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The how and how much of technology use in the classroom: a motivational approach to teachers' technology use

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ORIGINAL ARTICLE

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The how and how much of technology use in the classroom: A motivational approach to teachers' technology use

Loukia David | **Netta Weinstein**

Psychology and Clinical Language Science, University of Reading, Kozani, Greece

Correspondence
Loukia David, Department of Psychology, University of Reading, 7A Ptochokomeiou, Kozani 50132, Greece.
Email: loukia.david@pgr.reading.ac.uk

Abstract

Technology in the classroom can facilitate learning, but little is known about how the motivational climate set by teachers shapes its impacts on students. Informed by self-determination theory, the current study explored technology use in English language classrooms to understand how autonomy-supportive and structured teaching styles influenced positive outcomes of classroom technology use. Teachers ($N = 101$) reported on technology use and motivational styles, and students ($N = 550$) aged 9–16 years reported on basic psychological needs satisfaction (autonomy, relatedness and competence) and academic well-being (interest and effort). Findings of nested models showed no direct benefits for the amount of technology use; more autonomous teaching style and low structure linked to students' need satisfaction and interest. Beyond these main effects, when teachers were more autonomous, using technology enhanced student need satisfaction and interest; the combination of both was most beneficial for these student outcomes. Counter to expectations, when teachers had *low* structure technology use enhanced their impact on students. Findings suggest that to optimize student well-being and interest in learning, teachers benefit from combining autonomy-supportive education styles and technology use.

Raw data and analysis code for this study can be sent without undue reservation by emailing the corresponding author.

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KEYWORDS
classroom technologies, effort, interest, need satisfaction, SDT, teaching styles

1 | INTRODUCTION

Teachers' motivational styles in the classroom matter. A self-determination theory perspective to education (Ryan & Deci, 2017, 2019) posits that when teachers use autonomy-supportive styles—those that provide a sense of choice, self-expression and personal volition—students volitionally engage in learning activities and experience a sense of well-being in the classroom (Douwes et al., 2023). Such motivational styles also frame a broad set of teachers' behaviours and shape how they, in turn, influence learning. One such behaviour that may impact students' experiences is using technology. Technology is increasingly utilised in the classroom to create interesting educational resources to improve the classroom climate and teaching-learning process (Kosaretsky et al., 2022). With effective use of technology, students become more engaged and interested in learning because they are accustomed to using technology as a basis for exploration (Haleem et al., 2022). Integrating these views, we tested the expectation that the benefits (or costs) of technology use in education may also depend on the motivational climate teachers develop within the classroom, more broadly.

1.1 | Teachers' motivational styles and their outcomes

Research based on self-determination theory (SDT; Ryan & Deci, 2017) identifies two positive teaching styles that can enhance learning: autonomy-supportive and structuring. Autonomy-support teachers support students' sense of choice, personal volition and curiosity in the classroom. They seek to understand, and communicate in the service of developing, their students' innate interest, feelings, and preferences (Schabas, 2023). A structuring teaching style is understood as involving communications and other actions designed by teachers to guide (i.e., provide structure for) students. Highly structuring teachers strive to comprehend their students' abilities and assist them in feeling competent and mastering activities they assign in class (Meece, 2023; Vansteenkiste & Soenens, 2015). Autonomy-supportive teaching can complement teaching that is high structure; for example, teachers employing both may adjust lessons depending on their students' preferences (Aelterman et al., 2019; Hornstra et al., 2021). Past studies have suggested that autonomy support and structure can each result in positive outcomes for students (Curran et al., 2013; Jang et al., 2016, 2018; Vansteenkiste et al., 2012).

One such benefit is to satisfy students' psychological needs, namely those for relatedness, autonomy and competence (Ryan & Deci, 2017). The need for relatedness involves the experience of having meaningful connections with classmates and teachers. Autonomy need satisfaction is experienced in terms of having a sense of choice agency in one's learning; feeling that learning activities are self-driven and curiosity-fulfilling. Finally, the competence need involves feeling efficacious in meeting challenges and capable to pursue important learning goals; positive feedback and well-structured environments that have optimal challenges enhance healthy competence (Howard et al., 2021; Ryan & Deci, 2020). A substantial body of research has shown that satisfying these psychological needs within students is also linked to their academic well-being (David & Weinstein, 2023b), and that sets both outcomes are linked to teachers' autonomy-supportive teaching styles (Ryan & Deci, 2017; Vansteenkiste & Ryan, 2013; Wedell & Malderez, 2013).

