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The role of teachers' digital competence in primary school students' learning motivation

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This study examines the relationship between teachers' technological competencies and primary school students' motivation to learn, focusing specifically on autonomous forms of motivation. The study is based on a quantitative, non-experimental, correlational design and was conducted in public primary schools in Kosovo. The research involved 20 teachers and 350 fourth and fifth grade students, organized into 20 classes. Teachers' technological competencies were measured using the DigCompEdu Check-In instrument, while students' motivation was assessed using the Elementary School Motivation Scale, based on Self-Determination Theory. Analyses were conducted at the class level to maintain consistency between the measurement levels of the variables. The results showed that teachers display average to good technological competencies, while students have relatively high levels of motivation to learn, especially in the identified regulation dimension. Correlational analyses showed a positive and statistically significant relationship between teachers' technological competence and overall student motivation, as well as with intrinsic motivation and self-regulation identified in reading, writing and mathematics. In contrast, no significant relationship was found with external regulation of motivation. The findings suggest that technology is associated with student motivation only when it is integrated in a pedagogically intentional way and supports autonomous forms of motivation. The study offers important implications for teacher professional development and educational policies in primary education.

KEYWORDS
DigCompEdu, motivation to learn, pedagogical integration of technology, primary education, teachers' technological competence

1 Introduction

Over the past decade, digital transformation has become a central priority for education systems around the world, especially in pre-university education. Governments and educational institutions have invested significantly in digital infrastructure, learning platforms and educational technology, with the expectation that the integration of technology would improve the quality of teaching and student learning outcomes. However, empirical evidence consistently shows that the presence of technology in itself does not guarantee pedagogical improvement or increased student engagement (OECD, 2020). The impact of technology on education depends largely on how it is integrated into teaching practice. The scientific literature emphasizes the crucial role of teachers in the meaningful use of technology in the classroom. Teachers are not simply users of digital tools, but active designers of

learning environments, whose pedagogical decisions determine whether technology supports contemporary, student-centered approaches, or whether it simply reproduces traditional teaching models in digital form. Studies conducted in the context of primary education show that, when teachers do not possess sufficient technological and pedagogical competencies, the use of technology remains superficial and has limited impact on student motivation and engagement (Instefjord and Munthe, 2017). The theoretical framework known as Technological Pedagogical Content Knowledge (TPACK) emphasizes that effective technology integration requires the combination of technological, pedagogical, and content knowledge (Koehler et al., 2013). Teachers who possess more developed technological-pedagogical competencies are more likely to design interactive, engaging, and cognitively demanding learning activities, which directly affect the increase in student motivation and active involvement (Tondeur et al., 2017). From the perspective of motivation to learn, research in educational psychology shows that student engagement and motivation are closely related to teaching practices that promote autonomy, a sense of competence, and meaningfulness of the learning content. Numerous studies demonstrate that teaching approaches that actively involve students and connect learning to real-world situations contribute to higher levels of motivation, especially in primary education (Fredricks et al., 2004). Digital technology, when used pedagogically purposefully by competent teachers, can reinforce these dimensions through interactive, collaborative, and visually supportive activities. Although the potential of technology to increase student motivation is well-known, empirical findings on the relationship between teachers' technological competencies and student motivation remain inconsistent. Some studies report positive associations between innovative use of technology and student engagement, while other studies show limited or insignificant effects, especially when technology is used without pedagogical clarity (Schindler et al., 2017). These inconsistencies suggest that technology is not the determining factor in itself; the quality of teachers' technological and pedagogical competencies emerges as a key element influencing student motivational outcomes. Despite the growth of studies on the digital transformation in education, relatively little research has focused directly on primary education and the relationship between teachers' technological competencies and student motivation to learn. Addressing this gap, the current study aims to examine the relationship between teachers' technological competencies and primary school students' motivation to learn, with the aim of providing empirical evidence that can inform teachers' professional development, teaching practice, and educational policies in emerging digital contexts.

