this study also found some well-established comparison points between online and face-to-face PD. These points can be listed as accessibility, interactivity, and educational environment management. From these three

points, specifically accessibility and interactivity were the most highlighted controversial points. Everybody that was involved in this PD asserted accessibility as pros of OPD and interactivity as cons of OPD.

First of all, according to study participants, accessibility contains different aspects. As first aspect, having OPD might give chance everybody no matter where they located to attend PD. This was already well-accepted argument in the literature. One of the most important advantages of OPD that serves teachers' lives is its accessibility for everybody (Collins & Liang, 2015). According to PD facilitator and coordinator, this was viewed as important development for reducing the inequivalences between different regions of the country or even world. For example, in Turkey's context, there is huge socioeconomical gap west and east regions of the country. However, OPD opportunities are considered as the baby steps of a high-quality education equality. So that, any teacher who is motivated and curious enough to learn and improve professionally would have a chance to get education over it.

As a second aspect of accessibility, study participants proposed that even if face-to-face PD is conducted in the same city that they were located, it would be always challenging to spend time on the way of PD. For example, in Istanbul context, it is a big challenge to catch up somewhere right on time in rush hours. PD participants claimed that since they are in-service teachers, it would be quite hard to save some time for PD from their already busy schedules. This could be considered as highly consistent what many studies proposed (Bates et al., 2016; Dash et al., 2014; Dede et al., 2009; Elliot, 2017). This was viewed as one of the reasons of why OPD evolved (Collins & Liang, 2015; Dede, 2004; Vu et al., 2014). As an additional strand, PD participants asserted that since they usually could not get any support from their institutions, it would get even harder to find time for PD. It was proposed that getting support from the institution or administers might have a serious effect on teachers' motivations for attending PD (van Driel et al., 2012; Loucks-Horsley et al., 2009; Penuel et al., 2007).

Furthermore, importance of online education in our lives was realized once more, after COVID-19 outbreak. Everybody had to stay home and complete their studies or works from home. As one of the biggest advantages, accessibility feature of online education provided many opportunities to people throughout the world. It might be one of the most important realization points of importance of online education. Therefore, online learning settings including OPD would be more efficient if they are studied more.

PD participants expressed that they could attend the PD anywhere they want on that time and day with OPD opportunities. This is why, at the very beginning, they asserted that they searched for an OPD to attend. Only one PD participant was not agreed with the timing of the OPD even though she was located outside of Istanbul. She claimed that since it was in the weekdays and in the evening time, she had hard time to fully comprehend the PD content. But still, she was appreciating accessibility of OPD.

Second biggest discussion point of having OPD was interaction-related issues within this context. Everybody that was involved in this PD has agreed on that electronic environments are still far from what is natural. In other words, if getting participative and feeling comfortable enough to share is a challenge for participants in face-to-face PD, it would be even harder in OPD. PD facilitator confirmed PD participants' this assumption as stating he was the active person who talks all the time. On contrary to what was suggested in the literature (Carey et al., 2008; Dede, 2004; Elliot, 2017; Treacy et al., 2002; Trust et al., 2016), interactive issues of OPD did not provide any favor to this study's PD participants. So, for this particular PD facilitator claimed that he was the teller which was the exact opposite of how active learning was suggested to occur (Darling-Hammond et al., 2017). However, since he was aware of this problem, he stated that he intended to work on it in the following years.

In the literature, it was proposed that OPD could provide many interactive opportunities to participants such as creating online communities (Carey et al., 2008; Elliot,

2017; Treacy et al., 2002; Trust et al., 2016), getting instant help from these communities in any time and place (Bates et al., 2016; Carey et al., 2008; Fishman et al., 2013; Trust et al., 2016), and serving more comfortable learning environment for those who prefer to be silent and shy in the face-to-face PD (Dede, 2004). According to some studies, OPD serves better for self-directed learning. They argue that teachers might learn with their own pace (Albers et al., 2015; Beach, 2017; Elliot, 2017; Prestridge & Tondeur, 2015). This is why, interactive tools of OPD also could work on-demand. In other words, if PD participants are willing to learn, then they could reach through on-purpose examples for their particular circumstances (Bates et al., 2016; Beach, 2017; Carey et al., 2008). However, this OPD was not totally based on unstructured and self-directed learning environment. So that, it might be considered as reasonable for participants to demand for some initiatives for interaction.

In this manner, PD coordinator, facilitator, and participants suggested that every possible communication tool that is available should be used during OPD to maximize interactivity sources. They also added that further OPD venues should provide environment that offers active participation opportunities for not only PD facilitator but also PD participants since they are the learners of that educational environment. However, these suggestions do not necessarily mean that they imply for every OPD.

Even though many variables for PD participants to be shy and hesitatant to share other than not having enough opportunities in OPD environment were proposed, still there might be need for many works in regard of designing efficient OPD venue. In this manner, PD coordinator believed that PD facilitator has the hardest work. He asserted that conducting OPD necessitates multitask expertise such as following the sessions, following participants' actions, asking probing questions and at the same time enabling them to participate by following whether they want to ask or share something. So, it may take some time for everybody to get used to since face-to-face and OPD systematically work in different ways (Elliot, 2017; Prestridge & Tondeur, 2015). At this point, some of the PD participants, PD coordinator and facilitator suggested to include follow-up communication tools such as forums or WhatsApp groups. So that, those who could not find the opportunity to share or

points could not be discussed during PD sessions would be went through. So that it may come one step closer to what was considered as natural and comfortable environment for learning.

Finally, as one of the discussion points of OPD studies, question of having OPD without facilitator (Albers et al., 2015; Beach, 2017; Prestridge & Tondeur, 2015; Treacy et al., 2002; Richardson et al., 2017; Wynants & Dennis, 2018) was not quite answered and remained open to debate under this study. For some studies, it would be better without facilitator since OPD serves better for self-paced learning (Albers et al., 2015; Beach, 2017; Prestridge & Tondeur, 2015; Wynants & Dennis, 2018). On the other hand, for some, it would be better if it would be triggered by PD facilitator (Prestridge & Tondeur, 2015; Richardson et al., 2017). According to this study's findings, PD participants were highly satisfied with having competent person as PD facilitator. Some of them even mentioned efforts for learning the exact same PD content by themselves but they stated that it would always be easier to learn someone who is more knowledgeable and experienced.

8. CONCLUSIONS AND IMPLICATIONS

In this study, some of themes that were considered as high-quality PD characteristics were already repeatedly emphasized by many studies in the furtherance of the *consensus view.* For example, PD as being content-focused (Borko et al., 2010; Bransford et al., 2007; Darling-Hammond et al., 2017; Desimone, 2009; Garet et al., 2001; Guskey, 2003; Kennedy, 1998; 2016; Yoon et al., 2007) with coherent examples and applications (Borko et al., 2010; Desimone, 2009; van Driel et al., 2012; Garet et al., 2001; Hawley & Valli, 1999; Thompson & Zeuli, 1999), PD conducted with sustained duration (van Driel et al., 2012; Garet et al. 2001; Loucks-Horsley et al., 2009; Wayne et al., 2008; Yoon et al., 2007), PD as inducing active learning environment (Desimone, 2009; Garet et al., 2001; Loucks-Horsley et al., 2009), and PD as reinforcing collective participation (Borko et al., 2010; Darling-Hammond et al., 2017; Guskey, 2003; Little, 1993; Loucks-Horsley et al., 2009; Penuel et al., 2007; Wayne et al., 2008) are viewed as main elements of effective PD in the literature. Thus, within this study's context, these characteristics were considered as important and underlined by study participants.