We explored academic well-being in terms of students' interest in Burchard Erdvik et al. (2019), Howard et al. (2021) and effort (Basarkod et al., 2024; Hossain et al., 2023) towards their studies. These two indicators make important contributions to understanding students' learning outcomes. Interest in academic environments is an important quality of students' motivation that helps them to flourish during their education and sustain their

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engagement in learning over long periods (Ferrell & Barbera, 2015; Khasawneh et al., 2024). Effort, as well, is a helpful way to assess current academic well-being in terms of students' current engagement in their education (Goodman et al., 2011), and reflects time and energy a student invests in learning (Van Brussel et al., 2020; Van Gaalen et al., 2021). Effort is closely knit to value; when the student values a learning task, they put more effort in the learning process (Dietrich et al., 2017; Guo et al., 2016; Song & Chung, 2020; Willems, 2011).

Considering this literature in sum, we set out to test a first hypothesis, that

> **H1.** Autonomy-supportive teaching and structuring teaching would relate to greater psychological need satisfaction (for autonomy, relatedness, and competence) and academic well-being.

1.2 | How does technology use affect students?

In a largely siloed literature, researchers have suggested that incorporating technology into interactive teaching supports students' well-being (Bedwell et al., 2014; David & Weinstein, 2023a). Specifically, learning environments that are rich in technology use have proven to be useful for fostering the interactive learning climates that motivate intrinsic motivation (Hidayat et al., 2018; Reguera & Lopez, 2021). The majority of studies, to date, have sought to understand teachers' perception on the use of technologies in the classroom (Abdelraheem & Ahmed, 2015; Cahyono et al., 2023; Hidayat et al., 2018; Liu & Lai, 2023; Nariyati & Pratiwi, 2020; Nobre & Moura, 2017; Widiana et al., 2017) or students' perception on using technology for their learning (Erbas et al., 2015; López et al., 2023; Yu et al., 2023). Few have explored whether teachers' reported teaching styles links to students' psychological needs of autonomy, relatedness, competence and their academic well-being of interest and effort. We therefore sought to understand the connection between teachers' individual motivational differences and technology use in the classroom, and hypothesised that

> **H2.** Using technology in the class would relate to greater psychological need satisfaction for autonomy, relatedness, and competence, as well as greater academic well-being.

1.3 | Teachers motivation orientations and technology use

Motivational theories can help to explain how to optimize classroom technology use. Evaluating the use of technology within the lens of the SDT can help to understand how to promote intrinsically motivating learning environments, a goal that is essential for the 21st century learning methods (Kam & Umar, 2018). Such learning methods can be designed to optimally support autonomy, competence and relatedness satisfaction and enhance learners' intrinsic motivation, thus, in turn increases participation, engagement, excitement and academic performance (Nikou & Economides, 2018).

Indeed, educational psychologists assume that the use of technologies in the classroom enhances student motivation (Amadieu & Tricot, 2014; De Bruyckere et al., 2015; Schwartz et al., 2022). But results in support of this view are mixed. For example, Timotheou et al. (2023) identified a positive outcome of technology use and motivation while Zhang et al. (2024) observed no such benefits.

Mende et al. (2017) found support in favour of technology integration but stressed that it was not the use of technology that made the difference to students' experiences, but rather the nature of the activities that were performed with the assistance of technology that resulted in positive motivational outcomes. Other researchers have also highlighted that learning activities must be designed to provide inspiration and motivate students (Chiu et al., 2023). In a previous experiment examining an autonomy-supportive motivational intervention during an experiential classroom activity—with the use of "clickers" that engaged students in interactive quiz-like learning

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indicated that framing technology use in autonomy-supportive and structured motivations helped students experience greater psychological needs and academic well-being during the activity (David & Weinstein, 2023a). The current project extends this existing body of work to understanding individual differences in teachers' motivational orientations and technology use in the classroom and explores whether motivational orientation and technology use have added benefits when used in conjunction with one another. We hypothesised (H) that

H3. Autonomy-supportive teaching would moderate the effects of technology use on well-being. We anticipate that the highest well-being will be observed when technology use is paired with autonomy support.

H4. Structuring teaching would moderate the effects of technology use on well-being. The highest well-being will be observed when technology use is paired with high structure.

1.4 | Current research

Is it the amount of technology use, or the motivational climate in which it is delivered, that influences children's learning, or instead do the two have additive effects? Little work has been done to integrate these issues, but the knowledge is important for identifying how to invest in classroom resources (Antonietti et al., 2023). The current study explored technology use in an English language classroom in terms of three primary features: amount of technology use in the classroom, autonomous teaching style, and structuring teaching style, each which provide a particular motivation climate for technology use. We tested these issues in a sample of teachers and their students, connecting teachers' reports of their behaviours with students' reports of their learning experiences.

We tested these hypotheses in the context of foreign language education. Foreign language teachers have not yet realised the benefits technology offers and seek recommendations on *how* to use technology in their lessons (Tseng, 2018). This study sought to bridge the research gap that exists in the field of technology-enhanced foreign language learning.

