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Strategies for Engaging Students through Motivational Framing of Experiential Technology Use in the Classroom

PhD in Psychology

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Declaration of original authorship

"I confirm that this is my own work and the use of all material from other source has been properly and fully acknowledged."

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Declaration of Contributions

Chapter 3 was written as a paper, and was published in the European Journal of Psychology of Education under the title *"Using Technology to Make Learning Fun: Technology Use is Best Made Fun and Challenging to Optimize Intrinsic Motivation and Engagement".*

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These papers provide a review of the literature on Gamified Experiential Technology within the framework of Self Determination Theory. I carried out the literature reviews, conducted all the studies presented, analysed the data, and interpreted the findings. My supervisor, Netta Weinstein, as co-author, guided me throughout this process, developed the design, undertook the data analyses with me, and edited the manuscripts for submission.

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Abstract

This thesis dives into an understudied but important question for educators: how can we use technology in classrooms to truly inspire and engage students? Although gamified tools and tech-based learning are becoming more common to support learning in schools and in the context of focus – second language learning, little attention has been paid to how these tools can be designed and framed to meet students' deeper psychological needs and enhance their intrinsic motivation. Drawing on Self-Determination Theory (SDT), the research presented in the thesis takes an integrative look at the motivational power of technology in education, particularly focusing on how it can support students' needs for autonomy (sense of choice and volition), competence (sense of efficacy), and relatedness (feeling connected to others). Through a pilot study and three large-scale experiments with students aged 9 to 16 years, this thesis examines the importance of combining gamified technology with motivational framing strategies. These strategies include teamwork, friendly competition, and offering students choices in how they engage with technology-based learning. The results across studies suggested that when these strategies are thoughtfully combined with technology, students show greater interest in lessons and feel more engaged. Furthermore, these strategies helped to satisfy students' psychological needs for autonomy, relatedness, and competence, which indirectly linked motivational framing for technology with interest and engagement. Teachers' approaches also influenced the learning environment: When teachers used autonomy-supportive styles, encouraging curiosity and providing structure without pressure, the benefits of technology increased. By integrating insights from motivational psychology, technology design, and education, this thesis develops a triadic model of learning, where students thrive at the intersection of engaging technologies, supportive teachers, and an inspiring classroom environment. The findings suggest that technology, used the right way, can transform education—not just by making it fun but by nurturing deep, sustained motivation.

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Abbreviations

CD	Compact Disc
GET	Gamified Experiential Technology
GKO	Global Kids Online
HLM	Hierarchical Linear Modeling
ICT	Information and Communication Technology
IMI	Intrinsic Motivation Inventory
MSLQ	Motivated Strategies of Learning Questionnaire
PC	Personal Computer
SDT	Self Determination Theory
SIS	Situation-in-School Questionnaire
SPSS	Statistical Package for the Social Sciences
SRS	Student Response System
UK	United Kingdom
VR	Virtual Reality

Chapter 1

Strategies for Engaging Students through Motivational Framing of Experiential Technology Use in the Classroom

Background

Teachers aim to create ideal classroom environments for students to learn and progress through active participation and effort; they also want their students to find their lessons interesting and engaging (Flunger et. al., 2022) because engagement is the key to successful learning (Philp & Duchesne, 2016). Engagement refers to the students' active involvement in an activity and the extent of the activity being purpose-driven and goal directed (Hiver et al., 2024). However, even though engagement has been prioritized within the study of classroom education, it has not been given sufficient attention in practice (Mercer, 2019). It is not always easy to engage students. Children and teenagers to an even greater extent show very little engagement in lessons (Mahatmya et al., 2012). For example, a questionnaire administered to over 13,000 teenagers in Quebec measuring their engagement in high school showed that one-third reported decreases in their interest and willingness to learn. Students who showed low engagement from the start had higher risk of dropping out of school later (Archambault et al., 2009).