2 Literature review

2.1 Teachers' technological competencies

Contemporary digital education literature treats teachers' technological competence as a complex professional construct, which includes not only the ability to use digital tools, but also the capacity to integrate them in a pedagogically meaningful way into the teaching and learning process. Numerous studies show that the availability of technology in schools is not sufficient to improve the quality of learning if teachers do not possess the appropriate competencies to use it (OECD, 2020). The DigCompEdu framework has provided a structured basis for conceptualizing and measuring teachers' digital competences, directly linking them to teaching practices, digital assessment and student empowerment (Redecker, 2017). DigCompEdu shifts the focus from technical skills to integrated professional competences, emphasizing the role of the teacher as a designer of learning environments and not simply as a user of technology (Ghomi and Redecker, 2019). Empirical studies show that higher levels of digital competence are associated with more frequent use of interactive strategies, greater differentiation of learning, and more systematic use of digital formative assessment (Tzafilkou et al., 2023). Research conducted in the context of primary education shows that teachers with more developed digital competences create cognitively richer and more supportive learning environments for students, integrating technology for exploration, collaboration and reflection, and not just for the transmission of content (Instefjord and Munthe, 2017; Tondeur et al., 2017). In this context, technological competences are closely linked to the quality of pedagogical practice and student orientation. Similarly, the literature on the TPACK framework emphasizes that technological competence is inseparable from pedagogical and content knowledge. Systematic reviews and meta-analyses have shown that TPACK is a theoretically sound construct, but that it requires clearer links to student outcomes, including motivation and engagement (Schmid et al., 2024). Various authors argue that the effect of TPACK on student outcomes is indirect and mediated by concrete teaching practices, especially strategies that support student autonomy and active involvement (Koehler et al., 2013; Scherer et al., 2021). In this vein, the literature suggests that technological competencies should be understood as part of a broader pedagogical-professional competency, where technology serves as a tool for achieving didactic and motivational goals, and not as an end in itself (Di Pietro and Castaño Muñoz, 2025; Hattie, 2017). This approach is particularly important in primary education, where the teacher's influence on the learning experience and student motivation is direct and long-term.

2.2 Motivating students in primary education

Student motivation to learn is a key construct in primary education and has been studied extensively within the framework of Self-Determination Theory. This theory distinguishes intrinsic motivation, identified regulation, and other forms of external regulation, emphasizing the role of autonomy, competence, and belonging in fostering sustained motivation (Deci and Ryan, 2000). In the context of primary education, these psychological needs are considered particularly sensitive, as early learning experiences directly influence the formation of long-term attitudes toward school and learning (Ryan and Deci, 2017). In early school years, motivation often appears to be domain-specific, i.e., it varies across learning domains. Studies by Guay and colleagues show that motivation

for reading, writing, and mathematics constitute distinct but interconnected dimensions of students' learning experiences (Guay et al., 2003; Guay et al., 2010). These differences suggest that students do not build a single motivational orientation towards school, but develop different motivational profiles depending on their didactic experience in each subject (Marsh et al., 2015). For this reason, contemporary studies recommend the analysis of motivation according to learning areas, especially in primary education. Empirical research shows that autonomous forms of motivation, namely intrinsic motivation and identified regulation, are positively related to cognitive engagement, persistence and satisfaction from learning, while controlled forms of motivation show weaker or short-term relationships with academic performance (Benabou and Tirole, 2003; Guay et al., 2010). In this sense, the sustainability of motivation to learn depends more on the experience of meaningfulness and autonomy than on external rewards or pressure. Recent meta-analyses confirm that the learning environment and the role of the teacher are crucial factors in shaping student motivation, especially in primary education (Bureau et al., 2021; Fredricks et al., 2004). Teaching practices that support autonomy, provide constructive feedback, and create a supportive emotional climate are found to be among the strongest predictors of student autonomous motivation (Niemiec and Ryan, 2009; Reeve, 2012).

Emerging research suggests that student motivation should be conceptualized as a dynamic and contextual process, shaped through the interaction of pedagogical practices, teacher–student relationships, and the classroom environment (Howard et al., 2021). This approach is particularly relevant in studies examining the impact of innovative practices, including the use of technology, on students' motivational experiences.

In summary, the literature shows that motivation in primary education is not simply an individual characteristic of the student, but the result of a pedagogical process mediated by the teacher and the learning environment. This makes motivation a key variable for analyzing the impact of teachers' professional competencies, including technological competencies, on the quality of learning.

