Research Article https://doi.org/10.12973/eu-jer.14.4.1331

European Journal of Educational Research
Volume 14, Issue 4, 1331 - 1345.
ISSN: 2165-8714
http://www.eu-jer.com/

Self-Determination Theory to Explore Physics Teachers' Identities: Innovative or Traditional?

Ozden Sengul*
Boğaziçi University, TÜRKİYE

Received: May 19, 2025 ▪ Revised: July 25, 2025 ▪ Accepted: August 15, 2025

Abstract: This study explored how the Self-Determination Theory (SDT) framework shaped physics teachers' professional identities. Through a qualitative case study design, the researcher analyzed the teaching practices, interactions, and pedagogical preferences of two experienced physics teachers. The data sources included classroom observations, semi-structured interviews, informal conversations, and teaching materials. The male teacher adopted a traditional, authority-based approach, while the female teacher employed a student-centered, autonomy-supportive, and relationship-based teaching approach. These findings revealed that teacher identity differed significantly according to the level of meeting the three basic components of SDT: autonomy, competence, and relatedness. The teacher, who gave her students the right to choose experimental activities, collaborated with science centers and included parents in the process, developed a more flexible, participatory, and supportive structure. The other teacher allowed limited student participation in decision-making processes and created a more control-oriented classroom atmosphere. These results showed the importance of addressing autonomy-supported approaches in science teacher education.

Keywords: *Identity, physics teacher, self-determination theory.*

To cite this article: Sengul, O. (2025). Self-determination theory to explore physics teachers' identities: Innovative or traditional? *European Journal of Educational Research*, *14*(4), 1331-1345. https://doi.org/10.12973/eu-jer.14.4.1331

Introduction

Physics teaching presents challenges worldwide, including limited student engagement, low motivation to learn, and traditional lecture formats that fail to foster student inquiry (Sengul, 2024a). Recent international and national (e.g., in Türkiye) curriculum reforms call for more inquiry-based, student-centered approaches. Nevertheless, in many schools, physics classrooms remain teacher-centered and content-focused, with few opportunities for students to actively explore, question, and construct knowledge. In response, this study examines how physics teachers' identity and motivational dynamics influence their adoption of inquiry-based instruction. Specifically, we focus on how self-determination theory (SDT) — a motivational framework highlighting autonomy, competence, and relatedness — intersects with teachers' sense of identity to shape their pedagogical decisions.

Research on science teacher identity reveals that teachers' self-perceptions (e.g., as content experts, inquiry facilitators, or classroom managers) significantly impact their classroom practices (Şengül, 2023; Zhai et al., 2024). However, empirical studies drawing on SDT in this domain remain limited. While some studies have explored SDT in teacher professional development in STEM contexts (Chiu et al., 2023), few directly link SDT to the identity formation of physics teachers implementing inquiry-based practices. Educational contexts, such as Türkiye, present a particularly compelling focus: the reform curriculum emphasizes inquiry and active learning, yet teachers often feel constrained by exam pressures, content demands, and limited support (Sengul, 2024b). There is a documented research gap around how physics teachers in Türkiye negotiate identity and motivation when adopting inquiry-based teaching, and how SDT might support or explain these transitions.

This study aims to examine how inquiry-based physics teaching experiences relate to the development and reinforcement of teachers' identity and how SDT's psychological needs (autonomy, competence, relatedness) influence physics teachers' capacity and willingness to enact inquiry-based pedagogy. The purpose is twofold: to enrich theoretical understanding by combining identity research in physics teacher education with motivational frameworks, and to yield

* **Correspondence:**
Ozden Sengul, Boğaziçi University, North Campus, Faculty of Education, Sarıyer/Istanbul, Türkiye. ozden.sengul@bogazici.edu.tr

© 2025 The Author(s). **Open Access** - This article is under the CC BY license (https://creativecommons.org/licenses/by/4.0/).

practical implications for teacher development and policy in contexts such as Türkiye. Thus, the main research questions are:

1. How do physics teachers' professional identity characteristics develop when engaging in inquiry-based instruction?

2. How do autonomy, competence, and relatedness (SDT) influence their motivation to adopt and sustain inquiry-based pedagogies?

This study is significant because it integrates two connected streams of research—teacher identity and SDT—in a reform-oriented, subject-specific context. Findings may inform the design of professional development, initial teacher education, and school support systems aimed at fostering sustainable pedagogical change.

Literature Review

Physics Teacher Professional Identity

Professional identity refers to how teachers perceive themselves as professionals, as content experts, facilitators, or reflective practitioners, and how these identities inform their actions (Beijaard et al., 2004; Zhai et al., 2024). Empirical studies of physics teacher identity show considerable variation. For example, a multiple case study by Kapucu and Yıldırım (2014) examined Turkish physics teachers' beliefs under the national high school physics curriculum, which advocated multiple methods, including inquiry-based approaches. Interviews and classroom observations found that while teachers believed in using real-life examples and discussion, actual practices often remained teacher-led, reflecting alignment gaps between beliefs and practices. These identity tensions between reform ideals and enacted practice show that identity shaped pedagogical choices more powerfully than declarative beliefs. Şengül (2023) identified three identity types—question-oriented, project-oriented, and lecture-oriented—linked to distinct instructional beliefs and practices (e.g., teachers maintaining lecture routines versus those designing student-centered projects). Another study using activity theory found that physics teachers negotiate tension between discipline content and classroom practices in shaping their professional identity (Sengul, 2024b). The study concluded that many teachers hold transitional epistemological beliefs but still teach traditionally, often due to perceived student expectations and systemic constraints, highlighting identity-practice misalignment in physics classes.

Teachers' professional identity evolves through their experiences and social interactions, guiding them to perceive and enact their professional roles in the classroom and adapt to new situations, such as curriculum reform or implementation problems (Karaolis & Philippou, 2019). Teacher identity supports teachers in making instructional decisions, reflecting on practices, and integrating new curricula in their classrooms (Izadinia, 2013). Teachers' professional identity develops through both intrinsic factors, such as professional knowledge, beliefs, and motivation, as well as extrinsic factors, including the teaching environment. Physics teachers' professional identity encompasses their personal beliefs and contextual and systemic factors, influencing their instructional approaches. The scoping review by Zhai et al. (2024) calls for more longitudinal, cross-cultural, and subject-specific studies (e.g., focusing on physics) to trace identity changes over time and across different settings. Thus, while previous research has mapped identity types and their links to instructional styles, there remains limited insight into how identity develops in response to specific reform practices, such as inquiry physics learning.

Self-Determination Theory (SDT) in Teacher Education

Self-Determination Theory motivates teachers to pursue professional development and tailor their practices to meet the demands of reform (Ryan & Deci, 2020). According to a self-determination approach, the education process is a self-regulated procedure that integrates various fundamental teaching and learning components into a comprehensive system. The self-determination theory helps teachers recognize the importance of autonomy in determining their teaching objectives and methods, as well as their teaching needs, resources, and reflections on their teaching practice. This methodological procedure helps teachers determine their actions as educators in response to the challenges present in a given context. The self-determination theory provides a framework for continued professional growth as it centers on promoting autonomy, competence, and relatedness with reflection and revision (Ryan et al., 2022). In this practice, teachers see the flexibility in restrictive regulations and resist undesirable constraints. Reform-minded practices aim to question standard practices, generating flexibility and multi-dimensionality in teaching and learning through new policies that articulate standards for all learners.