2 | METHOD

2.1 | Participants and recruitment

Recruitment was conducted through the Pan-Hellenic Federation of Language School Owners in Greece. We set the inclusion criterion that student participants were between the ages of 9–16 years; there were no other exclusion criteria. We could not anticipate how many teachers and students would participate as we opened the study to all who wished to participate. However, we sought to maximize participant numbers to support nested data modelling. We aimed to obtain at least three student data points per teacher to model between as well as within data variability.

The study involved 550 students studying in Foreign Language Institutes in Greece. Of these, 338 were boys (61.5%) and 212 were girls (38.5%) between the ages of 9 and 16 years (age group 9–11, 31.6%; 12–14, 50.9%; 15–16, 17.4%) (Table 1). Data were collected during the school year 2021–2022 with the consent of their parents. The majority were Greek (94.3%) and the minority were Albanian (2.8%), Russian (1.5%), Polish (0.6%), German (0.4%), Kenyan (0.2%) and Bulgarian (10.2%) (Table 2).

Students were in classes taught by 101 teachers who worked at the equivalent Foreign Language Institutes, 89 women (88.1%) and 12 men (11.9%), between the ages of 21 and 64 years (age group 21–30, 10%; 31–40, 30%; 41–50, 29%; 51–64, 31%) (Table 1). The majority were Greek (93%) and the minority were American (1%), British (1%), Canadian (1%), and with dual-nationality Greek/Australian (3%), Greek/British (1%) (Table 2).

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TABLE 1 Percentage of gender demographics.

	Gender		Age groups (years old)						
	Male	Female	9–11	12–14	15–16	21–30	31–40	41–50	51–60
Students	61.5	38.5	31.6	50.9	17.4				
Teachers	88.1	11.9				10	30	29	31

TABLE 2 Percentage of nationality demographics.

	Albanian	American	British	Bulgarian	Canadian	German	Greek	Kenyan	Polish	Russian	Dual
Students	94.3	2.8		10.2		0.4		0.2	0.6	1.5	
Teachers	93	1	1		1						4

Teachers and students in their classes completed questionnaires concerning teaching and learning constructs described further below.

2.2 | Ethical procedures

The study received Ethics approval from the University Research Ethics Committee of the University of [masked] (num. 2022-046-NW) and was pre-registered (https://osf.io/r84kg/). Teachers and head teachers volunteered after being contacted through a community listserv to which the researcher belongs. The students' parents received the consent form via email and were asked to respond if they did not consent to their child taking part. Students opted-in with a separate consent form that was age-adjusted. Teachers, student participants and their parents were fully informed before the start of the study, including instructions on the nature of the study, their right to decline to answer any questions that they wished, their right to withdraw, and data handling. Raw data and analysis code for this study can be sent without undue reservation by emailing the corresponding author.

2.3 | Measures

Following consent procedures, students and teachers responded to surveys delivered through Qualtrics Survey Solutions after the surveys was translated into Greek and back-translated (see on https://osf.io/r84kg/). Surveys evaluated students' basic psychological need satisfaction and perceived academic well-being of interest and effort and teachers' teaching styles and technology use.

2.3.1 | Students' measures

Students completed the shortened Intrinsic Motivation Inventory (IMI; Deci & Ryan, 1985), reference shifted to lessons rather than task. Items were paired with a 7-point Scale options ranging from 1 "not at all true", to 4 "somewhat", to 7 "very true".

2.3.1.1 | *Basic psychological need satisfaction*

Students' perceptions that their basic psychological needs were satisfied were measured through three subscales. ***Autonomy*** was measured with three items: "I believe I have choice about doing this lesson," "I learn in the lesson because I want to," and "I do this lesson because I have to" (R) ($\alpha = .70$). ***Competence*** was measured with

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three items: "I think I am pretty good at this lesson," "After working at this lesson for a while, I feel pretty competent," and "I don't do well at this lesson" (R) ($\alpha = .75$). Finally, ***relatedness*** was measured with four items including "I feel close and connected to others during the lessons" and "I feel close to my teacher in class" ($\alpha = .85$).

2.3.1.2 | *Academic well-being*

Academic well-being was measured through self-reported interest and effort. Specifically, ***interest*** was measured with four items including: "I enjoy doing this lesson very much," and "I think this is a boring lesson" (R) ($\alpha = .84$). ***Effort*** involved four items including "I put a lot of effort into this lesson," and "I do not put much energy into this lesson" ($\alpha = .74$).

2.3.2 | Teachers' measures

Teachers were asked to complete a short survey on how often or whether they use technology in the classroom.

2.3.2.1 | *Amount of technology use*

How often technology was used in the classroom was measured with a 7-point Likert scale ranging from 1 "rarely", to 4 "often", to 7 "always".