2.3 The relationship between teachers' technological competencies and student motivation

A large body of research suggests that the impact of technology on student motivation is not direct, but rather mediated by the quality of pedagogical integration. When teachers have more developed digital competencies, they are more likely to use technology to create interactive, collaborative, and student-centered activities, which are positively associated with motivation and engagement (Cabalbag, 2025; Chiu, 2022). Studies show that the use of technology that supports student autonomy and provides immediate feedback is particularly associated with increased intrinsic motivation and perceived regulation (Chiu, 2022). These findings are consistent with Self-Determination Theory, which states that teaching practices that support autonomy and competence foster more enduring forms of motivation (Ryan and Deci, 2017). Other research shows that teachers' technological competencies influence student motivation by increasing the clarity of learning goals, active involvement, and personalization of learning (Scherer et al., 2021; Tondeur et al., 2017). In the context of primary education, these mechanisms are particularly important, as students depend more on pedagogical structure and teacher support to build engagement in learning. Recent meta-analyses suggest that the motivational effects of technology are more evident when it is used for formative assessment, immediate feedback, and reflection, rather than for passive transmission of content (Di Pietro and Castaño Muñoz, 2025; Hattie, 2017). These results reinforce the argument that technological competencies should be conceptualized as indirect predictors of motivation, mediated by concrete teaching practices.

Teachers' digital competencies do not directly influence student motivation through the use of technology alone, but through the pedagogical way in which technology is integrated into the learning process. Teachers with more developed digital competencies are more likely to design interactive learning activities, provide immediate feedback, and create opportunities for collaborative and exploratory learning. These pedagogical practices support students' autonomy, sense of competence, and meaningfulness of learning. According to Self-Determination Theory, these factors form the basis for the development of intrinsic motivation and identified regulation. In this sense, teachers' digital competencies can be conceptualized as pedagogical factors that structure the learning experience in the classroom and that, through this experience, influence student motivation.

2.4 Technological competencies as a predictor of motivation at the classroom level

In studies where the teacher is directly associated with a particular classroom, the methodological literature suggests analyzing at the classroom level to maintain consistency between the levels of measurement of variables (Cohen et al., 2018). This approach avoids aggregation errors and allows for a more accurate interpretation of the impact of teacher characteristics on the collective experience of students in the classroom (Marsh et al., 2015). Empirical studies show that the effects of technology on educational outcomes depend primarily on the competences and practices of the teacher, not on the presence of technology *per se* (Di Pietro and Castaño Muñoz, 2025; Hattie, 2017). Meta-analyses and multi-level studies suggest that the teacher accounts for the main level of variance in student engagement and motivation, especially in primary education, where classroom structure and pedagogical interaction are more centralized (Opdenakker and Van Damme, 2006; Wang and Degol, 2016). Research that examines teachers' professional competencies as predictors at the classroom level shows that dimensions related to the organization of instruction, clarity of instruction, and formative feedback have a more direct impact on student motivation than individual student characteristics (Schindler et al., 2017). In this sense, teachers' technological competencies can be conceptualized as indirect predictors of student motivation, mediated by the quality of classroom-level

pedagogical practice. Consequently, classroom-level analysis provides a suitable methodological framework to examine how teachers' technological competencies translate into collective motivational experiences for students, making this approach particularly relevant for studies in primary education (Raudenbush and Bryk, 2002).

2.4.1 Research questions

1. What is the level of technological competence of primary school teachers?
2. What is the level of motivation to learn of primary school students in reading, writing and mathematics?

2.4.2 Hypotheses

H_1. There is a positive relationship between teachers' technological competencies and the overall level of motivation to learn of primary school students.

H_2. Teachers' technological competencies are positively related to students' intrinsic motivation in reading, writing and mathematics.

H_3. Teachers' technological competencies are positively related to the identified regulation of students' motivation in reading, writing and mathematics.

H_4. Teachers' technological competencies are positively related to the external regulation of students' motivation in reading, writing and mathematics.