In the UK, a report found that over 700,000 18 to 24 year-olds and 55,000 16 to 17 year-olds were no longer in the education system during the second term of 2018 (NEET; Powell, 2018) and almost 11% of all youngsters in state education in the UK were absent persistently (DfE, 2018). Engagement is not solely an attribute inherent within the learner, but rather an accumulation or behaviors and attitudes that are affected by situational factors connected to the learners' developmental stage, socioeconomic income (Bae & Lai, 2020), the classroom setting and most importantly, their relationship with teachers, parents and peers

(Estell & Perdue, 2013; Wong et al., 2024). Theory speaking to the *motivational* climate within education argues that the key to students' engagement lies in providing a truly supportive educational context that inspires rather than forces engagement (Ryan et al., 2019). This literature furthermore argues that a focus on inspiring an interest and engagement in learning is ultimately more important than learning focused on grades and academic success, and equally important, for young people's well-being, and that indeed the latter focus threatens to undermine children's natural curiosity (Pulfrey et al., 2013; Ryan & Deci, 2000).

Recognizing this, the work conducting during my PhD was aimed at building on the literature concerned with motivational theory in education psychology (i.e., self-determination theory), to highlight its implementation alongside technology use in the classroom, and, building on siloed theory examining experiential learning and gamification in schools, to examine the combined benefits of supportive learning contexts that employ technology to in line with the motivational approach I study (Ryan et al., 2019; Ryan & Deci, 2020), I focus on intrinsic motivation – students' interest and engagement in learning – as key outcomes of supportive experiential education. I selected to focus on indicators related to intrinsic motivation, such as interest, effort and engagement, rather than focusing on academic performance to avoid undermining student motivation because of normative pressures to avoid discussing these outcomes (Wijsman et al., 2019), because measuring academic performance would enhance extrinsic motivation, directly contradicting principles of self-determination theory regarding the importance of intrinsic motivation, deep learning and sustained motivation or engagement (Ryan & Deci, 2017; Sun & Hsieh, 2018). In my studies, students were able to see their academic performance which was made possible because the technology gave feedback connected directly to their performance, progress over time and actions (Rigby & Ryan, 2011). It was vital for the game not to promote ego-based

competition but rather act more like a board game that helped students challenge themselves, have fun, and get positive feedback about their engagement, regardless of their performance (Akram & Abdelrady, 2023; Triantfyllakos et al., 2011). In a survey of students, for example, Pettit et al., (2015) found that friendly peer competition elicited the highest engagement in Student Response System learning during tiresome routine activities. In non-combative circumstances, having competition in the classroom is stimulating, and friendly peer competition is particularly engaging (Lehman et al., 2012). Research has shown that controlling or negative feedback can thwart competence (Na & Han, 2023), but intangible rewards which are also task contingent provide positive feedback for the students to improve and master the task (Davis & Singh, 2015). Other studies have also indicated positive outcomes (Bai et al., 2021; Christy & Fox,2014; David & Weintein, 2023; Landers et al., 2017; Landers & Landers, 2014; Pettit et al., 2015).

Setting the Scene for Learning Styles

Learning is defined as the process that contributes to the continuous formation and behavior of an individual (Kimmerie et al., 2015), which stems from a combination of practice and experience. It involves the acquisition of knowledge, strategies, skills, attitudes, beliefs which are affected by the ways in which the cognitive dynamics of the learner are shaped by various experiences (Bock et al., 2005). There are multiple ways to inspire learning.

Traditional Teaching

In *traditional teaching*, learning is teacher-centered, where the teacher imparts knowledge to the students and teaches a defined curriculum. Teachers are positioned opposite the "recipients," who are seated facing the front of the room. Hence, the teacher is in control of the learning process and the students play the role of passive recipients of knowledge.

There is little substantial interaction or exchanges between teacher and student (Newby et al., 2009). Arguments have arisen whether learning should be tailor-made depending on students' needs or students should see teachers merely as a source to obtain knowledge (Al-Zu'be, 2013); while the advantages of teacher-centered learning focus on syllabus completion, successful examinations and skill developments, students have reported that teachers who prioritize on these factors neglect their soft skill development (Nazaré de Freitas & Assoreira Almendra, 2022), including facilitating their problem-solving, critical thinking, creativity, communication and collaboration (Muganga & Ssenkusu, 2019).