However, some characteristics that was found in this study were not as much focused as *consensus view* characteristics in the literature. For example, in regard of content, being clear to participants and setting clear learning objectives before PD even started was one of these findings (Cheawjindakar et al., 2012; Guskey, 2000; Loucks-Horsley et al., 2009). To prevent, any kind of confusion or unclarity, it was suggested by PD participants that clearly stated syllabus could be presented before PD starts. As another PD characteristic, balancing cognitive load for PD participants was considered as essential in this study. Even though, importance of prior knowledge was emphasized by many studies (Ball & Cohen, 1999; Carpenter & Lehrer, 1999; Hammerness et al., 2007; Loucks-Horsley et al., 2009; NRC, 2000; Putnam & Borko, 1997; Sawyer, 2005), this characteristic was generally not added the effective PD characteristics. It might be possible that it can be approached as important

since it was already emphasized in the literature and this study also found its importance. Besides, it was suggested that taking prior knowledge of PD participants into consideration might be important for not only cognitive load but also their interactivity levels.

According to the literature (Collins & Liang, 2015; Parsons et al., 2019; Redmond, 2011; Vu et al., 2014) and PD participants of this study, as one of the most underlined drawbacks of having OPD, learning curve for learning and using new technologies might have a significant effect on participants' cognitive load. Other than importance of prior knowledge on cognitive load, arranging amount of PD content in conjunction with PD participants' backgrounds could be very important compound of cognitive load. Furthermore, it might be reasonable to decide on duration of the PD according to scope of the PD (van Driel et al., 2012). In this context of PD, this finding was clearly stated by the PD facilitator and not enough studies in the literature gives importance this stance of duration, but it might be one aspect to investigate more in regard of high-quality PD characteristics.

Even though assessment (Darling-Hammond et al., 2017; Guskey, 2003) and modelling (Borko et al., 2010; Darlin-Hammond et al., 2017; Yoon et al., 2007) regarded characteristics were emphasized by some studies, the enough consideration was not given before. Within this context of PD, it was found that inclusion of assessment process into PD duration and making PD participants prepare materials that they can use as a model of what was learned during PD would be very important for participants' learning processes.

As another highlighted findings of this study, giving specific attention to teachers' opinions was also underlined in the literature. This suggestion was found as a part of iterative process feature of PD. Additionally, philosophical stance of sustainability was specifically highlighted in the study findings and Loucks-Horsley et al. (2009)'s suggestions over capacity of sustainability. Similarly, it was found that teaching philosophy of the PD or scope of the PD as a vision might have a key role for its efficiency. There are some studies that

suggest it would be a good starting point for PD to frame its scope as a broad perspective (Guskey, 2000; Loucks-Horsley et al., 2009). However, not enough highlight could not be found about this stance in the literature.

In regard of OPD venue, there are some significant arguments in the literature. However, somehow venue or learning environment of the PD was not added effective PD characteristics. For example, technological infrastructure point of OPD venue was the most highlighted factor in this study's findings and the literature suggests almost same arguments. OPD venue could be more efficient if provide user-friendly interface (Elliot, 2017), and various communicative tools (Cheawjindakar et al., 2012; Elliot, 2017) would be provided, and kept every source under record for later use (Parsons et al., 2019). Additionally, according to PD coordinator and one of the PD participants, follow-up multimedia tools might be used for maintaining more interactive and active learning environment. Meanwhile, studies suggested that combining more than one online format under one course management system might increase the possibility of taking advantage of each format (Cheawjindakar et al., 2012; Elliot, 2017; Ginsburg et al., 2004).

Finally, some PD characteristics was found in this study that could not be found in the literature. There is a big possibility that they were not mentioned literature because these findings may be relevant to only this or similar contexts. However, it is also possible that they might reflect on new insights over high-quality PD. First of all, everybody that was involved in this PD were very appreciated of having diverse content. In this way, PD designers aimed to reach as many participants' interests and needs as possible. Meanwhile, PD participants were very contented about having knowledge of different paths in the field to follow, in this situation, different experts, different block-based coding applications or topics etc.

As another overlooked feature of PD, in regard of cognitive load is to balance amount of content according to PD participants' backgrounds on PD content or OPD venue. So that,

participants' cognition could not be reached over its limits. In regard of duration, it was viewed as essential to give attention to PD participants' work schedules and workloads while PD duration was decided. It might be very important to not break out their work routines and put too much work on their shoulders.

In regard of assessment, PD participants expected to know what assessment criteria would be used. Being clear on not only syllabus but also assessment criteria was specifically highlighted by this study's PD participants. It might be safe to say that according to PD participants, being clear on what will be learned and what will be expected might become one of the most demanded PD characteristics in this context.

In regard of moving iteratively, it was underlined that giving importance to each experience and material as data for better PD designs was considered as significant. This is why, at the beginning of PD design, it might be a good start making field research and literature review. For better PD implementation, it was also considered as important to be flexible through the process according to PD participants' reactions, requests, or improvement levels.

High-quality PD characteristic as teaching philosophy and specifying scope as broad purpose was found in this study as a fully new. This finding might imply in similar PD settings. It was underlined by PD coordinator and facilitator that they had their own broader goals other than what was specified in the PD syllabus. According to PD coordinator, this grand vision was mostly based on Integrated Teaching Framework and its sustainability goal. According to PD facilitator, this broader goal was to open some windows for teachers to use new teaching strategies so that new pioneers in the field can be trained. Even though these goals or philosophies were not written or directly said it to the PD participants, PD participants confirmed and mentioned about these philosophies. For example, they were highly convinced by the significance of the PD content because of its diversity and they started to use it in their classrooms. Later on, they mentioned being the influencer in their

professional surroundings. In this way, it seemed that PD coordinator aimed to sustain ITP by deploying teachers as becoming leader teachers to other teachers.

In regard of PD venue, especially optimum number of participants was underlined by most of the PD participants and the PD coordinator. It was suggested that in especially OPD design, it might be important to limit the number of participants if it is meant to be conducted synchronically. In this study's context, the limit was 10 people and seven participants were attended the PD. According to PD participants this was ideal. According to PD coordinator, when its optimization with financial issues and creating effective learning environment, 10 people would be ideal.