3 Methodology

3.1 Study design

This study was conducted using a quantitative, non-experimental, correlational design to analyze the relationship between teachers' technological competencies and primary school students' motivation to learn. The data were collected at a single point in time and reflect real-world classroom teaching practice. The correlational approach allows for the identification of relationships between key study variables in natural educational contexts, providing opportunities to explore meaningful relationships between variables without interfering with the existing learning process (Cohen et al., 2018; Creswell and Creswell, 2018).

3.2 Participants and data collection procedure

The study was conducted in public primary schools in Kosovo. The sample was selected through purposive sampling, based on pre-defined criteria, in accordance with the purpose of the study. Specifically, the sample included only classes where: (a) teachers taught with regular use of digital technology during the school year, (b) the class had a single teacher responsible for the main subjects, and (c) the class structure was stable during the school year. This type of sampling is considered appropriate for exploratory correlational studies that aim to analyze the relationships between teacher characteristics and the collective experience of students at the class level. A total of 370 participants participated in the study, namely 20 primary education teachers and 350 students, organized into 20 classes. The sample included 10 fourth and 10 fifth grades, where each class had a responsible teacher. This structure ensured a direct match between teacher competencies and students' motivational experience at the classroom level.

Data collection was carried out during the first semester of the 2025/2026 school year, respectively during the months of October and November 2025. Initially, institutional permissions for the study and informed parental consent for student participation were obtained. Students were informed about the purpose of the study in a language appropriate for their age and it was ensured that participation was voluntary. Questionnaires for students were administered during school hours, supervised by researchers and teachers, while teachers completed the questionnaires individually and anonymously. The average completion time was about 15 min for students and about 20 min for teachers.

3.3 Instruments and data analysis

Students' motivation to learn was measured using the Elementary School Motivation Scale, developed by Guay et al. (2010), based on Self-Determination Theory. The instrument measures academic motivation in the dimensions of intrinsic motivation, identified regulation, and external regulation, for each of the learning areas: reading, writing, and mathematics. The questionnaire includes a total of 27 items (9 for each subject), rated on a five-point Likert scale.

The instrument was linguistically adapted for use with fourth and fifth grade students. The adaptation included simplifying the language formulations and reviewing the items for compatibility with the developmental level of the students, by a team with experience in primary education. Before the main administration, the instrument was piloted on a small group of students to verify the clarity of the questions and the understandability of the rating scale.

Teachers' technological competences were assessed using the DigCompEdu Check-In instrument, a standardized self-assessment instrument developed within the DigCompEdu framework by the European Commission (Ghomi and Redecker, 2019; Redecker, 2017). The instrument includes 24 items organized into six domains: professional digital engagement, digital resources, technology-enabled teaching and learning, digital assessment, student empowerment, and student digital competence development. The assessment was conducted using a five-point Likert scale, with higher scores indicating more advanced levels of digital competence.

For each class, mean student motivation scores were calculated in each dimension and these were linked to the respective teacher's technological competence score. Statistical analyses were conducted at the class level ($N = 20$), to maintain consistency between the levels of measurement of the variables. Student motivation scores were aggregated to class-level means in order

to align the level of analysis with teacher-level variables. Because each teacher was responsible for a single class, the classroom represents the shared instructional context experienced by students. This approach is commonly used in classroom-level research examining the relationship between teacher characteristics and collective student outcomes. However, future studies with larger samples could further justify aggregation using multilevel indicators such as intraclass correlations. Data were analyzed using SPSS. Descriptive statistics and instrument reliability analysis were initially performed. The normality of data distribution was tested using the Shapiro–Wilk test. Since all main variables deviated statistically significantly from normal distribution ($p < .05$), non-parametric methods were used for inferential analyses. Normality was assessed using the Shapiro–Wilk test due to the small sample size. However, given the known sensitivity of normality tests in small samples, the decision to use non-parametric analyses was also based on the robustness of these methods when distributional assumptions may be violated. Relationships between variables were analyzed using Spearman's rank-order correlation. In similar studies, it is often recommended to use Structural Equation Modeling (SEM) to analyze the relationships between latent constructs and multiple mediating variables. However, the application of SEM requires a significantly larger sample size to ensure the statistical stability of the model. In this study, the analysis was conducted at the class level ($N = 20$), which does not meet the methodological criteria for the use of SEM. For this reason, non-parametric methods were used, namely Spearman correlation.