Self-Determination Theory (SDT) specifies three basic psychological needs that must be satisfied for the acquisition of internalized motivation and mental health (Deci & Ryan, 2012). This research suggests that when teachers have enough autonomy, competence, and relatedness, they are more intrinsically motivated, creative, and persistent in their teaching. According to Slemp et al. (2020), these effects are further enhanced when teachers experience a high level of autonomy, competence, and relatedness. Teacher autonomy allows teachers to make informed decisions about teaching methods and approaches. Furthermore, teachers can be trained or develop the confidence required to teach and engage with students (competence). Similarly, teachers make the most of the opportunities presented by the community to support collaboration and connectedness with both peers and students (relatedness).

Research has shown that educators' autonomy-supportive teaching, emphasized in inquiry-based learning settings, promotes learners' autonomy and subsequently enhances their intrinsic motivation and engagement (Reeve & Cheon, 2021; Vansteenkiste et al., 2020). Building on self-determination theory, Reeve and Cheon (2021) developed and evaluated several evidence-informed, teacher-targeted, well-constructed interventions to offer teachers professional development that would help them become autonomy-supportive. The early findings of trained interventions showed that teachers could be influenced to become more autonomy-supportive in their teaching behavior and methods. The second result indicated that teachers appreciated the instrumental impact of autonomy-supportive teaching on children, teachers, and the classroom climate. Reeve and Cheon (2021) conducted the study by considering students' sense of autonomy and analyzing the extent to which students were given meaningful choices, as teachers valued their input. Moreover, Vansteenkiste et al. (2020) reported that autonomy-supportive practices increased student interest and participation in science class discussions. Such practices activated students' thinking, especially in disciplines with a high conceptual density, such as science. Inquiry-based learning scenarios supported learners' autonomy by allowing them to make decisions in problem definition, hypothesis generation, and data interpretation. The study addressed implications for future research to understand the essential role of psychological needs in motivation. However, Manganelli et al. (2019) emphasized that students and teachers should have meaningful rights that are pedagogically structured. The study was an intervention study to investigate the relationship between self-determined motivation and the utilization of cognitive strategies in predicting the academic performance of Italian university students. The results showed that students' prior knowledge had a significant impact on academic performance, students' motivation, and the application of cognitive strategies. The study emphasized the essential influence of teachers' autonomy support in providing pedagogical guidance.

Competence refers to an individual's belief and sense of control while undertaking the task (Liacouras, 2021; Sheehan et al., 2018). In science education, the perception of competence is directly related to experimental activities in which students can apply their scientific process skills. Laboratory and experiment-based activities in science education can develop students' competence and increase their academic success (Manganelli et al., 2019). Student-centered environments enhance students' academic achievement and learning satisfaction through the lens of self-determination theory (Wood, 2019). The analysis of focus group interviews revealed that students' perception of teachers' effectiveness enhanced their competence to be successful, as student-centered activities positively contributed to teachers' effectiveness in promoting students' commitment. These results suggested that competence was linked to success, autonomous motivation, and interest in learning (Manganelli et al., 2019). In this process, students needed continuous and structured feedback to enhance competence. Teachers' structured feedback could increase students' ability to regulate their learning and reinforce self-confidence (Reeve & Cheon, 2021).

Cooperative learning strategies enhance the sense of relatedness among individuals, supporting motivation and competence. Self-determination theory also emphasizes the social aspect of relatedness to foster positive, supportive, and meaningful interactions between teachers and students, as well as among students. Integrating more group work activities could enhance collaboration practices and positively influence learning motivation (Wood, 2019). Vansteenkiste et al. (2020) stated that teachers' empathy toward and listening to students' opinions enabled students to develop positive feelings toward the course. A sense of emotional security allowed students to take a more active role in the classroom and participate in scientific discussions. However, some studies have observed that when relational support is neglected in the classroom, students tend to rely on extrinsic motivation and distance themselves from science lessons (Manganelli et al., 2019). This result showed that failure to meet relational needs could suppress students' intrinsic motivation.

Some studies examined SDT in the context of STEM education to address the interdisciplinary projects' role in supporting all motivational needs of teachers and students. Chiu et al. (2023) found that science-technology-engineering-mathematics (STEM)-focused project-based learning practices could enhance academic and social solidarity among students and deepen their commitment to the learning processes. Students' relationships with their peers and teachers enhanced their motivation while working together through teacher guidance. Teachers should develop autonomy-supporting strategies, such as feedback, and ensure students' active participation in learning processes. Self-determination theory is a practical framework in science education that positively influences teachers' attitudes and success. Future studies should investigate the impact of SDT on the development of teacher knowledge across diverse cultural contexts.

Studies exploring SDT in professional development show promising results. Chiu et al. (2023) demonstrated that PD framed around SDT and design thinking enhanced teachers' capacity to support students' needs and encouraged reflection and growth in STEM settings. More recently, Smith (2025) examined self-selection into PD: teachers with high perceived autonomy and relatedness were more likely to seek out opportunities for enhanced practice design. There is emerging interest in how SDT interacts with identity. For instance, when teachers feel supported (relatedness) and effective (competence), their emerging identities as facilitators or reform-oriented practitioners become more salient. However, explicit integration of SDT and identity frameworks remains rare in the literature.

Inquiry-Based Instruction and Its Motivational Dimensions

According to the SDT, teachers should tailor instruction to recognize students' cognitive, social, and emotional differences (Deci & Ryan, 2000). Teachers should design equitable classroom environments within an inclusive context to address the needs of students with diverse backgrounds, such as those with disabilities or from different cultures, by integrating a holistic learning approach. Teachers should also recognize students' cognitive, emotional, and motivational challenges to ensure their sense of belonging. Teachers should incorporate multiple types of tools, techniques, and assessments as scaffolding, such as pre-assessments, formative assessments, and summative assessments, to adapt the lesson plan and curriculum and provide feedback to improve students' comprehension of the content and engagement (Niemiec & Ryan, 2009). In this way, the teachers can learn to professionalize through flexible, responsive, and student-centered practices (Akkerman & Meijer, 2011). It is this full-figured sense of professional identity that enables teachers to adjust to the learning context and to make pedagogical decisions in light of what their learners can and may need.

Drawing on constructivist educational theory (Vygotsky, 1978), active teacher development is conceptualized in self-determination theory as a dynamic structure that develops in response to real-world experiences. In this regard, teachers can create environments that foster autonomy, motivation, and goal pursuit by designing enjoyable teaching experiences. Teachers can find new ways to practice, self-regulate, and collaborate to develop a sense of autonomy and agency, as well as to be aware of their professional responsibilities (Loeng, 2020). Group learning activities can also facilitate teachers' peer feedback on teaching and learning actions or experiences (Hmelo-Silver, 2004; Markula & Aksela, 2022). Furthermore, teachers need to know how to teach and deliver instruction in various ways beyond traditional approaches to address the natural differences in learners and utilize differentiated instruction. As a result, teachers are empowered to diagnose instructional needs, set goals, reflect on their instruction, and take steps to improve.