In regard of OPD design, especially accessibility, and interactivity issues were discussed among this study's participants. Accessibility stance of OPD was proposed as pro in both study findings and the literature (Bates et al., 2016; Collins & Liang, 2015; Dash et al., 2014; Dede et al., 2009; Elliot, 2017). However, in regard of interactivity, everybody that was involved in this PD suggested that there is a need for better thereupon it was not as efficient as it needs to be. On the other hand, interactivity point of OPD was proposed as pro in the literature (Carey et al., 2008; Dede, 2004; Elliot, 2017; Treacy et al., 2002; Trust et al., 2016). Therefore, interactivity point of view might be a discussion point for further studies since this study could not point out similar findings as most of the studies suggested.

As a final point, both PD coordinator of this study and the literature (Elliot, 2017; Prestridge & Tondeur, 2015) proposed that management of OPD is mostly different than traditional face-to-face PD. So that, it was considered as essential for PD facilitators to work on their OPD instructional management skills. It might be viewed as natural that for not only PD participants but also PD facilitators to take time to get adopt the OPD process since OPD and face-to-face PD works systematically different in most cases.

8.1. Limitations

First of all, since there was a time limitation to complete master thesis, any further investigation could not be done other than interviews. It could have been better if observations would be made in the classrooms while PD participants implying their lesson plans in this PD content. In this way, PD effect on teacher change and classroom environment could be studied better.

Secondly, despite of all efforts, it could not be reached all the PD participants. I sent more than one e-mail and tried to reach thorough their social media accounts. I interviewed the five PD participants out of seven. Even though it was suggested that data would reflect better if as many people who have experience the phenomenon as possible could be involved in the study (Creswell, 2007). This suggestion was partially could be applied. It might strong level of trustworthiness data, if it was possible to reach everybody that was involved in this PD process.

8.2. Implications for Further Research

With all its limitations, this study proposed some high-quality PD characteristics from different agents of PD. Since it had qualitative nature, its findings may not reflect on other PD contexts. However, because of the fact that context of the PD described in detail, it might be possible that considering its context, some reflections could be made for similar contexts based on this study's findings. Besides, it would be important contribution to the literature, if new data can be collected from same or similar PD contexts and check if new insights of this study – that are other than *consensus view* PD characteristics – are repeated.

It is well-suggested that by using the findings of this study, to conduct longitudinal study in the same or similar context and analyze the iterative process of PD implications. Afterwards, comparative studies can be conducted between this study and upcoming ones. Furthermore, this study's findings can be considered as important in regard of confirming

the *consensus view* and adding some new insights into the literature and they may become new investigation areas for scholars.

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APPENDIX A: INVITATION LETTER TO PARTICIPANTS (TURKISH)

KATILIMCI DAVET E-POSTASI

Sayın Katılımcı,

Ben Büşra Sümeyye Kurutaş. Boğaziçi Üniversitesi Ortaöğretim Fen ve Matematik Alanları Eğitimi Bölümü yüksek lisans öğrencisiyim. Bu program kapsamında bir öğretmen mesleki gelişim programının tasarlanma sürecinde göz önünde bulundurulan faktörleri ve bu faktörlerin hedeflerine ulaşma durumlarını üç farklı –proje yürütücüsü, dersin eğitimcisi ve dersin katılımcıları– bakış açısından keşfetmeyi amaçlayan bir tez çalışması yürütüyorum. Bu çalışmanın verileri bir öğretmen mesleki gelişim programı yürütücüsü, program kapsamında verilmiş bir dersin eğitim sorumlusu ve bu eğitimin katılımcılarıyla görüşmeler yapılarak toplanacaktır. Bunlara ek olarak katılımcıların eğitim sonunda hazırladıkları ders planları analiz edilecektir.

Bu tez çalışması kapsamında kabul ederseniz STEM: Bütünleşik Öğretmenlik Bilgi ve Becerileri Projesi yürütücüsü olarak sizinle yüz yüze görüşme fırsatı elde etmek istiyorum. Bu görüşmenin yaklaşık 90 dakika sürmesi planlanmaktadır. Sizin de rızanız doğrultusunda; görüşme bir ses kayıt cihazı ile kaydedilecek olup, sadece araştırmacı bu verilere erişme hakkına sahip olacaktır. Her türlü hakkınız size sunulacak olan bilgi ve onam formlarıyla korunacaktır. Sizin için uygun gün, yer ve saat bilgilerini belirttiğiniz takdirde, görüşmemizi gerçekleştirebilmeyi umuyorum.

Bu çalışma veya görüşme ilgili herhangi bir sorunuz olursa, telefonla veya e-posta yoluyla bana ulaşabilirsiniz.

Zaman ayırdığınız için şimdiden teşekkür ederim. Sizden haber bekliyor olacağım.

Saygılarımla,

APPENDIX B: INFORMED CONSENT FORM (TURKISH)

KATILIMCI BİLGİ VE ONAM FORMU

Sayın Katılımcı,

Boğaziçi Üniversitesi Fen Bilimleri Enstitüsü yüksek lisans öğrencisi Büşra Sümeyye Kurutaş, bir öğretmen mesleki gelişim programının tasarlanma sürecinde göz önünde bulundurulan faktörleri ve bu faktörlerin hedeflerine ulaşma durumlarını üç farklı –proje yürütücüsü, dersin eğitimcisi ve dersin katılımcıları– bakış açısından keşfetmeyi amaçlayan bir çalışma yürütmektedir. Çalışmanın amacı doğrultusunda proje yürütücüsünün öğretim gelişim programına ilişkin bilgi ve görüşlerinin elde edilmesi için görüşme yapılması hedeflenmektedir. Bu görüşme sessiz bir ortamda bireysel olarak yapılacak olup yaklaşık 90 dakika sürecektir. Görüşme sırasında görüşme bilgisini hatırlamak için bir ses kayıt cihazı kullanılacak olup sadece araştırmacı bu bilgilere erişme hakkına sahip olacaktır. Verilen cevaplara yönelik olumlu ya da olumsuz bir yaptırım olmayacaktır. Katılımcının görüşmeleri durdurma, görüşme sırasında ve sonrasında soru sorma, soruları cevaplamayı reddetme seçeneği olacaktır ve sonunda herhangi bir yaptırım olmayacaktır.

Bu araştırma bilimsel bir amaçla yapılmaktadır ve katılımcı bilgilerinin gizliliği esas tutulmaktadır. Katılımcının ismini, cevaplarını ve önerilerini içeren bütün hakları gizli tutacaktır ve hiçbir şahıs ve kurumla paylaşılmayacaktır.

Bu çalışmaya katıldığınız takdirde sizinle yarı yapılandırılmış sorulardan oluşan bir görüşme gerçekleştirilecek olup, görüşme öncesi size kısa birkaç demografik bilgi soruları sorulacaktır. Bu sorular yaşınızı, cinsiyetinizi, eğitim geçmişinizi, iş tecrübelerinizi ve daha önce herhangi bir öğretmen mesleki gelişim programı tasarlama sürecinde bulunup bulunmadığınızı öğrenmeye yönelik olacaktır.