2.3.2.2 | *Diversity of technology use*

For descriptive purposes, the type of technology use in the classroom was measured with a brief checklist. The teachers selected from options: interactive whiteboard with digital book, student response system, tablet, PC/laptop, Apps with students' mobiles (e.g., Kahoot), VR headset and other (with an open text response).

2.3.2.3 | *General motivational orientation*

Teachers responded to their behaviours across nine teaching domains (classroom rules, lesson plan, student complain, needing extra effort, transition to a new activity, student misbehaviour, arguing student, test results and remediation) taken from the Situation-in-School Questionnaire (SIS; Aelterman et al., 2019). This questionnaire was developed and validated by SDT experts (Evans et al., 2015; Taylor & Ntoumanis, 2007). Using a 7-point Likert scale ranging from 1 "does not describe me at all" to 7 "does describe me extremely well", teachers were asked to indicate the degree to which behaviours described their own style on two dimensions of interest: autonomy-supportive and structuring. ***Autonomy-Support*** was measured with nine items including "I offer a very interesting, highly engaging lesson," and "I listen with patience and understanding to what the students say about the test performance" ($\alpha = .70$). ***Structuring*** teaching was measured with nine items including "I show and teach them a helpful strategy for how to break down the problem to solve it step-by-step," and "I am clear about what the classroom guidelines and expectations are and I indicate what helpful, cooperative behavior is" ($\alpha = .77$).

3 | RESULTS

Frequency of technology use and diversity of technology use were measured for descriptive purposes. Teachers were initially asked whether they use technology in the classroom, 87.1% answered "yes" and 12.9% answered "no". They went on to respond to how often they use technology in the classroom (Table 3).

They then completed a short survey on what type they use. These technologies are described in Table 4.

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TABLE 3 Frequency of technology use in the classroom.

Amount	Rarely	2	3	Often	5	6	Always
Percentage	1.0	3.0	2.0	19.8	5.0	8.9	47.5

TABLE 4 Use of technology in the classroom.

Type	Interactive Whiteboard	Student response system	Tablet	PC/ laptop	Mobile apps	VR headsets	Other
Percentage	81	8	17	61	23	12	2

3.1 | Analytic approach

We analysed data with hierarchical linear modelling (HLM; Osborne, 2000) as it is best suited for nested data in education and other contexts, where in our case students were nested in teachers. Said another way, we accounted for the fact that multiple students shared one teacher (Sanfo, 2021). Student responses were therefore defined at Level 1, and teacher data were defined at Level 2. HLM models predicted students' academic well-being of interest and effort, and psychological need satisfaction from teachers' autonomy-supportive and structuring motivational orientations and amount of technology use in the classroom defined at Level 2. At level 2, we examined main effects and interactions between motivational orientation and technology use on each of the outcomes. No predictors were modelled at Level 1.

3.1.1 | Predicting perceived need satisfaction

Analyses showed no main effect of teachers' amount of technology use on students' report need satisfaction $F(1, 96) = 3.60$, $p = .061$. However, teachers who were high in an autonomous teaching style had students who reported greater need satisfaction $F(1, 95) = 68.52$, $p < .001$ (Means and effects summarised in Table 5).

Interaction effects showed two-way interactions were present between the amount of technology use and teachers' autonomy support, $F(1, 94) = 10.69$, $p = .002$. Examining simple slopes, for teachers low in autonomy support, there was no relation between technology use and need satisfaction, $b = 0.08$, 95% CI [−0.057, 0.218]. For teachers high in autonomy support technology use related to greater need satisfaction, $b = 0.15$, 95% CI [0.053, 0.252] (Figure 1 and Table 5).

Analyses showed no main effect on teachers' structuring teaching style predicting students' need satisfaction $F(1, 96) = 3.81$, $p = .054$ (Means and effects summarised in Table 6). An interaction effect was in evidence between the amount of technology use and teachers' structuring support in relation to students' need satisfaction, $F(1, 94) = 7.64$, $p = .007$. Examining simple slopes, for teachers low in structuring teaching style, technology use was linked to greater need satisfaction, $b = 0.15$, 95% CI [0.063, 0.226]. For teachers high in structuring teaching style, technology use did not relate to need satisfaction, $b = 0.09$, 95% CI [−0.032, 0.210] (Figure 2 and Table 6).

3.1.2 | Predicting academic well-being indicators (interest and effort)

There was no main effects present between teachers' technology use and students' interest, $F(1, 99) = 2.68$, $p = .105$. However, teachers who were high in an autonomous teaching style had students who reported interest, $F(1, 97) = 53.63$, $p < .001$ (Table 5).

Interaction effects showed two-way interactions were present between the amount of technology use and teachers' autonomy support, $F(1, 99) = 6.55$, $p = .012$. Examining simple slopes, for teachers low in autonomy support,

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TABLE 5 Nested data models predicting students' interest, effort, autonomy, competence and relatedness from teachers' amount of technology use, autonomous teaching style, and their interaction defined at Level 2.