Teachers require intrinsic motivation and autonomy of action to become competent and engage optimally in their collaborative activities. This model enables teachers to recognize and experience professional autonomy through various methods, thereby enhancing teaching efficiency. This approach to learning through questioning and inquiry is often applied in inquiry-based science education, where students are encouraged to be actively involved in posing questions, investigating, and constructing knowledge (Hattie, 2008; Teplá & Distler, 2025). A review of 142 studies (Strat et al., 2024) has reported that inquiry-based science education positively influences students' motivation and conceptual understanding. However, the practice of this pedagogical approach is primarily driven by teachers' beliefs, training, and classroom support. Questioning also frequently puts teachers' identities under pressure, at least those attaching themselves to content-expert or lecture-centered models. To embrace inquiry means rethinking the role of the teacher: from dispensing information to helping students explore and make sense of it. This movement can create tension, and identity may change if it is supported, or it may block change if it is unsupported. SDT can help explain such transitions: when teachers feel autonomous in designing inquiry tasks, competent in managing open investigations, and connected to supportive communities, they are more likely to embrace inquiry practice. Conversely, if these needs are unmet, inquiry may be burdensome or foreign. Professional development programs framed around both inquiry design and SDT show promise: PD emphasizing teacher autonomy in curriculum adaptation, peers coaching one another, and scaffolded design thinking fostered lasting changes in inquiry orientation (Chiu et al., 2023). However, few studies directly examine how teachers' identity trajectories change as they adopt inquiry methods.

These studies lack in-depth engagement with how identity evolves in response to specific instructional reforms, such as inquiry-based approaches. SDT offers a solid motivational framework, but its integration with identity research in physics teaching remains promising. Inquiry-based instruction is well-supported by evidence for student benefits, but teacher uptake depends heavily on their identity and beliefs. Hence, the current study addresses these intersecting gaps by exploring how inquiry-based physics teaching experiences shape professional identity and by examining the motivational mechanisms that support or hinder this process.

Methodology

Research Design

The research design of the study is a multiple case study design, which is frequently recommended for thorough qualitative exploration of complex social phenomena in real-life settings (Stake, 2013; Tisdell et al., 2025; Yin, 2014). The use of case studies is particularly appropriate when the demarcation between the phenomenon and its context is indistinct (Yin, 2014). The phenomenon investigated in our study—the professional identity construction of in-service physics teachers informed by the SDT perspective—is closely related to the working environment, the school culture, and curriculum innovations of the teachers. The case study approach to research is convenient when exploring teachers' beliefs, motivations, and classroom practices. For a study comparing teacher experience, teaching strategies, and professional identities, a multiple case study design is suitable, involving two experienced teachers (one female and one male).

A multiple-case study design was adopted to provide comparison and strengthen the validity of the findings (Stake, 2013). Studying two teachers affords possibilities to discern similarities and differences, enhancing the strength of the analysis and permitting cross-case synthesis (Yin, 2014). This aligns with the logic of analytic generalization rather than

statistical generalization. By analyzing two cases with different gender perspectives and professional histories within the same institutional context, the study can capture variations while maintaining cultural and curricular framing.

Participant and Case Selection

The participants were two experienced physics teachers, selected through purposeful sampling to provide rich, information-intensive cases (Patton, 2014). Both teachers, referred to by pseudonyms as Megan (female) and Tristan (male), have over 15 years of teaching experience. Megan was trained in a physics teaching program, and Tristan transitioned to teaching after earning his degree in physics. Both teachers had received a formal teacher education and taught in the public schools with a traditional pattern of instruction. These teachers were, at the time of the study, working in the same Anatolian public high school in northwestern Türkiye, where most students had strong math and science backgrounds and came from families of medium socio-economic status. This school context was characterized by a traditional instructional structure, where classes were typically teacher-centered, with students seated in rows facing the front of the classroom. Such context was considered significant because it provided a setting where inquiry-based practices, as advocated by national curriculum reforms, might conflict with enacted practices, creating identity tensions. Teachers served as the primary source of information, providing teacher-led discussions rather than fostering active engagement. The rationale for selecting two participants from the same school is twofold: First, it controls for significant contextual variables, including school culture and resources, allowing focus on individual differences in professional identity and motivation. Second, it facilitates comparative depth rather than breadth, which is consistent with the study's interpretive aim of generating theoretical insights rather than generalizable findings. However, the sample size, comprising two teachers from a single school, is a significant limitation to the representativeness. This limitation is intentional and inherent to qualitative case study design, which prioritizes depth of understanding over breadth (Creswell & Poth, 2017). The findings are not statistically generalizable, but they aim for transferability (Lincoln & Guba, 1985). To support transferability, the study provides thick descriptions of the school context, participant backgrounds, and instructional practices, enabling readers to determine the applicability of insights in different settings.

Data Collection

Qualitative data collection aimed to explore participating teachers' knowledge, beliefs, practices, reflections, motivation, and intentions through semi-structured interviews, classroom observation notes, informal interviews after observations, and lesson artifacts. Data were collected from multiple sources to facilitate methodological triangulation (Denzin, 2012), thereby ensuring credibility and richness. The semi-structured interviews were two rounds per teacher, each lasting 60-90 minutes. The interview questions were designed to probe autonomy, competency, and relatedness within their teaching roles. The interviews explored teachers' professional identity, motivations, and practices through the lens of SDT. Sample interview questions can be listed as follows:

- How do you define your role as a physics teacher in students' learning?
- What does professional autonomy mean to you in lesson planning and classroom decisions?
- How do you take the initiative to develop instructional strategies?
- How do interdisciplinary collaborations shape professional identity?
- How do you maintain competence and confidence when facing curriculum changes?

Additionally, classroom observations were conducted in three sessions per teacher to focus on instructional strategies, student engagement patterns, and teacher decision-making during the lessons. Observations focused on the opportunities provided for student autonomy and participation, teacher scaffolding and feedback strategies to define their competence, and social interactions fostering teacher-student and teacher-teacher relatedness. The researcher also explores the use of experimental or inquiry-based practices and the structure of classroom climate. The researcher took descriptive and reflective fieldnotes to code them alongside the interview data. Following the observations, informal follow-up conversations allowed teachers to share their immediate reflections on classroom events and instructional decisions. The researcher also collected lesson plans, teaching materials, sample assignments, and reflective notes as supplementary evidence of the pedagogical choices made. These artifacts provided further insight into instructional planning, curricular adaptations, and assessment selection. The interview protocol, observation guidelines, and informal conversation questions are provided in the Appendix.

Data Analysis

The qualitative data, including transcriptions of interviews, field notes from classroom observations, lesson artifacts, and researcher analytic memos, were collected and organized in a narrative format to conduct the analysis. Data were analyzed using Braun and Clarke's (2006) thematic analysis, which involved six iterative phases:

- Familiarization with Data: Reviewing data to develop initial ideas
- Generating Initial Codes: Identify meaningful patterns related to SDT constructs and professional identity indicators
- Searching for Themes: Grouping codes into themes

- Reviewing and Refining Themes: Clarifying relationships across themes
- Defining themes: Creating operational definitions of themes
- Reporting findings: Presenting themes with sample quotations.

The themes were inductively derived from the raw data, exploring how teachers constructed their professional identities through the lens of Self-Determination Theory (Deci & Ryan, 2000; Rich & Pottratz, 2022). This theory pays attention to the three basic components of autonomy, competence, and relatedness:

- Autonomy involves teachers' control in their judgments, planning, students' requirements, and teaching alternative ways.
- Competence represents the self-efficacy and confidence of the teachers to preserve an effective climate in the classroom.
- Relatedness is linked to maintaining contact with colleagues and collaborators.