Ben, (katılımcının adı) ....., yukarıdaki metni okudum ve katılmam istenen çalışmanın kapsamını ve amacını, gönüllü olarak üzerime düşen sorumlulukları tamamen anladım. Araştırmacının bilgi toplamasına ve araştırmanın

gereklilikleri yerine getirmesine yardımcı olarak tez konusundaki görüşme sorularını gönüllü olarak yanıtlayacağım. Çalışmayla alakalı bütün sorularıma cevap alma imkânına eriştim.

Bu koşullarda söz konusu araştırmaya kendi isteğimle katılmayı kabul ediyorum.

Katılımcının Adı-Soyadı:..... Araştırmacının Adı-Soyadı:.....

İmzası:.....

İmzası:.....

Tarih (gün/ay/yıl):...../...../..... Tarih (gün/ay/yıl):...../...../.....

APPENDIX C: CONSENT TO BE AUDIO-TAPED (TURKISH)

SES KAYDI ONAM FORMU

Büşra Sümeyye Kurutaş'ın tez çalışması kapsamında yapacağı görüşmelerin ses kayıt cihazı ile kaydının yapılacağını ve veri transkripsiyonu için bu görüşmelerin kayıt altında tutulacağının farkındayım. Araştırmacının bu kayıtları gizli tutacağı, tek erişimin araştırmacıya ait olacağı, bu kayıtların araştırmacının bilgisayarında saklanacağı ve hiçbir şahıs ve kurumla paylaşılmayacağı, araştırma tamamlandıktan sonra kayıtların ve bu kayıtlara ait transkripsiyonların imha edileceği bilgisi benimle paylaşıldı.
Bu şartlar altında araştırmacıya izin veriyorum.

Katılımcının	Araştırmacının
Adı Soyadı:.....	AdıSoyadı:.....
İmzası:.....	İmzası:.....
Tarih (gün/ay/yıl):...../...../.....	Tarih (gün/ay/yıl):...../...../.....

APPENDIX D: INTERVIEW PROTOCOL FOR PD COORDINATOR (TURKISH)

PROJE YÜRÜTÜCÜSÜ İÇİN GÖRÜŞME PROTOKOLÜ

GÖRÜŞME DEMOGRAFİK BİLGİSİ:

Süre: Yaklaşık 90 dk.

Yer:

Tarih:

Amaç: Çalışmanın amacı doğrultusunda, proje yürütücüsünün, koordinesini sağladığı öğretmen mesleki gelişim programına ilişkin bilgi, görüş ve beklentilerinin öğrenilmesi için bu görüşmenin yapılması hedeflenmektedir.

YÖNERGE

1. Görüşme yeri ve zamanı katılımcıya göre önceden belirlenecektir. Seçilen ortamın sessiz ve görüşme için uygun özellikleri sağlayabilecek olmasına dikkat edilecektir. Görüşme öncesi ses kayıt cihazı test edilecektir.
2. Araştırmacı kendini tanıtacaktır. Çalışmaya katılmayı kabul ettiği için görüşme öncesi ve sonrasında katılımcıya teşekkür edilecektir. Görüşmeye başlamadan önce çalışma hakkında bilgilendirme yapılacak ve çalışmanın amacı açıklanacaktır. Bilgi ve onam formunda yer alan katılımcı hakları kendisine hatırlatılacaktır. Görüşme ve ses kaydı için katılımcının sözel olarak da izni alınacaktır.
3. Görüşme boyunca ses kaydının yanı sıra araştırmacı kısa notlar tutacaktır. Öncesinde belirlenmiş yarı yapılandırılmış görüşme soruların yanı sıra gerektiğinde katılımcının daha açık ve ayrıntılı bilgiler verebilmesi için ilave sorular sorulacaktır.

4. Ses kaydıyla alakalı kişisel hakların korunacağı açıklanacaktır ve herhangi bir şahıs ve kurumla paylaşılmayacağı bilgisi hatırlatılacaktır.

KATILIMCI DEMOGRAFİK BİLGİSİ

İsim:

Yaş:

Cinsiyet:

Akademik Özgeçmiş:

- **Eğitim geçmişi:**

- **Çalıştığı kurumlar ve görev tanımları:**

- **Daha önce bir mesleki gelişim programı tasarlama sürecinde bulunma durumu:**

  Evet **Hayır**

  Evetse program hakkında kısa bir bilgi ve katılımcı görev tanımı:

  _____

  _____

YARI YAPILANDIRILMIŞ GÖRÜŞME SORULARI

1. STEM: Bütünleşik Öğretmenlik Bilgi ve Becerileri Projesi nedir?
   a. Nasıl bir boşluğu doldurmak amacıyla bu proje geliştirildi? (çıkış noktası ve amaçları)
   b. Ortaya çıkış sürecini anlatır mısınız? (tasarım süreci ve etkin rol oynayan kişiler)
   c. Bu projeden beklentileriniz neler? (ulaşmayı hedeflediği kitle ve son nokta)
2. İleri STEM eğitimlerinin büyük çerçevede amaçları nelerdir?
3. İleri STEM eğitimlerinin çevrimiçi formatında yapılma nedenleri nelerdir? Avantaj ve dezavantajlarını tartışınız.
4. İleri STEM eğitimlerinin birçoğunun katılım şartları arasında motivasyon mektubu yazma ya da STEM Lider Öğretmen unvanına sahip olma ibareleri bulunuyor. Bu ön koşulların konulma sürecini ve nedenlerini açıklar mısınız?

   a. STEM Lider Öğretmen ne demek? Hangi şartların tamamlanması neticesinde bu unvan elde ediliyor?
   b. Bu iki ön koşul birbiri yerine geçebilecek nitelikteler mi? Nasıl?
5. İleri STEM eğitimleri bağlamında açılmış derslerin **içerikleri** hangi kişiler tarafından ve hangi amaçlar doğrultusunda seçildi? Açılacak derslerin seçilmesi sürecini anlatır mısınız?
   a. Derslerin açılması için ön koşullar ya da kriterler neler? Neden?
6. İleri STEM eğitimlerinin **tasarlanma** sürecini anlatır mısınız?
   a. Kimlere danışıldı? Kimler tarafından oluşturuldu?
   b. Derslerin tasarlanma sürecinde kendi rolünüzü nasıl tanımlarsınız?
   c. Dersler tasarlanırken göz önüne alınan noktalar nelerdi?
      i. **Aktif öğrenme** adına dikkat edilen unsurlar nelerdi?
      ii. **Aktif katılım** adına dikkat edilen unsurlar nelerdi?
      iii. 6 haftalık **süre** neye göre belirlendi? Neden?
      iv. Dersin **akıcılığı** dikkat edilen bir unsur muydu? Nasıl?
   d. Derslerin tasarlanma sürecinde göz önüne alınan ya da alınmayan bu noktaların bir değerlendirmesini yapar mısınız?
      i. Bir sonraki dönemde açılacak olan derslerde ilave ya da mevcut hangi noktalar üzerinde özellikle durulmasına dikkat edeceksiniz? Neden?
      ii. Dikkat ettiğiniz hangi noktaların beklentilerinizi karşıladığını düşünüyorsunuz? Neden?
   e. Ders izlenceleri (syllabus) hazırlanırken dikkat edilen noktalar nelerdi? Neden?
7. Bu proje bağlamında açılmış derslerin **eğitimcileri** hangi kişiler tarafından ve hangi kriterler altında seçildi?
   a. Bu kriterleri belirleme nedenleriniz nelerdi?
   b. Bu eğitimciler için sağlanan herhangi bir eğitim bulunuyor mu veya bu eğitimcilerin bu derslere nasıl hazırlandıklarını anlatır mısınız?
8. Bu derslerin ölçme değerlendirmesinin nasıl sağlandığından bahseder misiniz?
   a. Bu dersler bağlamında özellikle ödev vb. uygulamalara yer verilmesini istemeyişinizin nedenleri neler?
   b. STEM ders planı yarışmasını anlatır mısınız?
      i. Ulaşmayı hedeflediği amacı nedir?
      ii. Katılım şartları neler?
      iii. Değerlendirme kriterleri neler?
9. Bu proje bağlamında aldığınız dönütler nasıl oluyor? Ya da süreç içerisinde ekleme çıkarma yaptığınız noktalar oluyor mu? Bunlar neler? Neden?
10. Bu projenin sürdürülebilirliği hakkındaki düşüncelerinizi öğrenebilir miyim?