	Motivation orientation—autonomous teaching style			Amount of technology			Interaction orientation X technology		
Outcome	***d***	***t***	***p***	***d***	***t***	***p***	***d***	***t***	***p***
Needs	1.70	8.28	<.061	0.39	1.90	.061	0.67	3.27	.002
Interest	1.49	7.32	<.001	0.33	1.64	.105	0.51	2.56	.012
Effort	0.20	0.96	.340	1.16	0.76	.447	0.09	0.42	.671

Note: *d* = effect size across linear time (Benchmarks for Cohen's *d*—0.2 small, 0.5 medium, and 0.8 large).

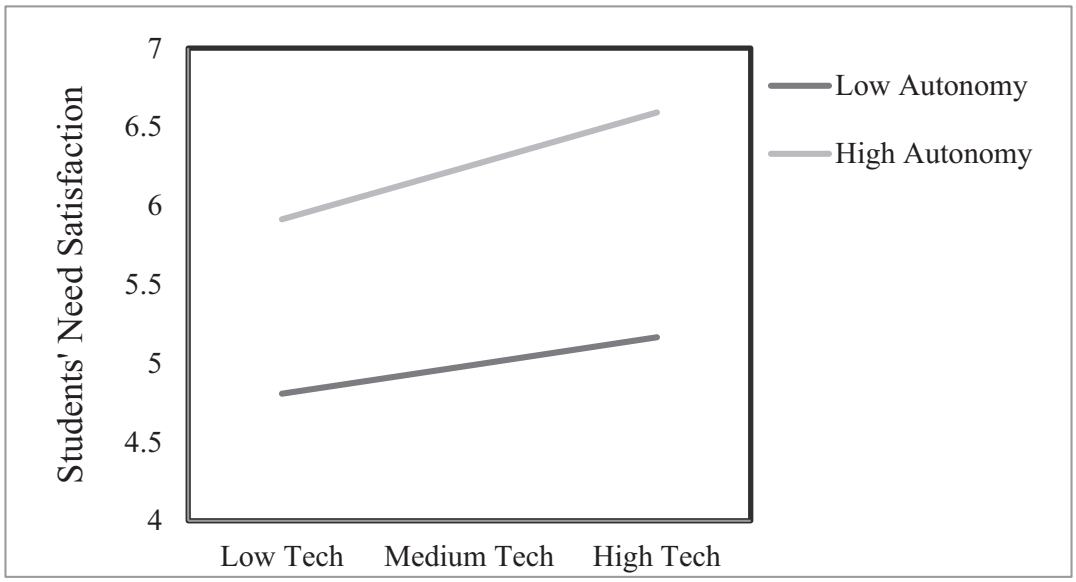

FIGURE 1 Autonomy-supportive teaching style × technology use effect on need satisfation. High Tech, high technology use in relation to other teachers in the sample; Low Tech, low technology use in relation to other teachers in the sample; Medium Tech, medium technology use. Lines represent low and high teacher autonomy orientation. Lines are plotted predicting students' need satisfaction in the classroom (*Y* axis).

there was no relation between technology use and interest, $b = 0.03$, 95% CI [−0.126, 0.175]. For teachers high in autonomy support technology use related to greater interest, $b = 0.17$, 95% CI [0.062, 0.280] (Figure 3 and Table 5).

There was no main effect on teachers' structuring teaching style predicting students' interest, $F(1, 101) = 1.01$, $p = .318$. Interaction effects showed two-way interactions were not present between the amount of technology use and teachers' structuring teaching style support, $F(1, 99) = 3.82$, $p = .005$. Examining simple slopes, for teachers low in structure, there was a relation between technology use and interest, $b = 0.13$, 95% CI [0.043, 0.221]. For teachers high in structure technology use related to no interest, $b = 0.06$, 95% CI [−0.068, 0.197] (Figure 4 and Table 6).

4 | DISCUSSION

Technology use in the classroom can facilitate learning, but the climate in which it is delivered may be important for student outcomes. The current study explored the role that teachers' motivational styles as autonomy-supportive and structuring play in children's learning experiences, operationalised in terms of basic psychological

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TABLE 6 Nested data models predicting students' interest, effort, autonomy, competence and relatedness from teachers' amount of technology use, structuring teaching style, and their interaction defined at Level 2.

	Motivation orientation—Structuring teaching style			Interaction orientation X technology		
Outcome	***d***	***t***	***p***	***d***	***t***	***p***
Needs	0.40	1.95	.054	0.57	2.76	.007
Interest	0.20	1.00	.318	0.40	1.95	.053
Effort	0.09	0.45	.654	0.07	0.36	.715

Note: *d* = effect size across linear time (Benchmarks for Cohen's *d*—0.2 small, 0.5 medium, and 0.8 large).