An inductive approach was used to enable themes to be identified from the data and interpreted within the framework of SDT (Deci & Ryan, 2000). Teachers' professional identity was conceptualized in the study using Self-Determination Theory to understand how educators manifest autonomy in their classrooms, gain confidence working within the constraints of instruction, and participate in collaborative conversations. The researcher also conducted a cross-case analysis to clarify any convergences or divergences between Megan and Tristan. The cross-case analysis helped to compare patterns across Megan and Tristan to identify shared and divergent expressions of autonomy, competence, and relatedness.

Ethical Considerations

The study was conducted with the approval of the relevant institutional review board. Participants were informed of the study's purpose and confidentiality. Subjects gave their consent to participate under terms that allowed them to remain anonymous and were assigned pseudonyms. All data were stored securely.

Trustworthiness and Validation

To increase the trustworthiness of the study, the author implemented several strategies (Lincoln & Guba, 1985). The methodological resources were variable, including interviews, observations, and artifacts to establish cross-validation of findings. The author aimed to have thick description through providing comprehensive contextual and narrative descriptions of participants' setting, background, and teaching approach to enhance transferability to different comparable situations. Participants discussed the initial results for their feedback. The analysis provided the accuracy of interpretations to ensure credibility.

Findings

This section presents results organized around the three core dimensions of Self-Determination Theory (SDT) – autonomy, competence, and relatedness - for each teacher. The analysis provided a thematic interpretation of the findings, accompanied by representative quotes. A cross-case analysis highlighted similarities and differences between cases.

Case-1: Megan

Megan's Autonomy

Megan demonstrated a high level of instructional autonomy, often departing from traditional textbook-driven lessons to design interactive, student-centered activities. Her teaching went beyond the existing national curriculum materials. Instead of enacting the curriculum verbatim, she adapted the curriculum materials and instructional strategies to meet students' needs and address their challenges, promoting deep learning. For instance, she started the lesson by eliciting students' prior conceptions about vector quantities such as displacement and velocity. She introduced a case study by drawing representations on the board to explain these concepts. She pulled out a table and graph to illustrate distance and time relationships, and then asked students to derive velocity versus time graphs. About her instruction, Megan stated,

> On Friday, I gave the lesson in the garden, where I had everyone participate in peer education. They solved, prepared, and asked each other questions. We should not force students to sit and listen to them for 40-45 minutes. We should let them produce naturally. We should not sell the knowledge and expect students to buy it.

This excerpt illustrates Megan's initiative to adapt the lesson format and physical setting to promote active learning. Megan emphasized the significance of students' active participation during the learning process. She valued students' real-life experiences and tailored his lessons to students' needs. She made independent decisions in her instructional practices to create an engaging classroom atmosphere, helping students connect physics concepts to everyday contexts. She recognized that traditional methods required students to absorb knowledge passively, so she sought to adapt them

to support student learning better. Her ability to reconfigure space and activities reflected strong decision-making independence, aligning with SDT's autonomy dimension.

Megan's autonomy extended to resource mobilization. She actively sought laboratory materials by collaborating with parents and purchasing equipment to integrate inquiry-based and student-centered strategies. These initiatives helped her explore new methods to enhance teaching effectiveness. She stated,

> … I asked students to buy Newton Experiment equipment…They bought it, did homework, and left it at school. I also purchased the optic set for the students, which the children bought. The electric sphere... We can obtain experimental materials independently. Physics teachers need their classrooms to have the equipment inside so that they can keep the materials.

This example showed Megan's agency in compensating for systemic limitations, reinforcing her identity as a proactive and self-directed teacher. However, structural constraints such as a lack of a dedicated physics lab hindered the full enactment of her plans, indicating that autonomy was contextually bounded. For example, Megan was unable to integrate her knowledge of the physics laboratory into her classes due to its inappropriate use. Megan suggested that each physics teacher should have their physics class with laboratory equipment.

Megan exercised substantial autonomy in curriculum adaptation and classroom organization, though resource and policy limitations occasionally restricted her initiatives.

Megan's Competence

Megan's sense of competence was evident in her confidence with inquiry-based instruction and ability to connect physics to real-world contexts. Megan built confidence in self-directed and student-centered teaching because she had strong pedagogical content knowledge of pedagogical strategies and student conceptions, enabling her to plan instruction using alternative methods and address students' learning difficulties. Megan valued physics teaching as being connected to the real world, so she framed problems around real-life phenomena rather than focusing on mathematical solutions. Besides classroom activities, her autonomy guided her inside and outside regular class hours to address students' academic needs through extracurricular activities. For example, she stated,

> Physics teachers need to shape life... Students should understand why physics is necessary. …Physics is used in many areas of life. For instance, 11th graders often think that friction always occurs in the opposite direction of movement, or it can be in the same direction; however, this would prevent you from walking. A connection must be established with life... We need to visit science museums outside of school.

Megan consistently integrated hands-on and problem-based strategies, encouraging conceptual discussions over rote memorization. Her competence was rooted in 26 years of teaching experience and ongoing professional learning through attending seminars. Megan expanded her professional development by integrating new laboratory equipment and physics simulations into her lesson planning for effective student-centered instruction. She also watched video case studies of inquiry-based classrooms to try new strategies, such as interactive problem-solving or conceptual discussions, which built confidence over time. Megan's remarks on using real-life cases, peer learning, and active instruction indicated her pedagogical versatility. Her high autonomy in decision-making enabled her to develop competence as an experienced physics teacher, particularly in her ability to adapt to different situations and foster meaningful learning experiences.

Megan displayed strong pedagogical competence, particularly in facilitating student engagement and conceptual understanding, though structural limitations constrained certain practices. Despite her expertise, Megan acknowledged barriers such as time limitations and inadequate laboratory infrastructure, which occasionally impeded experimental activities. Nevertheless, her confidence in designing alternative experiences, such as simulations and visiting museums, reflected her adaptive competence.

Megan's Relatedness

Megan demonstrated high relational engagement with students through dialogic interactions and collaborative learning. She preferred using dialogic interaction to enhance students' active participation. She incorporated structured discussions, formative assessments, and student-led problem-solving sessions. Her example classroom discussion is below:

> Teacher: When you hit the ball on the ice, does the ball travel farther?
>
> Student: Ice has little friction.
>
> Teacher: What happens if you hit the ball on a grass field?
>
> Student: …It would have stopped quicker.

This conversation illustrates Megan's use of questioning strategies to promote critical thinking and reasoning. Megan emphasized building a favorable classroom climate, enabling students to think critically without focusing on direct answers.

At the collegial level, Megan noted a limited collaborative culture among physics teachers in her school. She expressed a desire for structured peer collaboration and administrative support for experimental teaching. Megan tended to incorporate hands-on equipment and physics simulations to enhance effective physics instruction in her classes. However, physics teachers in her school tended to work in isolation to address the curriculum expectations; some teachers followed traditional instruction without integrating hands-on activities. The school administration did not encourage collaboration in planning and teaching, failed to support physics teachers with laboratory materials and experimental resources, and did not help teachers in building their experimental rooms.

Megan's relatedness also extended beyond school, as she sought engagement with the broader physics education community. However, she complained of a lack of guidance from university experts and limited access to science centers. Megan believed that university professors did not provide guidance to physics teachers on teaching specific physics concepts. She stated,

> Experimenting in today's physics… should be done in science centers with excellent laboratory facilities. I can provide students with an experiment in a museum that involves making measurements, taking values, drawing graphs, and performing calculations.