a. Bu proje farklı bir bağlamda ve farklı yürütücülerle devam ettirilse ya da genişletilse proje aynı misyonu devam ettirebilir mi? Değişirse neler değişir, neden?

Matematik Dersinde Blok Tabanlı Kodlama Uygulamaları Özelinde

1. İleri STEM eğitimleri bağlamında bu dersin yeri ve ne önemi nedir?
2. Bu dersin hangi boşluğu doldurmak amacıyla açılmasına karar verildi?
    a. Dersin amacı nedir?
    b. Bu dersin ulaşmayı hedeflediği katılımcı kitlesini açıklar mısınız?
    c. Bu ders tasarlanırken özellikle göz önünde bulundurulan noktalar nelerdi?
    d. Bu dersin sonunda ulaşılmasını hedeflediğiniz beklentileriniz nelerdi?
        i. Sizce bu beklentileriniz sağlandı mı? Hangi yönlerden sağlandı? Hangi yönlerden sağlanmadı?
        ii. Bu dersi yeniden açmayı düşünüyor musunuz? Neden?
            1. Aynı kişi ve içerikle mi?
                a. Hayes yerine bu dersi veren bir başkası olsaydı neler değişirdi? Neler aynı kalırdı?
            2. Değiştirilecek noktalar ne olurdu?
3. Bu ders için Hayes'i seçme nedeniniz ve seçerken beklentileriniz nelerdi?
    a. Beklentilerinizin sağlandığı veya sağlanmadığı noktalardan bahseder misiniz?
    b. Hayes'i bu ders kapsamındaki rolünü nasıl tanımlarsınız?
4. Bu ders özelinde hazırlanan ders planlarının hâlihazırda değerlendirme kriterleri (rubric) bulunuyor muydu? Ya da dersin ölçme ve değerlendirmesinin nasıl yapıldığından bahseder misiniz?

KAPANIŞ

a. Görüşmenin sonunda söylediklerine eklemek istediği bir şey olup olmadığı bilgisi sorulacaktır.
b. Görüşmeye dair herhangi bir sorusu olup olmadığı bilgisi öğrenilecektir.
c. Görüşme kayıtlarının gizliliği katılımcıya tekrar hatırlatılacaktır.
d. Çalışma tamamlanınca bir özetinin istenip istenmediği bilgisi öğrenilecektir.

APPENDIX E: INTERVIEW PROTOCOL FOR PD FACILITATOR (TURKISH)

MATEMATİK DERSİNDE BLOK TABANLI KODLAMA UYGULAMALARI DERSİNİN EĞİTİMCİSİ İÇİN GÖRÜŞME PROTOKOLÜ

GÖRÜŞME DEMOGRAFİK BİLGİSİ:

Süre: Yaklaşık 90 dk.

Yer:

Tarih:

Amaç: Çalışmanın amacı doğrultusunda, matematik dersinde blok tabanlı kodlama uygulamaları dersinin eğitimcisinden, eğitimini verdiği derse ilişkin bilgi, görüş ve beklentilerinin öğrenilmesi için bu görüşmenin yapılması hedeflenmektedir.

YÖNERGE

1. Görüşme yeri ve zamanı katılımcıya göre önceden belirlenecektir. Seçilen ortamın sessiz ve görüşme için uygun özellikleri sağlayabilecek olmasına dikkat edilecektir. Görüşme öncesi ses kayıt cihazı test edilecektir.

2. Araştırmacı kendini tanıtacaktır. Çalışmaya katılmayı kabul ettiği için görüşme öncesi ve sonrasında katılımcıya teşekkür edilecektir. Görüşmeye başlamadan önce çalışma hakkında bilgilendirme yapılacak ve çalışmanın amacı açıklanacaktır. Bilgi ve onam formunda yer alan katılımcı hakları kendisine hatırlatılacaktır. Görüşme ve ses kaydı için katılımcının sözel olarak da izni alınacaktır.

3. Görüşme boyunca ses kaydının yanı sıra araştırmacı kısa notlar tutacaktır. Öncesinde belirlenmiş yarı yapılandırılmış görüşme soruların yanı sıra gerektiğinde katılımcının daha açık ve ayrıntılı bilgiler verebilmesi için ilave sorular sorulacaktır.

4. Ses kaydıyla alakalı kişisel hakların korunacağı açıklanacaktır ve herhangi bir şahıs ve kurumla paylaşılmayacağı bilgisi hatırlatılacaktır.

KATILIMCI DEMOGRAFİK BİLGİSİ

İsim:

Yaş:

Cinsiyet:

Akademik Özgeçmiş:

- **Eğitim geçmişi:**

- **Çalıştığı kurumlar ve görev tanımları:**

- **Daha önce bir mesleki gelişim programı tasarlama sürecinde bulunma veya programın eğitimcisi olma durumu:**

Evet **Hayır**

Evetse program hakkında kısa bir bilgi ve katılımcı görev tanımı:

YARI YAPILANDIRILMIŞ GÖRÜŞME SORULARI

1. Öncelikle sizin blok tabanlı kodlama uygulamalarıyla ilgilenme sürecinizi öğrenebilir miyim?
    a. İlk motivasyonunuz ne olmuştu? Nasıl devam ettirdiniz?
        i. Bu içerik özelinde herhangi bir eğitime katıldınız mı?
    b. Matematik öğretmeniyim dediniz. Daha çok bilgisayar ağırlıklı olan kodlama, yazılım ve kriptoloji üzerine yoğunlaşma nedenleriniz nelerdi?

i. Öğretmenlik mesleği özelinde bu ilginizin size pozitif veya negatif dönütlerinden bahseder misiniz?

c. Scratch özelinde kendinizi ilerletme sebebiniz nedir?

d. Kendi tecrübeleriniz üzerinden matematik dersinde blok tabanlı kodlama uygulamalarının öğretmenler ve öğrenciler üzerindeki yansımalarından örnekler vererek bahseder misiniz?