4 Data analysis

4.1 Reliability of the instruments

4.1.1 Reliability of the teachers' digital competence questionnaire (DigCompEdu)

Internal consistency reliability of the questionnaire measuring teachers' digital competence was assessed using Cronbach's alpha (Table 1). The instrument consists of 24 items organized into six subdimensions aligned with the DigCompEdu framework.

TABLE 1 Internal consistency of the teachers' digital competence questionnaire.

Dimension	Number of items	Cronbach's α
Professional digital engagement	4	0.84
Digital resources	4	0.81
Teaching and learning with technology	4	0.86
Digital assessment	4	0.83
Empowering learners	4	0.79
Facilitating learners' digital competence	4	0.82
Total scale	**24**	**0.91**

Bold values indicate higher Cronbach's alpha coefficients.

The results indicate high internal consistency for all subdimensions ($\alpha \geq 0.79$) and excellent reliability for the overall scale ($\alpha = 0.91$). These findings confirm that the questionnaire provides a stable and reliable measure of teachers' digital competence and is appropriate for subsequent correlational analyses.

4.1.2 Reliability of the students' academic motivation questionnaire

The students' motivation questionnaire measures academic motivation across three subjects (reading, writing, mathematics) and three motivational dimensions (intrinsic motivation, identified regulation, external regulation). Internal consistency was examined separately for each subject area (Table 2).

All subscales demonstrate acceptable to good internal consistency, with Cronbach's alpha values exceeding the commonly accepted threshold of 0.70. The results indicate that the questionnaire reliably captures students' motivation across subjects and motivational dimensions. Before conducting inferential analyses, the distribution of data for the main study variables, including teachers' technological competencies and students' motivation dimensions, was tested. The normality of the distribution was assessed using the Shapiro–Wilk test, which is appropriate for small samples ($N = 20$ classes).

The results showed that teachers' overall technological competencies deviated from a normal distribution ($W = 0.87$, $p = .012$). Similarly, students' overall motivation did not follow a normal distribution ($W = 0.89$, $p = .018$). Analysis of the motivation dimensions also showed violations of the normality assumption for intrinsic motivation ($W = 0.90$, $p = .021$), identified regulation ($W = 0.88$, $p = .015$), and external regulation ($W = 0.91$, $p = .026$).

Since all key variables showed statistically significant deviations from normal distribution ($p < .05$), it was decided to perform all inferential analyses using nonparametric methods, which do not require the assumption of normality of the data. Accordingly, Spearman's rank-order correlation was used for relational analyses.

4.1.3 What is the level of technological competence of primary school teachers?

The results show that teachers have an average to good level of technological competence, with an overall mean of $M = 3.67$. The

TABLE 2 Internal consistency of the students' academic motivation questionnaire.

Subject area	Motivation dimension	Number of items	Cronbach's α
Reading	Intrinsic motivation	3	0.83
	Identified regulation	3	0.81
	External regulation	3	0.78
Writing	Intrinsic motivation	3	0.82
	Identified regulation	3	0.80
	External regulation	3	0.77
Mathematics	Intrinsic motivation	3	0.85
	Identified regulation	3	0.83
	External regulation	3	0.79

subscale Teaching and learning with technology shows the highest mean value (M = 3.71), suggesting that teachers feel more confident in the pedagogical use of technology during teaching. Digital assessment shows the lowest mean value (M = 3.59), indicating that aspects of digital assessment are less consolidated in daily teaching practice (Table 3).

4.1.4 What is the level of students' motivation to learn in reading, writing, and mathematics?

Students display relatively high levels of motivation, especially in the dimension of identified regulation, which in all three subjects has average values above 3.90. Intrinsic motivation is highest in reading (M = 3.89) and lowest in mathematics (M = 3.68), suggesting differences between subjects in the emotional experience of learning. External regulation has lower and more stable values, indicating that students' motivation is not primarily based on external rewards or pressure (Table 4).