Megan's relatedness manifested strongly in student involvement, moderately in colleague collaboration, and weakly at the institutional and community levels, where systemic barriers persisted.

Case-2: Tristan

Tristan's Autonomy

Tristan exhibited limited autonomy in instructional decision-making, adhering largely to textbook-based and teacher-centered methods to solve problems. Regarding pedagogical autonomy, Tristan prioritized content delivery and adjusted teaching based on students' needs in crowded classrooms. During the instruction, he had strict classroom norms, which reduced noise in class and allowed flexibility without disrupting student learning. The teacher stated,

> I get distracted when noise is made in class… He can lie down and sleep during class; my only request is that he does not make a noise.

This excerpt reflects a classroom management style prioritizing discipline and order over student agency. While Tristan allowed minor flexibility with non-disruptive behaviors, his approach lacked substantive autonomy and supportive practices such as implementing student-driven inquiry.

Tristan expressed frustration with the misalignment of curriculum and exams, advocating for systemic reforms. Tristan critiqued standardized assessments, arguing that they do not align with real-life applications and that the curriculum should be adjusted accordingly. He stated,

> University entrance examinations have focused on entirely abstract concepts… Both the curriculum and the examination system should be compatible.

The teacher advocated for curriculum-assessment alignment, indicating his desire for more teacher control over student learning evaluation. Although he desired greater control over assessment design, Tristan did not translate this aspiration into concrete classroom-level innovations. His autonomy was aspirational rather than enacted.

Tristan's autonomy was constrained both by institutional structures and his adherence to traditional norms, resulting in limited instructional flexibility.

Tristan's Competence

Tristan's competence beliefs were mixed. He was optimistic about students' learning processes in physics. He aimed to make physics a less intimidating subject and encourage students to believe in themselves and achieve success in physics. He felt confident in content knowledge and communication skills. He stated,

> I discovered that every student has a different learning style, and I adapted my teaching accordingly.

He identified students' needs to define strategies and improve students' understanding. He preferred giving students responsibilities to write questions and ask each other. The teacher was confident that providing proper explanations and effective communication would resolve student concerns.

He employed humor and informal interactions as a deliberate strategy to sustain student engagement. He stated,

> I enjoy joking around with students and teaching them. Sometimes, I like to tease them and attract their attention in other ways.

However, Tristan acknowledged feeling incompetent early in his career and still reported challenges with experimental instruction, citing resource shortages and curricular constraints.

> We have a laboratory, but the materials do not allow us to do every experiment. We could attract more student attention if there were at least four different experiments.

He complained about the insufficiency of laboratory facilities. He had confidence in teaching physics but felt uncertain and limited in the experimental aspect of physics.

His emphasis on exam pressures and student resistance suggested a competence perception tied to external limitations rather than intrinsic mastery. Tristan's competence was moderate, anchored in content delivery and classroom rapport, but weaker in innovative or inquiry-based practices. He stated that curriculum, course duration, and student prejudices made teaching difficult, although there was still an effort to find a solution. Despite these challenges, he demonstrated resilience by seeking practical solutions within the constraints. Tristan's professional journey evolved through gaining teaching experience and self-reflection, rather than relying solely on formal training. Tristan learned through experience and valued mentorship and role models, indicating a strong belief in the importance of continuous learning.

Tristan's Relatedness

Tristan's sense of relatedness defined how he built relationships with his students. He focused on boosting students' confidence and motivation in physics before emphasizing content. Tristan prioritized emotional support and motivational reassurance for students. He stated,

> Physics is one of the subjects that students dislike the most… My priority is to make them believe they can succeed in this course without forcing them to study physics.

This indicates a relationship-centered approach within a traditional instructional frame. He viewed himself as a mentor, guiding students through a subject they often feared.

However, Tristan reported feeling institutionalized and isolated, lacking structured collaboration with colleagues. He addressed overcrowded classrooms and limited resources as barriers to building more prosperous learning communities. Tristan's relatedness was strong in teacher-student relationships, but minimal at the colleague and systemic levels.

Table 1. Cross-Case Analysis based on SDT dimensions

Dimension	Megan	Tristan
Autonomy	High: Frequently adapted lessons, initiated outdoor and peer learning; proactive resource acquisition.	Low: Limited to minor classroom flexibility, primarily textbook-driven with an aspirational curriculum critique.
Competence	High: Confident in inquiry-based methods, connecting physics to life, and diversifying pedagogy.	Moderate: Strong in content delivery and rapport; weak in experimental teaching and innovation.
Relatedness	High with students; moderate with peers; limited systemic/community collaboration.	High with students (motivational focus); low collegial and institutional connectedness.

Cross-case Analysis

Megan's autonomy was characterized by innovation and agency, manifested in curriculum adaptation and proactive problem-solving. She demonstrated substantial autonomy in teaching physics through inquiry-oriented practices. Megan differentiated teaching strategies to connect physics teaching and learning with students' real-life experiences. However, Tristan's autonomy was constrained, with a preference for maintaining traditional structures and routines. Tristan demonstrated limited engagement with self-directed practices for teaching physics through inquiry-oriented methods. His self-directed teaching was limited to textbook-driven methods for solving variable questions to address the instructional goals. Limited resources and participation in professional development opportunities constrained his autonomy. This divergence between teachers underscored SDT's claim that autonomy was not merely granted but enacted through teacher identity and perceived control. In terms of competence, both teachers recognized structural barriers. Megan demonstrated adaptive competence by leveraging experience and self-learning to integrate inquiry elements. She played a role as a guide to students' learning by addressing their needs and challenges in out-of-class and extracurricular activities, thereby enhancing students' involvement in science. Her teaching supported her confidence in acting as a student-centered teacher and enhanced her relationships with students, colleagues, and parents. Tristan's competence remained content-dependent, with limited movement toward pedagogical diversification. In terms of relatedness, both teachers prioritized student relationships, though Megan fostered critical dialogue, while Tristan

emphasized emotional reassurance. Collegial and systemic relatedness was weak in both cases, reflecting institutional isolation prevalent in many Turkish schools. These findings indicated that SDT provides a valuable lens to understand the structural needs; professional development targeting identity reconstruction and satisfaction of SDT needs may therefore be critical for fostering inquiry-based teaching.

Discussion

This research offers a nuanced explanation of how self-directed teaching contributes to teacher autonomy, competence, and relatedness regarding professional identity, within the framework of Self-Determination Theory (Deci & Ryan, 2000). SDT suggests that individuals will flourish if they can fulfill three psychological needs—autonomy, competence, and relatedness. Within an educational framework, such needs encompass teachers' capacity to make educational decisions (autonomy), their belief in being effective in attaining pedagogical aims (competence), and the establishment of meaningful relationships with students and colleagues (relatedness). Megan's teaching was innovative, flexible, and collaborative, which was a self-determined teacher who met these three categories. In contrast, Tristan's perspective drew attention to how narrow autonomy and a lack of relational engagement could result in limited professional development and more traditional teaching.

Although earlier research has argued that self-directed professional development leads to professional identity development (Izadinia, 2013; Korthagen, 2004), the existing literature offers more justification for this assertion. For instance, Qin and Liu (2023) found that autonomy-supportive environments in teacher education produced greater inquiry-based, student-oriented practices in teachers. In this case study, Megan's self-regulatory strategies were indicative of personal initiative as well as the existence of an ecological context (such as school climate, administrative support, and exposure to mentoring) that supported her development of autonomy and competence. This aligns with Slemp et al. (2020), who indicated that institutional flexibility and trust from leadership promoted teachers' provision of innovative pedagogical practices.