2. Bu dersin amacı nedir?

3. Bu dersin ulaşmayı hedeflediği katılımcı kitlesini açıklar mısınız?

   a. Katılımcılarınızın bu içerik özelinde önceki tecrübelerinden haberdar mıydınız? Anlatır mısınız?

   b. Motivasyon mektuplarında dikkat ettiğiniz unsurlar nelerdi?

   c. Katılımcıların derse yönelik motivasyonlarını nasıl değerlendirirsiniz?

4. Bu ders adına kendi rolünüzü nasıl tanımlarsınız?

5. Dersin tasarlanma sürecini anlatır mısınız?

   a. STEM: Bütünleşik Öğretmenlik Çerçevesi hakkında öncesinde bilginiz var mıydı?

      i. Dersin tasarımı öncesinde ve boyunca Steve'le olan paylaşımlarınızın içeriğinden bahseder misiniz?

      ii. Steve'in bu ders kapsamındaki rolünü tanımlar mısınız?

      iii. Sizi bu projenin bir parçası olmaya iten unsurlar nelerdi?

   b. Hangi kaynaklara başvuruldu?

   c. Kimlere danışıldı? Kimler tarafından oluşturuldu?

      i. Sam özelinde konuşacak olursak; Derslerde adından sıkça bahsettiniz ve dersin hazırlıklarını yaparken de kendisiyle görüştüğünü söylediniz. Bunu biraz detaylandırır mısınız?

         1. Ders süreci boyunca ve sonrasında paylaşımlarınız oldu mu? Paylaşır mısınız?

   d. Ders izlencesi (syllabus) hazırlanırken dikkat edilen noktalar nelerdi? Neden?

      i. Katılımcılara isterlerse üzerinde konuşulup değişiklik yapılabileceğinden bahsettiniz. Süreç içerisinde ekleme çıkarma yaptığınız noktalar oldu mu? Bunlar nelerdi? Neden?

      ii. 10 yıllık öğretmenlik geçmişinizin bu dersin tasarım sürecindeki etkisini yorumlayınız.

iii. İçeriğin sıralamasını nelere göre belirlediniz?
    1. İlk aktivite olarak paddle oyununu seçme sebebiniz neydi?
iv. Sıklıkla farklı uygulamalardan, projelerden, bu alandaki kişilerden bahsettiniz (örn.Bagel, Sam, Walfram Alpha, Griffpatch). Bu paylaşımları yaparken amacınız neydi? Sizce bu paylaşımlarınız hedeflediğiniz amaca ulaştı mı? Katılımcılar bunu ileriye taşıdı mı? Nasıl?
v. Derslerde sıklıkla bahsettiğiniz SNAP uygulaması yerine Scratch uygulaması üzerinden derslerinizi sürdürmenizin sebepleri nelerdi? SNAP uygulamasından sıklıkla bahsetme sebebiniz neydi?
vi. Derslerde üzerinden özellikle geçtiğiniz aktiviteleri seçerken göz önünde bulundurduğunuz unsurlar nelerdi? (örn. Öklit algoritması, Chase problem, Saat uygulaması, Ağaç örneği, Turtle Geometry)
    1. Hesaplamalı düşünmeyi matematiğe entegre bakımından sizce öğretmenler için en faydalı uygulama hangisi oldu? Neden?
    2. Matematiğin sanat ayağının ve Turtle Art'ın üzerinde özellikle durma sebebiniz neydi?

e. Dersler tasarlanırken göz önüne alınan noktalar nelerdi?
    i. **Aktif öğrenme** adına dikkat edilen unsurlar nelerdi?
        1. Bazı aktiviteleri beraber yaptınız bazılarını kendilerinin incelemesi –kurcalaması– üzerine bağlantısını paylaştınız. Aktiviteler arasındaki bu ayrıma neye göre karar verdiniz?
            a. Buradaki kurcalamaktan kastınız neydi? Nasıl yapılmalıydı?
        2. Katılımcıları bu bağlamda nasıl değerlendirirsiniz?
        3. Bu dersi bu bağlamda nasıl değerlendirirsiniz?
    ii. **Aktif katılım** adına dikkat edilen unsurlar nelerdi?
        1. Parmak kaldırma uygulamasından bahsetmenize rağmen kimsenin kullanmaması nelerden kaynaklanıyor olabilir?
        2. İlk ders kişilerin seslerini açmayı denediniz ve bir aksaklık oldu ve diğer derslerde bunun konusu bir daha açılmadı. Bu özelliği kullanmama tercihini neye göre verdiniz?
        3. Katılımcılara yorum kısmından ve mail üzerinden size ulaşabileceklerini sıklıkla hatırlattınız. Katılımcıların yorum kısmında çekimser kalma sebepleri ne olabilir?
            a. Mail üzerinden size yorum, soru, görüş, tavsiye vb. bildiren oldu mu? Örnekler veriniz.
        4. Katılımcıları bu bağlamda nasıl değerlendirirsiniz?
    iii. Dersin **süresi** neye göre belirlendi? Neden?
        1. Sizce yeterli miydi? Nasıl?

iv. Programın **akıcılığı** dikkat edilen bir unsur muydu? Nasıl?

6. Bu dersin ölçme ve değerlendirmesini nasıl planladınız?
    a. Bu ders özelinde hazırlanan ders planlarının hâlihazırda değerlendirme kriterleri (rubric) bulunuyor muydu? (eğer varsa bizimle paylaşır mısınız?
        i. Bu kriterleri neye göre ve hangi amaçla belirlediniz?
        ii. Öğretmenlerinize isterlerse ders planlarını STEM ders planı yarışmasına gönderebileceklerini söylediniz. Değerlendirme açısından bu yarışmada nelerin göz önünde bulundurulduğundan bahseder misiniz?
            1. Değerlendirmeyi siz gerçekleştirecek olsaydınız bakacağınız ilave noktalar ne olurdu?
7. Bu dersin çevrimiçi formatta yapılmasının dersin amaçlarına ulaşması bakımından olumlu ve olumsuz yönlerini tartışınız.
8. Bu içerik özelinde bir ders hazırladığınız için özellikle dikkat etmeye çalıştığınız unsurlar ne oldu?
9. Bu dersin katılımcılarından eğitim sonunda ulaşmalarını hedeflediğiniz beklentileriniz nelerdi? Sizce bu beklentileriniz sağlandı mı? Hangi yönlerden sağlandı? Hangi yönlerden sağlanmadı?
10. Bu dersin sınıf içinde uygulama ve matematiğe entegrasyonu bakımından öğretmenler üzerindeki etkisini ve sizinle paylaşılan deneyimlerden bahseder misiniz?
    a. Bu dersin devamı nasıl sağlanmalı?
    b. Katılımcılarınızdan dersi bitirdiğiniz noktadan ilerisine devam ettiğini bildikleriniz var mı? Anlatır mısınız?
11. Bu dersi sizin yerine bir başkası verecek olsa, o kişiye vereceğiniz tavsiyeler ne olurdu?
12. Bu dersi yeniden verecek olsaydınız aynı bırakacağınız ya da değiştireceğiniz noktalar ne olurdu?
    a. Bu ders sonunda aldığınız dönütlerden ve kendi farkındalıklarınızdan bahseder misiniz?
        i. İlk dersin sonunda katılımcılardan bir anket doldurmasını istediniz. Bunu her ders sonunda istemeyişinizin sebebi ne oldu?
    b. Eğitimler sonrası katılımcılarınızla paylaşımlarınızın olup olmadığından bahseder misiniz?
13. Gelecek dönem yeniden açılacak bu ders bildiğim kadarıyla. Bununla alakalı geçen dönemin bitişinden bu zamana gerçekleştirdiğiniz çalışmalarınızdan bahseder misiniz?