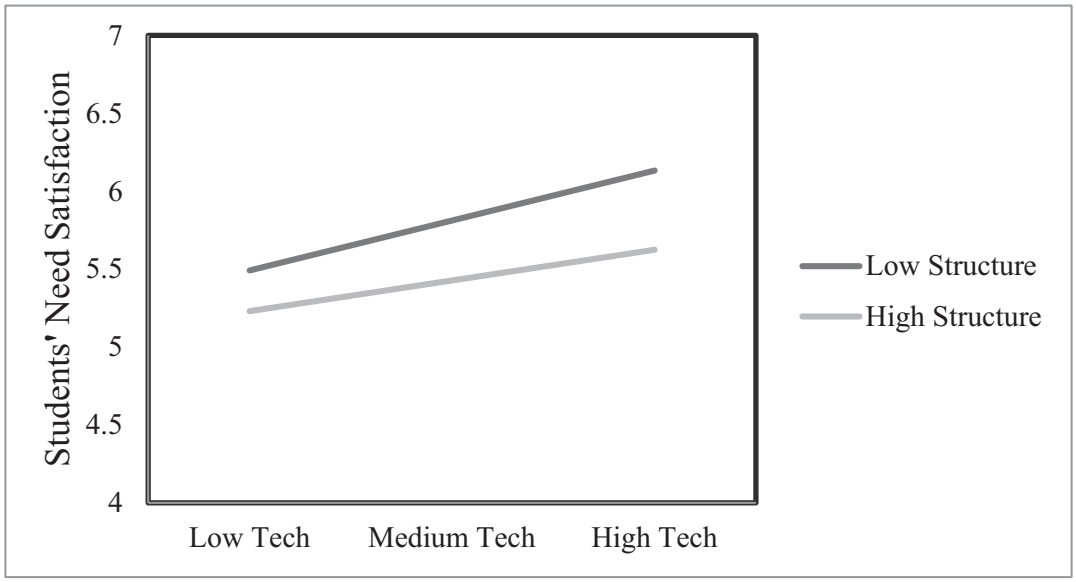

FIGURE 2 Structuring teaching style × technology use effect on need satisfation. High Tech, high technology use in relation to other teachers in the sample; Low Tech, low technology use in relation to other teachers in the sample; Medium Tech, medium technology use. Lines represent low and high teacher structuring teaching style. Lines are plotted predicting students' need satisfaction in the classroom (*Y* axis).

needs, and academic well-being of interest, and effort. We did so by assessing teachers' reports of their own behaviours (both motivational and in terms of technology use) across a variety of situations in schools to complement previous studies in which experimental manipulations were used to assess outcomes of technology use in schools (David & Weinstein, 2023a, 2023b; Luarn et al., 2023).

Findings showed no relation between amount of technology use and students' need satisfaction or interest, but a relation was present between autonomous teaching style and students' need satisfaction and their interest in learning. Our finding that an autonomous teaching orientation may benefit students is not new. However, more central to the current research question and extending previous work, technology use and teachers' autonomy-supportive motivation orientation had additive effects with the frequency with which they used technology in the classroom. Teachers with autonomous teaching styles benefited all the more from using technology in the classroom, such that technology had the greatest benefits on students' need satisfaction and interest for these teachers. Those teachers who used technologies in the lessons *and* provided autonomy-supportive teaching most enhanced their students' need satisfaction and interest.

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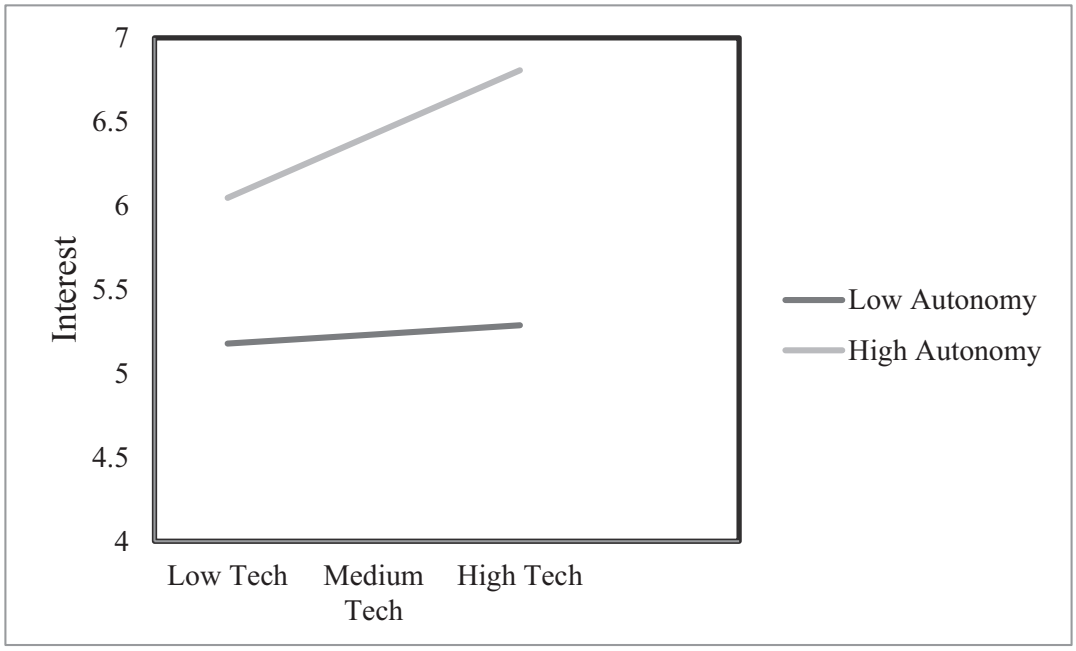