Spearman analysis showed a positive and statistically significant relationship between teachers' technological competencies and overall student motivation at the classroom level ($\rho = 0.49$, $p < .05$) (Table 5). The coefficient value indicates a moderate effect, suggesting that increased teachers' technological competencies are associated with higher levels of average student motivation. This result indicates that technological competencies constitute an important factor in students' motivational experience, although their impact is not isolated and interacts with other pedagogical and contextual factors. Hypothesis H_1 is supported.

TABLE 3 Descriptive statistics for teachers' digital competence.

Dimension	Mean	SD
Professional digital engagement	3.78	0.54
Digital resources	3.65	0.49
Teaching and learning with technology	3.71	0.56
Digital assessment	3.59	0.52
Empowering learners	3.62	0.47
Facilitating learners' digital competence	3.68	0.50
Overall digital competence	**3.67**	**0.46**

Bold values indicate higher mean values.

TABLE 4 Descriptive statistics for students' academic motivation (class-level averages).

Subject	Motivation dimension	Mean	SD
Reading	Intrinsic motivation	3.89	0.41
	Identified regulation	4.01	0.38
	External regulation	3.32	0.45
Writing	Intrinsic motivation	3.74	0.43
	Identified regulation	3.96	0.40
	External regulation	3.28	0.47
Mathematics	Intrinsic motivation	3.68	0.46
	Identified regulation	3.92	0.42
	External regulation	3.35	0.44

TABLE 5 Spearman correlation between teachers' digital competence and overall student motivation.

Variable	Spearman's ρ
Teachers' digital competence – Overall student motivation	0.49*

*$p < .05$.

TABLE 6 Spearman correlations between teachers' digital competence and motivation dimensions.

Motivation dimension	Reading	Writing	Mathematics
Intrinsic motivation	0.46*	0.44*	0.41*
Identified regulation	0.53*	0.49*	0.46*
External regulation	0.27	0.24	0.29

*$p < .05$.
$p > .05$.

The results showed positive and statistically significant relationships between teachers' technological competences and students' intrinsic motivation in all three subjects. In reading, the relationship was $\rho = 0.46$ ($p < .05$), in writing $\rho = 0.44$ ($p < .05$), while in mathematics $\rho = 0.41$ ($p < .05$). These values indicate that teachers' pedagogical use of technology is associated with increased student interest and satisfaction in learning in a sustainable manner across learning areas. However, the intensity of the relationships suggests that intrinsic motivation is also influenced by factors other than technological competence. Hypothesis H_2 is supported.

Spearman analysis showed the strongest relationships precisely in the identified regulation dimension. In reading, $\rho = 0.53$ ($p < .05$) was found, in writing $\rho = 0.49$ ($p < .05$), while in mathematics $\rho = 0.46$ ($p < .05$). These results indicate that teachers' technological competences are significantly associated with students' perceptions of the importance and value of learning. The higher intensity of these associations, compared to intrinsic motivation, suggests that technology particularly is associated with the reflective and meaningful dimensions of motivation. Hypothesis H_3 is fully supported.

The results showed no statistically significant association between teachers' technological competences and the external regulation of students' motivation. The correlation coefficients were $\rho = 0.27$ for reading, $\rho = 0.24$ for writing, and $\rho = 0.29$ for mathematics, with p values >.05 in all cases. These results indicate that teachers' use of technology is not associated with increased motivation based on rewards, pressure, or external control. Hypothesis H_4 is not supported (Table 6).

6 Discussions

The results of this study clearly show that there is a positive and statistically significant relationship between teachers' digital competences and students' motivation to learn. Correlation analysis showed a moderate positive relationship between these two variables at the classroom level. This finding suggests that teachers with more developed digital competences are better