KAPANIŞ

e. Görüşmenin sonunda söylediklerine eklemek istediği bir şey olup olmadığı bilgisi sorulacaktır.
f. Görüşmeye dair herhangi bir sorusu olup olmadığı bilgisi öğrenilecektir.
g. Görüşme kayıtlarının gizliliği katılımcıya tekrar hatırlatılacaktır.
h. Çalışma tamamlanınca bir özetinin istenip istenmediği bilgisi öğrenilecektir.

APPENDIX F: INTERVIEW PROTOCOL FOR PD PARTICIPANTS (TURKISH)

MATEMATİK DERSİNDE BLOK TABANLI KODLAMA UYGULAMALARI DERSİNİN KATILIMCILARI İÇİN GÖRÜŞME PROTOKOLÜ

GÖRÜŞME DEMOGRAFİK BİLGİSİ:

Süre: Yaklaşık 90 dk.

Yer:

Tarih:

Amaç: Çalışmanın amacı doğrultusunda, matematik dersinde blok tabanlı kodlama uygulamaları dersinin katılımcısından, eğitimini aldığı derse ilişkin bilgi, görüş ve beklentilerinin öğrenilmesi için bu görüşmenin yapılması hedeflenmektedir.

YÖNERGE

1. Görüşme yeri ve zamanı katılımcıya göre önceden belirlenecektir. Seçilen ortamın sessiz ve görüşme için uygun özellikleri sağlayabilecek olmasına dikkat edilecektir. Görüşme öncesi ses kayıt cihazı test edilecektir.
2. Araştırmacı kendini tanıtacaktır. Çalışmaya katılmayı kabul ettiği için görüşme öncesi ve sonrasında katılımcıya teşekkür edilecektir. Görüşmeye başlamadan önce çalışma hakkında bilgilendirme yapılacak ve çalışmanın amacı açıklanacaktır. Bilgi ve onam formunda yer alan katılımcı hakları kendisine hatırlatılacaktır. Görüşme ve ses kaydı için katılımcının sözel olarak da izni alınacaktır.

3. Görüşme boyunca ses kaydının yanı sıra araştırmacı kısa notlar tutacaktır. Öncesinde belirlenmiş görüşme soruların yanı sıra gerektiğinde katılımcının daha açık ve ayrıntılı bilgiler verebilmesi için ilave sorular sorulacaktır.
4. Ses kaydıyla alakalı kişisel hakların korunacağı açıklanacaktır ve herhangi bir şahıs ve kurumla paylaşılmayacağı bilgisi hatırlatılacaktır.

KATILIMCI DEMOGRAFİK BİLGİ FORMU

İsim:

Yaş:

Cinsiyet:

Akademik Özgeçmiş:

- **Eğitim geçmişi:**

- **Çalıştığı kurumlar ve görev tanımları:**

- **Daha önce bir mesleki gelişim programı katılımcısı olma durumu:**

  ☐ **Evet** ☐ **Hayır**

  Evetse program hakkında bilgi (Adı, konusu, süresi, amaçları):

  _____

  _____

STEM: Lider Öğretmen Mesleki Gelişim Programına katılma zamanı ve bu süre zarfında aldıkları diğer eğitimler

_____

GÖRÜŞME SORULARI

1) Öncelikle İleri STEM eğitimleri içerisinden bu dersi tercih etme sebeplerinizi öğrenebilir miyim?
   a) Blok tabanlı kodlama uygulamalarıyla ilgilenme sürecinizi öğrenebilir miyim?
      i) İlk motivasyonunuz ne olmuştu? Nasıl devam ettirdiniz?
         (1) Bu içerik özelinde başka bir eğitime katılmış mıydınız? Tecrübeleriniz nelerdi?
         (2) Bu içerik özelinde neden özellikle bu platformu tercih ettiğinizi öğrenebilir miyim? Alternatiflerini araştırmış mıydınız? Nelerdi?
      ii) Matematik öğretmeni olduğunuzu biliyorum. Daha çok bilgisayar ağırlıklı olan kodlama, yazılım ve kriptoloji üzerine yoğunlaşma nedenleriniz nelerdi?
         (1) Öğretmenlik mesleği özelinde bu ilginizin size pozitif veya negatif dönütlerinden bahseder misiniz?
      iii) Scratch özelinde kendinizi ilerletmek isteme sebebiniz nedir?
   b) Derse yönelik ilk düşünceniz ve duygunuz nasıldı?
2) İleri STEM dersleri için sunulan katılım şartlarını yorumlar mısınız?
   a) **Seçenek 1:** Bu derse katılım koşulu olarak STEM Lider Öğretmen olduğunuzu biliyorum. Bu unvanı kazandığınız 8 aylık eğitimin bu ders özelinde size etkisi oldu mu? Ne açılardan oldu?
      i) Önceki katıldığınız bu mesleki gelişim programındaki tecrübelerinizden ve bu tecrübelerin hayatınızdaki yansımalarından bahseder misiniz?
      ii) Sizi bu projenin bir parçası olmaya iten unsurlar nelerdi?
      iii) STEM: Bütünleşik Öğretmenlik Çerçevesi hakkında öncesinde bilginiz var mıydı?
         (1) Bu dersi STEM Bütünleşik Öğretmenlik Çerçevesi özelinde yorumlarsanız neler söyleyebilirsiniz?
            (a) Hesaplamalı düşünme size göre ne demek?
   b) **Seçenek 2:** Bu derse katılım koşulu olarak motivasyon mektubu yazdığınızı biliyorum. Sizi bu derse ilişkin motive eden unsurlardan bahsedebilir misiniz?

i) Sizi bu platformda ders almaya iten unsurlar nelerdi?

(1) STEM: Bütünleşik Öğretmenlik Çerçevesi hakkında öncesinde bilginiz var mıydı?

(a) Hesaplamalı düşünme size göre ne demek?