However, Tristan's experience was different. The fact that his exam-oriented approach and reluctance to collaborate were not only personal reluctance but also potentially created by institutional factors. As Vansteenkiste et al. (2020) have pointed out, teachers were too reactive in shaping their teaching by contextual demands, particularly in performance pressure educational environments where high-stakes testing culture has flourished, and these contexts of such performance pressure tended to force teachers to show a control-oriented style, thus their autonomy as well as their students' autonomy was diminished. Consequently, if we assume that Tristan's resources and his capacities have been somewhat restricted, then certain conclusions can be drawn from the overall system, the details of which might bring to light questionable, systemic features.

One of the main findings of this research is the recognition of the mismatch between teacher identity and enacted teaching practices. Both teachers conveyed a promise of student success, but only Megan repeatedly enacted this pledge in the form of learner-centered instruction. This emphasizes the results of Hong et al. (2024), suggesting that professional identity was sometimes not reflective of practice, especially when issues related to institutional pressures, scarcity of resources, or professional support services were involved. The case of Megan, however, also indicated how a teacher could overcome curricular restraints by having a strong professional identity. She modified the curriculum, created assignments, and engaged families and outside organizations to help foster learning. These were practices from the type of identity-in-practice differentiated by Beauchamp and Thomas (2009), suggesting that teachers' internalized values were practiced in pedagogies. The many-faced nature of Megan's professional identity also echoed the model of multiplicity that Akkerman and Meijer (2011) proposed for teacher identity. Tristan, on the other hand, seemed to be suffering from identity tension (Pillen et al., 2013): When the static vision of teaching (such as textbook-bound and exam-driven) slowed down the process of reflecting, developing, and learning. Although he recognized and understood varied student learning styles, he did not adjust his teaching techniques accordingly. This inconsistency indicates that there is a disconnect between cognitive acknowledgment and pedagogical enactment, a problem also noted in other studies on teacher belief-practice fit (Friedrichsen et al., 2021).

Megan and Tristan were two people at opposite ends of a continuum, with Megan embodying the constructivist, autonomy-supportive educator, and Tristan being firmly grounded in an authoritative, directive framework. Between these extremes, there is a continuum of levels, with teachers aspiring to professionalism in their innovative practice, but confronted by contextual or personal limitations. This is in line with the results of Sengul (2024a) on epistemological beliefs and instructional decisions, finding that teachers with more advanced beliefs were also unable to teach constructivist practices because of institutional constraints.

Furthermore, the variation in the teachers' feedback usage and student engagement practice highlighted another layer of self-directed teaching. Megan's approach was based on formative feedback loops and a project-based learning model, which promoted student competence and agency. By contrast, Tristan's restricted feedback and activities were detrimental to the students' cognitive engagement and intrinsic motivation. These differences further emphasize findings to reconceptualize self-directed teaching as not merely a function of teacher autonomy but as a multi-dimensional construct that includes responding to student needs, reflection, and teacher development.

This research expands SDT's reach by showing that it interfaces with teacher identity. Although SDT has generally been used to explain student motivation, more recent work (Reeve & Cheon, 2021; Vansteenkiste et al., 2020) has urged researchers to examine the extent to which teachers' own motivational experiences influence their teaching decisions. Megan served as a compelling case in point: an autonomy-supportive teacher not only nurtured student agency but also reaffirmed her sense of identity and meaning. Conversely, Tristan's restricted agency and control-based instruction implied that inhibited psychological needs might result in a lack of pedagogical innovation.

What institutional and cultural forms are required so that we take care of teachers' psychological needs? As Ryan and Deci (2020) claim, motivation is context-dependent. Hence, the school leaders and policymakers must create a culture that supports teacher autonomy, provide constructive feedback, and promote collegial collaboration. In the absence of support, such professional identity develops perhaps despite the best intentions of teachers, rather than in directions that lead to student-centered practice.

Conclusion

The purpose of this study was to explore the connection between teacher identity and self-directed teaching within Self-Determination Theory (SDT). The experiences of two teachers (Megan and Tristan) serve to demonstrate the fact that teacher identity is not merely static, but that it dynamically adapts depending on how much autonomy, competence, and relatedness they perceive within their working environment. Megan has a powerful professional identity that not only legitimizes her work but also allows her to be independent and intrinsically motivated. The aesthetics of choice align with innovative and collegial student-centered teaching. While this may be an extreme example, Tristan's inability suggests that his unmet psychosocial needs are holding him back in both his professional growth and student engagement.

One of the key contributions of this research is the extension of SDT—which has primarily been used in understanding student motivation—to an entirely separate construct, teacher professional identity. In schools with supportive cultures that offer autonomy and collaboration to their teaching staff, teachers can develop a much stronger professional identity. These environments improve teaching and keep teachers motivated. Our results highlight the importance of recognizing that identity formation is not just based on individual self-reflection, but also embedded in micro- and macro-cultural surroundings. Megan was able to design curriculum, put together student-centered practices, and work with parents and community groups because of a school culture that supported teacher quality. Meanwhile, the exam-driven textbook mode of teaching to which Tristan defaulted reflected an educational environment short on collaboration and learning. These results are consistent with van der Want et al. (2015), who conclude that the development of professional identities is dependent on a mandate for autonomy-supportive environments. Teacher identity flourishes in a culture of professional autonomy, competence, and relatedness.

Recommendations

This study sheds light on the relationship between self-directed teaching, teachers' psychological needs, and professionals-in-becoming. The cases of Megan and Tristan illustrate that identity becomes as much from lived experience and process reflection as it does from aspiration in systemic positionality. Identity is like a mirror that reflects the dimension in which an educator recognizes the contemporary self and is a compass for purposes of professional growth. These identity definitions must be embraced with aligned efforts across teacher preparation, school leadership, professional learning, and policy.

Teacher education programs should prioritize identity development as an integral part of professional growth, rather than developing technical skills. Preservice teachers need safe spaces to reflect on their values, motivations, and beliefs and to test a variety of pedagogies. Identity mapping, critical incident analysis, and teaching portfolios are a few of many strategies that can assist candidates in connecting their growing identities to actual classroom practices. Combining the lesson planning, assessment, and learner support can create early autonomy, competence, and relatedness. These themes suggest that identity-sensitive approaches need to be integrated into the science of physics education—inquiry-based and constructivist pedagogical practices could bridge cultural beliefs with teaching methodologies, to eliminate the disconnection between identity and practice evident within test-driven classrooms.

School culture strongly shapes identity. Megan was encouraged; Tristan followed a prescriptive curriculum. In high-stakes systems, such as Turkey, the role of autonomy-supportive environments, such as trust in teachers' pedagogical decisions, time for collaborative planning, and teacher voice in decision-making, is essential. Moving from compliance to creativity may mean flexible textbook use, curricula that deviate from standardized tests, and research opportunities for teachers. Thus, teacher professional training should also address the emotional, motivational, and identity aspects of teaching.

Traditional top-down models overlook how teachers experience variability. The alternative is teacher-owned networks, professional learning communities, peer observations, and action research, which support shared reflection and growth. Since teachers with novice professionalism are struggling to maintain their emerging identities, there is a critical need for emotional (caring), informational (guidance), and skill-support (role modeling) in their daily work. Both cognitive

and affective dimensions need to be cultivated through professional growth, with support being provided in emotional resilience, identity negotiation, and teacher-student relationships. Whole teacher engagement and reflection occur when teachers feel cared for and valued.