FIGURE 3 Autonomy-supportive teaching style × technology use effect on interest. High Tech, high technology use in relation to other teachers in the sample; Low Tech, low technology use in relation to other teachers in the sample; Medium Tech, medium technology use. Lines represent low and high teacher autonomy orientation. Lines are plotted predicting students' interest (*Y* axis).

These findings built on previous research showing that autonomy-supportive teachers' styles benefit student psychological needs satisfaction and academic well-being (Curran et al., 2013; Howard et al., 2021; Jang et al., 2010; Ryan & Deci, 2017; Vansteenkiste et al., 2012; Vansteenkiste & Soenens, 2015; Zhou & Gao, 2022). Our research showed that these benefits can be amplified when technology is used. When teachers combined their autonomy-teaching style with frequent use of technology, it formed an interactive teaching approach that strengthened the students' interest. Such an additive effect suggests that interventions to enhance interactive student academic well-being through experiential technologies that foster a dynamic exchange between students and teachers (Bedwell et al., 2014; David & Weinstein, 2023a) would benefit from the motivational climate within the classroom, more broadly.

The current findings also build on work investigating technology use in the classroom. Here, we identified that in the absence of an autonomy-supportive teacher style, technology use had no benefits for students' psychological needs and interest. Findings were aligned with the views of Bitner and Bitner (2002), who described the beneficial effects of technology integration in the classroom but stressed that it was not the use of technologies, themselves, that resulted in positive student outcomes, but rather the technology-based activities that were performed (Price & Kadi-Hanifi, 2011).

Our observations that autonomy-supportive motivational orientation enhances technology use effects further informs Huang et al. (2019), who described that activities are most effective for learning when they satisfy students' basic psychological needs for autonomy, relatedness, and competence (see also Squire, 2011; Wouters et al., 2013).

The findings for teachers' structuring behaviours were more complicated and did not support our expectations. When teachers were *low*, not high in structure, technology seemed to facilitate learning. However, in the current research we could not examine how autonomy support may have further affected this relationship. Autonomy-supportive style can complement structure, and it may be that technology would be most beneficial

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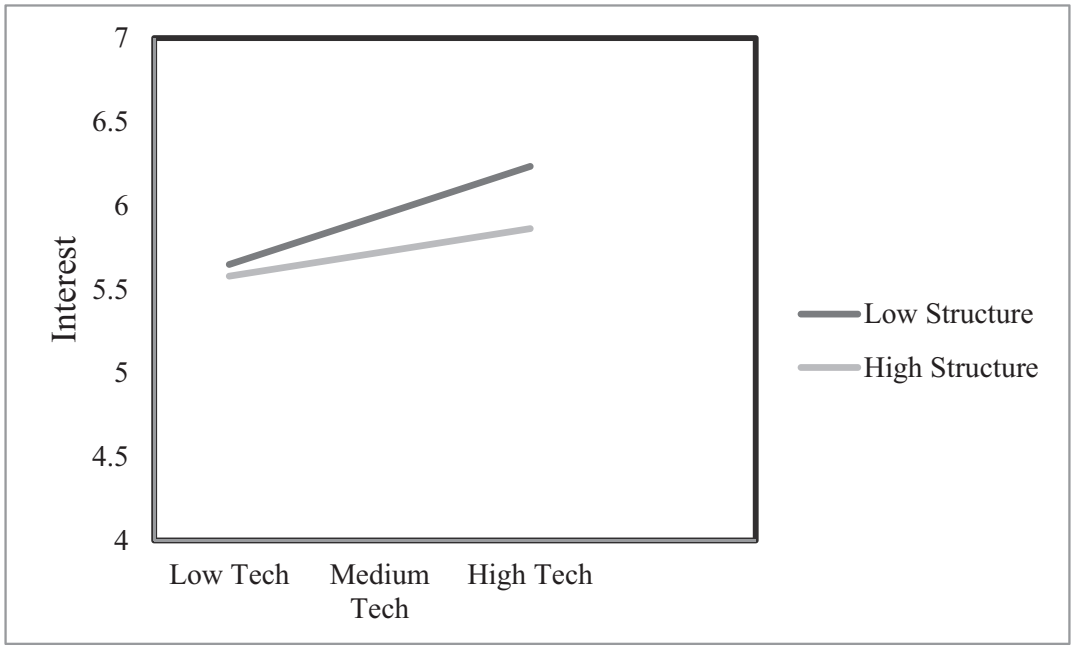