3) Size göre bu dersin amacı neydi?
   a) Bu dersin başında size sunulan ulaşılması hedeflenen kazanımlar nelerdi?
4) Ders izlencesini (syllabus) öğrenme sürecinizi göz önünde bulundurduğunuzda nasıl değerlendiriyorsunuz? Yorumlar mısınız?
   a) Size, sizin isteğiniz doğrultusunda ders izlencesinde değişiklikler yapılabileceği seçeneği sunuldu. Bu imkânı kullandınız mı? Neden?
   b) İçeriğin işleniş sırasından memnun muydunuz?
   c) Derslerde birlikte yapmak üzere seçilmiş uygulamalardan memnun muydunuz? Neler farklı olabilirdi?
      i) Dersin işleniş şeklinin eğitim verdiğiniz kademeye uygun olduğunu düşünüyor musunuz ya da böyle bir ayrım hissettiniz mi? Neden?
         (1) Ders sürecinde bu yüzden zorluk yaşadığınız oldu mu?
      ii) Hesaplamalı düşünmeyi matematiğe entegre bakımından sizin için en faydalı uygulama hangisi oldu? Neden?
   d) Ders süresince sıklıkla farklı uygulamalardan, projelerden, bu alandaki kişilerden bahsedildi. Hatırladığınız örnekler var mı? (örn.Bagel, Sam, Walfram Alpha, Griffpatch). Sizce bu paylaşımlar hangi amaca yönelik yapıldı? Siz bu paylaşımlardan faydalanarak kendinizi dersin ötesine taşıdınız mı? Nasıl?
5) Bu dersi öğrenme ortamı olarak nasıl değerlendirirsiniz?
   a) **Aktif öğrenme** olanakları nasıldı?
      i) Ders sırasında beraber yapılan aktiviteler faydalı oldu mu? Neler farklı olabilirdi?
      ii) Bu aktiviteler sırasında size yeterli dönüt ve zaman verildi mi? Nasıl?
      iii) Ders süresince size sorulan etkileşimli soruları nasıl değerlendirirsiniz?
   b) **Aktif katılım** açısından nasıl değerlendirirsiniz?
      i) Eğitimciyi katılıma teşvik açısından nasıl değerlendirirsiniz?

(1) Eğitimcinin parmak kaldırma uygulamasından bahsetmesine rağmen kimse tarafından kullanılmama nedenleri neler olabilir?

(2) İlk ders eğitimci kişilerin seslerini açmayı denedi ve bir aksaklık oldu ve diğer derslerde bunun konusu bir daha açılmadı. Bu özelliğin kullanılması sizce neleri değiştirir ya da değiştirmezdi?

(a) Ders sırasında mikrofonla etkileşim halinde olmayı tercih eder miydiniz? Neden?

(3) Eğitimci yorum kısmından veya mail üzerinden kendisine ulaşabileceği bilgisini verdi. Kendinizi bu bağlamda nasıl değerlendirirsiniz?

(a) Mail üzerinden eğitimciye yorum, soru, görüş, tavsiye vb. bildirdiniz mi? Örnekler veriniz.

(b) Bütün sorularınızı sorup, cevaplarınızı alabildiniz mi?

(c) Bu anlamda ders süresince kendinizi rahat hissedip istediğiniz her türlü paylaşımda bulunabildiniz mi? Nasıl? Bunlar hangi anlardı?

c) Dersin **süresi** hakkında ne düşünüyorsunuz? (6 hafta 1er saat)

d) Dersin sizin sınıf içi ihtiyaçlarınıza uygunluğunu ve **akıcılığını** nasıl yorumlarsınız?

6) Bu dersin ölçme değerlendirme kriterlerini nasıl yorumlarsınız?

a) Hazırlayacağınız ders planlarıyla alakalı yeterli bilgiyi aldığınızı düşünüyor musunuz? Nasıl?

i) Yetersiz bilgiyi aldığınızı düşündüğünüz noktalarda eğitimciyle rahatlıkla iletişime geçebiliyor muydunuz?

b) Hazırladığınız ders planlarını STEM ders planı yarışmasına göndermenizin size faydası oldu mu? Bunlar nelerdi?

c) Bu ders kapsamında hazırladığınız ders planlarının size ne gibi bir getirisi oldu? Alternatif ne olabilirdi?

i) Bu planı sınıfınızda uyguladınız mı? Dönütleri ve tecrübeleriniz nasıl oldu?

d) Ders planlarınıza dair değerlendirme kriterlerinden haberdar mıydınız? Bunlar nelerdi?

e) Ders planlarınıza dair yeterli ve açıklayıcı geribildirimi aldığınızı düşünüyor musunuz? Nasıl?

7) Bu dersin çevrimiçi formatta yapılmasının dersin amaçlarına ulaşması bakımından olumlu ve olumsuz yönlerini tartışınız.
   a) Videoların size yeniden izleme imkânı sunulması adına kayıt altına alınması uygulamasını öğrenme sürecinizi göz önünde bulundurduğunuzda nasıl değerlendiriyorsunuz?
8) Bu dersi almaya karar verdiğinizde dersten beklentileriniz nelerdi? Sizce bu beklentileriniz sağlandı mı? Hangi yönlerden sağlandı? Hangi yönlerden sağlanmadı?
   a) Bu dersin hedef kazanımlarına sizin açınızdan ulaşıldı mı?
      i) Kendi tecrübeleriniz üzerinden matematik dersinde blok tabanlı kodlama uygulamaları dersinin sizin ve öğrencileriniz üzerindeki varsa etkisinden örnekler vererek bahseder misiniz?
         (1) Bu kazanımların hazırladığınız ders planlarına yansımalarından bahseder misiniz?
   b) Bu eğitime katıldıktan sonra hayatınızda neler değişti?
9) Sizce bu eğitimin devamı nasıl sağlanmalı?
   a) Siz dersi bitirdiğiniz noktadan sonra neler yaptınız?
   b) Bu dersi yeniden almayı düşünür müsünüz? Neden?
   c) Eğitimler sonrası eğitimcinizle paylaşımlarınızın oldu mu? Neden?
10) Sizce bu ders yeniden açılacak olsaydı neler farklı olmalı, neler aynı kalmalıydı?
   a) Bu anlamda eğitimciye geribildirimde bulundunuz mu? Neydi?
      i) İlk dersin sonunda sizden bir anket doldurulması istendi. Bu anket her ders sonunda doldurulsaydı daha faydalı olur muydu? Yorumlayınız.
         (1) Siz sorulara yanıt vermiş miydiniz? Ne yönde geribildirimlerde bulunmuştunuz?
   b) Sizce farklı bir eğitimciyle ve farklı bir platformla beraber bu ders özelinde neler değişirdi?

KAPANIŞ

1. Görüşmenin sonunda söylediklerine eklemek istediği bir şey olup olmadığı bilgisi sorulacaktır.

2. Görüşmeye dair herhangi bir sorusu olup olmadığı bilgisi öğrenilecektir.

3. Görüşme kayıtlarının gizliliği katılımcıya tekrar hatırlatılacaktır.

4. Çalışma tamamlanınca bir özetinin istenip istenmediği bilgisi öğrenilecektir.