In this exploration of identity formation, we illustrate how personal characteristics develop or result from psychological and institutional environments that are premised on the associated discourses; therefore, future multi-level longitudinal data are necessary. To measure Identity Development, long-term mixed-method studies might be needed, including structured interviews, observations in the field, and reflective journals with students and teachers. Likewise, tools such as Chao's (2017) self-determined teaching scale can be used quantitatively to evaluate and help guide approaches to increasing autonomy, competence, and relatedness. Comparative research across centralized, exam-driven systems and decentralized, inquiry-based systems can highlight the different ways identity formation occurs.

Future work might further incorporate SDT with sociocultural identity theories, ecological models of teacher agency, or critical pedagogies to address relational, cultural, and power dimensions. Policy informed by qualitative studies can be responsive and equity-oriented, elevating the voices of teachers. Policymakers benefit by regularly examining how autonomy, well-being, and career-long growth are enacted over time in response to mandates, relationships, and meaning-making.

Limitations

Although this study provides valuable qualitative data, it is constrained by a small sample size and a specific context. For the future, it would be possible to enlarge the sample to other teachers, departments, disciplines, and types of institutions. Finally, a longitudinal approach would be beneficial in examining how teachers' identities evolve and how autonomy, competence, and relatedness continuously interact with the contextual changes brought about by institutional reforms. Additional studies are also necessary to investigate the role of cultural norms and teacher motivation. As Ryan and Deci (2020) have observed, SDT has been tested predominantly in Western cultures. Becoming an insider in the sense of adapted interpretation and problem-solving would require researchers to examine the ways culturally-bound beliefs about authority, collaboration, and individual agency, and to address teacher identity formation, thus motivating and sustaining extended professional development.

Ethics Statements

The study involved human participants and was reviewed and approved by Boğaziçi University. Our project was approved in the meeting on 26.08.2022, with the 2022/08 number. The participants provided their written informed consent to participate in this study.

Conflict of Interest

There is no conflict of interest for the author.

Funding

The Boğaziçi University-BAP 19949 project funds the study.

Generative AI Statement

The manuscript was entirely developed without AI-generated content.

References

Akkerman, S. F., & Meijer, P. C. (2011). A dialogical approach to conceptualizing teacher identity. *Teaching and Teacher Education*, *27*(2), 308-319. https://doi.org/10.1016/j.tate.2010.08.013

Beauchamp, C., & Thomas, L. (2009). Understanding teacher identity: An overview of issues in the literature and implications for teacher education. *Cambridge Journal of Education*, *39*(2), 175-189. https://doi.org/10.1080/03057640902902252

Beijaard, D., Meijer, P. C., & Verloop, N. (2004). Reconsidering research on teachers' professional identity. *Teaching and Teacher Education*, *20*(2), 107-128. https://doi.org/10.1016/j.tate.2003.07.001

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77-101. https://doi.org/10.1191/1478088706qp063oa

Chao, P.-C. (2017). Development of a scale to measure educators' practice in teaching self-determination. *European Journal of Educational Research*, *6*(4), 433-440. https://doi.org/10.12973/eu-jer.6.4.433

Chiu, T. K. F., Ismailov, M., Zhou, X., Xia, Q., Au, C. K., & Chai, C. S. (2023). Using self-determination theory to explain how community-based learning fosters student interest and identity in integrated STEM education. *International Journal of Science and Mathematics Education*, *21*, 109-130. https://doi.org/10.1007/s10763-023-10382-x

Creswell, J., & Poth, C. (2017). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed). Sage.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, *11*(4), 227-268. https://doi.org/10.1207/S15327965PLI1104_01

Deci, E. L., & Ryan, R. M. (2012). Self-determination theory. In P. A. M. Van Lange, A. W. Kruglanski, & E. T. Higgins (Eds.), *Handbook of theories of social psychology* (pp. 416-436). Sage Publications. https://doi.org/10.4135/9781446249215.n21

Denzin, N. K. (2012). Triangulation 2.0. *Journal of Mixed Methods Research*, *6*(2), 80-88. https://doi.org/10.1177/1558689812437186

Friedrichsen, P. J., Ke, L., Sadler, T. D., & Zangori, L. (2021). Enacting co-designed socio-scientific issues-based curriculum units: A case of secondary science teacher learning. *Journal of Science Teacher Education*, *32*(1), 85-106. https://doi.org/10.1080/1046560X.2020.1795576

Hattie, J. (2008). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. Routledge.

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review*, *16*, 235-266. https://doi.org/10.1023/B:EDPR.0000034022.16470.f3

Hong, J., Cross Francis, D., & Schutz, P. A. (2024). Reconceptualizing teacher identity development. *Educational Psychologist*, *59*(3), 159-176. https://doi.org/10.1080/00461520.2023.2292713

Izadinia, M. (2013). A review of research on student teachers' professional identity. *British Educational Research Journal*, *39*(4), 694-713. https://doi.org/10.1080/01411926.2012.679614

Kapucu, S., & Yıldırım, U. (2014). Physics teachers' behavioral, control, and normative beliefs about teaching physics according to the national high school physics curriculum in Turkey. *International Journal of Environmental and Science Education*, *9*(2), 133-157.

Karaolis, A., & Philippou, G. N. (2019). Teachers' professional identity. In M. S. Hannula, G. C. Leder, F. Morselli, M. Vollstedt, & Q. Zhang (Eds.), *Affect and Mathematics Education: Fresh Perspectives on Motivation, Engagement, and Identity* (pp. 397-417). Springer. https://doi.org/10.1007/978-3-030-13761-8_18

Korthagen, F. A. J. (2004). In search of the essence of a good teacher: Towards a more holistic approach in teacher education. *Teaching and Teacher Education*, *20*(1), 77-97. https://doi.org/10.1016/j.tate.2003.10.002

Liacouras, S. (2021). Restoring self-efficacy in learning: A critical examination of the modern test-centric educational environment and its impact on the psychology of underachieving students. (Publication No. 190) [Master of Science, West Chester University]. Online Repository of WCU's Intellectual and Creative Work. https://digitalcommons.wcupa.edu/all_theses/190

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. SAGE.

Loeng, S. (2020). Self-directed learning: A core concept in adult education. *Education Research International.* Advance online publication. https://doi.org/10.1155/2020/3816132

Manganelli, S., Cavicchiolo, E., Mallia, L., Biasi, V., Lucidi, F., & Alivernini, F. (2019). The interplay between self-determined motivation, self-regulated cognitive strategies, and prior achievement in predicting academic performance. *Educational Psychology*, *39*(4), 470-488. https://doi.org/10.1080/01443410.2019.1572104

Markula, A., & Aksela, M. (2022). The key characteristics of project-based learning: how teachers implement projects in K-12 science education. *Disciplinary and Interdisciplinary Science Education Research*, *4*, Article 2. https://doi.org/10.1186/s43031-021-00042-x

Niemiec, C. P., & Ryan, R. M. (2009). Autonomy, competence, and relatedness in the classroom: Applying self-determination theory to educational practice. *Theory and Research in Education*, *7*(2), 133-144. https://doi.org/10.1177/1477878509104318

Patton, M. Q. (2014). *Qualitative research & evaluation methods: Integrating theory and practice* (4th ed.) SAGE Publications, Inc.