FIGURE 4 Structuring teaching style × technology use effect on interest. High Tech, high technology use in relation to other teachers in the sample; Low Tech, low technology use in relation to other teachers in the sample; Medium Tech, medium technology use. Lines represent low and high teacher structuring teaching style. Lines are plotted predicting students' interest (*Y* axis).

in the context of structure-supportive teaching that is also autonomy supportive (Aelterman et al., 2019). Indeed, past studies have suggested that autonomy support and structure are closely related and can result in the most positive learning outcomes (Jang et al., 2010; Sierens et al., 2009; Vansteenkiste et al., 2012). In the absence of autonomy support, structure may have felt demotivating and 'dry' (Aelterman et al., 2019; Haerens et al., 2016), and in those classrooms, using technology may have played a beneficial role in inspiring a sense of 'fun' that was otherwise absent for students. Were this the case, the ideal design would examine three-way interactions between structure, autonomy support, and technology use—but in our current study we did not have the sufficient numbers of teachers to conduct these analyses.

In all, our results in this study were also aligned with studies of students' experiences showing that students benefit most when they take part in digital activities without pressure (Luarn et al., 2023), and when they are involved in activities that they enjoy (Chang, 2013; Huang et al., 2012). However, they also indicated a broader motivational climate may drive these experiences of support. These findings also informed a previous field experiment that tested an autonomy-supportive motivational intervention during an experiential classroom activity to test its effects on academic well-being. Those findings showed that across time, students who received a gamified experiential technology intervention (GET; David & Weinstein, 2023a) in a supportive motivational framing experienced higher psychological need satisfaction.

It is worth noting that we did not find benefits of autonomy-supportive teaching paired with technology use on students' effort. However, few studies show a relation between effort and basic psychological need satisfaction (Liebendörfer et al., 2022; Schiefele et al., 2003) or between effort and interest (Schiefele et al., 2003), and effort may reflect task valuing that is independent from intrinsic motivation (Dietrich et al., 2017; Guo et al., 2016; Song & Chung, 2020; Willems, 2011).

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5 | LIMITATIONS

The current findings should be viewed in light of several limitations. One limitation had to do with our recruitment strategy and final sample size. As the recruitment was conducted through the Pan-Hellenic Federation of Language School Owners in Greece, there was no way of knowing how many teachers and students would participate in the study; we sought maximum participant numbers to model nested data and to test interactions between study variables but could not study three-way interactions or examine effects as a function of different technological devices used by teachers. The use of technology is, in reality, more nuanced, as is the interplay of different motivational climates created by teachers. Future well-powered research should examine these more complex relationships between motivation and technology use in larger samples, but we recommend that such studies once again measure both teachers and students rather than relying only on one of these two sources.

In addition, the study involved teachers and schools from private language institutes with learning contexts that may be specific to these settings. For example, students attended these schools approximately three times a week and results may not extend to full-time educational contexts. Alternatively, they may be more robust when the relationship between teachers and students is more involved. In addition, students were from a fairly high socioeconomic status and teachers generally had access to technology, if they wished to use it. Additional research should be conducted with more diverse learning contexts.

Finally, the study relied on survey responses collected from both teachers and students at a single time-point. Future research that examines these questions using experimental approaches (e.g., through motivational communication training or by introducing new technologies in the classroom), or approaches examining longitudinal associations, would be an important next step in the research.

6 | CONCLUSION

Evaluating nested models of students and their teachers, the current study provided insights regarding antecedents of psychological need satisfaction and academic well-being. Specifically, we observed that the beneficial effect on technology use on learning outcomes does not depend merely on *how often* technology is used, but rather on whether frequent technology use is delivered in the context of an autonomy-supportive teaching climate. Both were additive; teachers who used technology more frequently and engaged in more autonomy-supportive behaviours were particularly more satisfying to their students' needs for autonomy, relatedness, and competence and they reported more interested in their learning. In a nutshell, technology use engaged students' intrinsic motivation, especially when students felt deeply supported by teachers.

CONFLICT OF INTEREST STATEMENT

None.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID

Loukia David https://orcid.org/0000-0003-3935-9101

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