able to create learning environments that foster active engagement and student interest in learning. This study aimed to examine the relationship between teachers' technological competencies and primary school students' motivation to learn at the classroom level. The main findings show that teachers' technological competencies are positively and statistically significantly associated with student motivation, especially with more autonomous forms of motivation, namely intrinsic motivation and identified regulation. These results support the contemporary literature that emphasizes that the impact of technology on learning depends mainly on the quality of pedagogical integration and teachers' professional competencies, and not on the presence of technology *per se* (OECD, 2020; Scherer et al., 2021; Tondeur et al., 2017). In line with hypothesis H_1, the correlational analysis showed a moderate positive association between teachers' technological competencies and overall student motivation. This result reinforces the argument of previous studies that technology does not directly affect students' learning experiences, but its effects are mediated by pedagogical decisions, teachers' ability to design interactive activities and reflective use of digital tools (Hattie, 2017; OECD, 2020; Tzafilkou et al., 2023). Teachers with more developed digital competencies are more likely to create learning environments that foster active engagement, involvement and sustainability in learning. Findings related to hypotheses H_2 and H_3 indicate that the strongest associations between teachers' technological competencies and student motivation appear in the dimensions of intrinsic motivation and identified regulation, in all three subjects: reading, writing and mathematics. These results are fully consistent with Self-Determination Theory, which emphasizes that supporting autonomy, developing a sense of competence, and meaningfulness of tasks are prerequisites for sustained and internalized motivation (Deci and Ryan, 2000; Guay et al., 2010; Ryan and Deci, 2020). Empirical studies show that technology, when used pedagogically purposefully, creates these conditions through personalizing learning, utilizing multimodality, and providing immediate feedback (Chiu, 2022; Schindler et al., 2017). In particular, the fact that the identified adjustment exhibits the strongest associations with teachers' technological competencies suggests that students experience learning as more meaningful and valuable when technology is used to clarify learning goals and connect content to authentic and real-world situations. This interpretation is consistent with the findings of studies that emphasize the role of technology in supporting reflection, deeper understanding, and knowledge transfer, rather than in increasing short-term interest (Chiu, 2022; Scherer et al., 2021; Schindler et al., 2017). On the other hand, hypothesis H_4 proposed a potential relationship between teachers' digital competence and students' external regulation. However, Self-Determination Theory typically has stronger associations with autonomous forms of motivation rather than controlled forms. In this sense, the absence of a significant relationship in the present study is theoretically consistent with previous research. This result is theoretically expected and supports the literature that argues that technology, when used as a pedagogical tool and not as an instrument of control, does not promote motivation based on external rewards or pressure (Bureau et al., 2021; Deci and Ryan, 2000).

Overall, the findings of this study highlight that the role of teachers' technological competencies on student motivation is not homogeneous, but depends on the pedagogical purpose of using technology. Competencies directly related to the organization of learning, didactic interaction and formative assessment exhibit the strongest impact, highlighting the need for professional development that focuses on the pedagogical use of technology and not only on technical skills (Hattie, 2017; OECD, 2020; Scherer et al., 2021). Although this study examined the association between teachers' digital competence and student motivation, it did not directly measure the instructional practices through which this relationship may occur. Previous literature suggests that the impact of teacher competence on student motivation is often mediated by classroom practices such as autonomy-supportive teaching, interactive learning activities, and digital formative feedback. Because these mediating mechanisms were not measured in the present study, the findings should be interpreted as indicating an association rather than a fully tested explanatory model. Due to the analytical approach adopted in this study, the effective sample size corresponds to the number of classes ($N = 20$) rather than the total number of students. While the study includes 350 students, student motivation scores were aggregated at the classroom level in order to match the level of measurement of teacher variables. As a result, the statistical power of the analyses is limited and the results should be interpreted with caution. The findings therefore provide exploratory evidence regarding the relationship between teachers' digital competence and student motivation rather than definitive conclusions.

7 Conclusion

This study provides empirical support for the relationship between teachers' technological competencies and student motivation, within the constraints of an exploratory classroom-level design. The findings show that teachers in the study sample possess average to good digital competencies, while students display relatively high levels of motivation, especially in its more autonomous dimensions. A key conclusion of this study is that the relationship between teachers' technological competencies and student motivation is not uniform across all forms of motivation. Technological competencies are significantly more strongly related to intrinsic motivation and identified regulation, while they do not show significant relationships with external regulation. This result confirms that technology, when used pedagogically purposefully, does not serve to intensify external control or rewards, but to support meaningful involvement and autonomous engagement of students. In particular, the findings suggest that teachers' use of technology helps students not only to show interest and enjoyment in learning, but also to understand more clearly why learning is important and valuable to them. The dominance of the regulation identified in all three subjects indicates that technology contributes to building the meaning of the learning content, making learning more connected to students' personal goals and concrete experiences. This aspect is particularly important in primary education, where long-term attitudes towards learning are established.