Pillen, M., Beijaard, D., & den Brok, P. (2013). Tensions in beginning teachers' professional identity development, accompanying feelings, and coping strategies. *European Journal of Teacher Education*, *36*(3), 240-260. https://doi.org/10.1080/02619768.2012.696192

Qin, X., & Liu, S. (2023). The relationship between principal support, teacher professional identity, and teacher professional learning in China: Investigating gender differences. *Psychology in the Schools*, *60*(12), 4871-4884. https://doi.org/10.1002/pits.23066

Reeve, J., & Cheon, S. H. (2021). Autonomy-supportive teaching: Its malleability, benefits, and potential to improve educational practice. *Educational Psychologist*, *56*(1), 54-77. https://doi.org/10.1080/00461520.2020.1862657

Rich, J., & Pottratz, S. T. (2022). Strategies to promote self-determination in collegiate rowing selection. *Journal of Sport Behavior*, *45*(1), 115-125. https://bit.ly/3Jhff7e

Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology*, *61*, Article 101860. https://doi.org/10.1016/j.cedpsych.2020.101860

Ryan, R. M., Duineveld, J. J., Di Domenico, S. I., Ryan, W. S., Steward, B. A., & Bradshaw, E. L. (2022). We know this much is (meta-analytically) true: A meta-review of meta-analytic findings evaluating self-determination theory. *Psychological Bulletin*, *148*(11-12), 813-842. https://doi.org/10.1037/bul0000385

Sengul, O. (2024a). Epistemological beliefs and classroom practices of experienced physics teachers: are they related? *Frontiers in Education*, *9*, Article 1362426. https://doi.org/10.3389/feduc.2024.1362426

Sengul, O. (2024b). Understanding physics teachers' professional identity: An activity theory perspective. *International Journal of Science Education*, *46*(15), 1650-1670. https://doi.org/10.1080/09500693.2024.2364369

Şengül, Ö. (2023). Examination of high school physics teachers' professional identity: A case study. *e-Kafkas Journal of Educational Research*, *10*(3), 505-519. https://doi.org/10.30900/kafkasegt.1377223

Sheehan, R. B., Herring, M. P., & Campbell, M. J. (2018). Associations between motivation and mental health in sport: A test of the hierarchical model of intrinsic and extrinsic motivation. *Frontiers in Psychology*, *9*, Article 00707. https://doi.org/10.3389/fpsyg.2018.00707

Slemp, G. R., Field, J. G., & Cho, A. S. H. (2020). A meta-analysis of autonomous and controlled forms of teacher motivation. *Journal of Vocational Behavior*, *121*, Article 103459. https://doi.org/10.1016/j.jvb.2020.103459

Smith, Y. C. (2025). *Who do you think you are? An arts-based narrative inquiry of teacher personal identity and professional learning.* (Publication No. 32045109) [Doctoral dissertation, University of Missouri-Kansas City]. ProQuest Dissertations & Theses Global. http://bit.ly/4fCpId7

Stake, R. E. (2013). *Multiple case study analysis*. Guilford Press.

Strat, T. T. S., Henriksen, E. K., & Jegstad, K. M. (2024). Inquiry-based science education in science teacher education: A systematic review. *Studies in Science Education*, *60*(2), 191-249. https://doi.org/10.1080/03057267.2023.2207148

Teplá, M., & Distler, P. (2025). The impact of long-term inquiry-based science education on students' motivation and knowledge acquisition: the role of gender, subject, and level of inquiry. *Humanities and Social Sciences Communications*, *12*, Article 239. https://www.nature.com/articles/s41599-025-04437-3

Tisdell, E. J., Merriam, S. B., & Stuckey-Peyrot, H. L. (2025). *Qualitative research: A guide to design and implementation* (5th ed.). John Wiley & Sons.

van der Want, A. C., den Brok, P., Beijaard, D., Brekelmans, M., Claessens, L. C. A., & Pennings, H. J. M. (2015). Teachers' interpersonal role identity. *Scandinavian Journal of Educational Research*, *59*(4), 424-442. https://doi.org/10.1080/00313831.2014.904428

Vansteenkiste, M., Ryan, R. M., & Soenens, B. (2020). Basic psychological need theory: Advancements, critical themes, and future directions. *Motivation and Emotion*, *44*, 1-31. https://doi.org/10.1007/s11031-019-09818-1

Vygotsky, L. S. (1978). *Mind in society.* Harvard University Press.

Wood, R. (2019). Students' motivation to engage with science learning activities through the lens of self-determination theory: Results from a single-case school-based study. *Eurasia Journal of Mathematics, Science and Technology Education*, *15*(7), Article em1718. https://doi.org/10.29333/ejmste/106110

Yin, R. (2014). *Case study research design and methods* (5th ed.). Sage.

Zhai, Y., Tripp, J., & Liu, X. (2024). Science teacher identity research: A scoping literature review. *International Journal of STEM Education*, *11*, Article 20. https://doi.org/10.1186/s40594-024-00481-8

Appendix

A. Interview Protocol

This semi-structured interview guide was developed to investigate how experienced physics teachers explain their professional identity and motivation, framing it through the lens of SDT. Interviews took place in phases to probe different reflections. Interview questions are listed below:

- Please describe your path to teaching physics.
- What is your teaching philosophy?
- How do you define your role as a physics teacher in students' learning?
- How have you evolved as a physics teacher in the course of your career?
- How much freedom do you feel that you have in designing your lessons as you wish?
- Are there elements of your curriculum or school type that impede your teaching?
- What does professional autonomy mean to you in lesson planning and classroom decisions?
- How do you take the initiative to develop instructional strategies?
- Can you share a time when you deviated from the curriculum?
- What do you do when students suggest new plans about instruction?
- Are you comfortable with inquiry-based learning?
- How do you evaluate your effectiveness as a teacher?
- What support has allowed you to grow as a physics teacher?
- Describe your relationships with students.
- How do you work with your colleagues?
- How well-integrated do you feel into the broader physics education?
- How do school policies support or impede your teaching?
- How do interdisciplinary collaborations shape professional identity?
- How do you maintain competence and confidence when facing curriculum changes?
- What are your greatest struggles on the practice level?
- If you could make one change to the teaching environment, what would it be?

B. Observation Guidelines

The observation protocol was designed to understand how teachers were enacting the SDT needs, including autonomy, competence, and relatedness, in their instruction, interactions with students and colleagues, and learning context. The study included three-hour observations, with each session lasting 45-60 minutes. The researcher took descriptive and analytical field notes during the observation. The following questions guided the observation process:

- Did the teacher give students a choice about problem-solving, etc.?
- Are students encouraged to investigate or discuss?
- Are inquiry-based or open-ended activities used?
- What kinds of activities or assessments are used?
- Are there alternative representations in the physics lesson?
- Does the teacher ensure all students understand and accommodate teaching based on students' needs?
- What kind of cognitive skills (analysis, prediction, explanation) are involved in the lesson?
- Do students take ownership of their learning?
- What are the qualities within teacher-student interactions?
- Is collaboration between students encouraged? Or is competition encouraged?
- Does the teacher recognize students' ideas or needs?
- Are any lab materials, visuals, or technology being used?
- Do students perform experiments?
- How is the arrangement of the classroom setting?

C- Informal Conversations

After the observation, the researcher conducted informal conversations with the teachers using the following questions:

- What did you accomplish in today's lesson?
- Why did you select that method and activity?
- Did you have any specific student response that you recognized as a misunderstanding?