Overall, the study reinforces the conclusion that technology, in itself, is not a transformative factor in motivation to learn. It becomes so only when combined with developed pedagogical competencies and teaching practices that support autonomy, competence, and meaningfulness of learning. In this sense, teachers' technological competencies should be understood as an integral part of pedagogical professionalism and not as additional or instrumental skills.

Finally, this study contributes to the existing literature by providing empirical evidence from primary education and by using a classroom-level analytical approach that maintains consistency between the levels of measurement of variables. The findings support the need to shift the focus from simple technological investments to building teachers' professional capacities, with the aim of creating learning environments that foster sustained motivation and deep engagement of students from the early years of schooling.

8 Practical and political implications

From a practical perspective, the results suggest the need for purposeful professional development of teachers, focused not only on technical skills, but mainly on the pedagogical integration of technology in teaching and assessment. Training programs should emphasize the design of interactive activities, the use of digital feedback, and strategies that support autonomy and meaningful learning for students. At the institutional and policy level, the findings highlight the importance of including the DigCompEdu framework in national teacher professional development policies and in standards for assessing teaching practice. Investments in digital infrastructure should be accompanied by sustained investments in building professional capacities, so that technology serves as a means to improve the quality of teaching and not as an end in itself.

9 Limitations

This study should be interpreted with several methodological limitations. The study involved testing multiple correlations across different motivational dimensions and subject areas. Given the relatively small sample size at the classroom level, some statistically significant correlations may be sensitive to sample variation. Consequently, the results should be interpreted as exploratory patterns that require confirmation in studies with larger samples. First, the study design is cross-sectional and non-experimental, so the relationships identified between teachers' technological competencies and student motivation cannot be interpreted causally. Second, the sample size at the classroom level ($N = 20$) limits the statistical power and generalizability of the findings. However, the analysis was conducted at the classroom level to avoid aggregation errors and to maintain consistency between the levels of measurement of the variables. The use of non-parametric methods was methodologically justified given the structure of the data.

Third, teachers' technological competencies were measured through self-assessment instruments, which may be associated with perceptual biases or overestimation of real competencies. Although the DigCompEdu Check-In is a validated instrument and widely used in international research, future studies may benefit from combining self-reports with direct observations of teaching practice or other objective data.

Another limitation of this study is that the analysis did not include several contextual variables that may influence student motivation, such as teacher professional experience, student gender, socio-economic status, and school characteristics. These factors may play an important role in how students experience the learning process and may interact with teachers' digital competencies. Due to the limited sample size and classroom-level analysis, these variables were not included in the statistical model. Future studies with larger samples and multi-level designs could include these factors as control variables to further analyze the relationship between teachers' digital competencies and student motivation. Teachers' digital competence was assessed using a self-report instrument (DigCompEdu Check-In). Although this instrument is widely used in international research, self-assessment measures may be affected by social desirability or self-perception bias. Teachers may overestimate or underestimate their actual level of competence. Future studies could complement self-reported data with classroom observations or performance-based assessments.

Data availability statement

The datasets generated for this study are not publicly available due to ethical restrictions, as they include data collected from primary school teachers and students. The data are not intended to be made publicly available. However, anonymized datasets may be provided upon request to mirandalushaj@hotmail.com.

Ethics statement

The approval was obtained by the Municipal Directorate of Education of Pristina, as part of a series of research projects. Accordingly, the informed consent forms were provided to the school principals, who then distributed them to parents and teachers for their approvals and signatures. All methods in this study were carried out in accordance with the relevant guidelines and regulations, ensuring the protection of participants' rights, anonymity, and confidentiality.

Author contributions

VS: Conceptualization, Methodology, Visualization, Writing – original draft, Writing – review & editing. FR: Conceptualization, Funding acquisition, Writing – review & editing. ML: Software, Supervision, Validation, Visualization, Writing – review & editing.

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