Experiential Learning

More recently, the *"experiential learning"* method has gained traction. Experiential learning is a learning process based on the pedagogical principle of *"learning through practice"*. Experiential learning approaches are based on the view that students gain knowledge and skills to the extent that they can experience new things within their learning environment (Beard & Wilson, 2006). In this, it reflects a shift away from students being instructed or told facts, to students moving towards engagement and practice as they learn better in experiential situations when compared to teacher-centered learning and have higher performance in these contexts (Randler & Hulde, 2007). This has been evidenced within the context of learning English as a foreign language (Al-Zu'be, 2013; Nazim et al., 2024), alongside other contexts (Randler & Hulde, 2007). Experiential learning activities not only develop creative and critical thinking but also place knowledge in the long-term memory and stimulate positive attitudes towards learning in general (Ardeleanu, 2021).

It is assumed that the experience of learning will enable students to understand what they value – which will have an impact on their future life. In particular, with underachievers, students who do not have good academic results because they do not seek progress out of

laziness and lagging (Supendi, 2020), teachers feel that it is their duty to guide them so that they can ameliorate their learning performance. Teachers recognize, however, that the issue cannot be resolved by creating motivation, but by finding it where students already have it (Alderman, 2013). The motivation that is powerful enough to trigger experiential learning must be deeply embedded in the learner (Illeris, 2016). Thus, teachers aim to connect to the psychological or practical, external or internal potentials of their students' lives that are powerful enough to trigger motivation (Illeris, 2014). If they are able to do so, students show interest (Katznelson et al., 2017), invest their time, exert energy and persist on a task (Bakar, 2014). It is the drive that helps students to undertake the learning process with a positive attitude. The internal desire, urge, need to achieve their goal facilitates more sustained learning across the long term (Filgona et al., 2020).

Gamifying Learning

To achieve this type of learning, the field of education has considered ways to *gamify* learning. Gamification appears to be a promising way to create a culture of collaborative learning in the context of student-centered teaching approaches, and provides communication and teaching opportunities in the spirit of cooperation and teamwork (Li, 2023). This gives all students the right, regardless of educational ability, to participate in the learning process. It coheres with *'inclusive education,'* which aims to ensure equality in the classroom, but also other values such as the psychological needs of all students without exception and respect for diversity (Gordon-Gould & Hornby, 2023).

The definition of gamification is often confused with serious games or game-based learning. Gamification differs from these constructs in that it involves adding elements to games and adapting game techniques and designs to non-game environments to solve problems more effectively and to increase users' interest and involvement (Werbach &

Hunter, 2012). Gamification is not just a game, but a pedagogical practice that aims to increase students' intrinsic motivation and self-efficacy, and takes on an essential role in learning. Gamification is gaining ground today. Studies on the role of gamification in education have been conducted, but most deal with the tertiary sector where it is mainly applied to develop incentives in fields such as marketing and in the workplace (Thorpe & Roper, 2019). These studies have reported the positive effects of gamification in daily life (Oliveira et al, 2022). Recently, it has also been applied in the classroom in modern technologies (Sun & Hsieh, 2018, David & Weinstein, 2023, 2023a). Educational technologies in the class can help students with varying abilities and hence contribute to alleviating the pressure on the educational system (Obi et al., 2023). Using technologies in a gamified way provides an effective tool to create more experiential and creative activities which are more participatory for all, and thus enhance students' motivation (Manzano-León et al., 2022). This implies that techniques, methods and educational procedures in general must be flexible and adapted in each case such that learning needs are met without exception. One such technique is the use of gamification in inclusion (Smith & Abrams, 2019). This thesis investigated *how* gamification can be implemented in the classroom and more specifically *which* motivational framing strategies - with the use of technologies - can be used to trigger student motivation to enhance academic outcomes.

Digitalization has brought about many changes in education (Aldalur & Perez, 2023). These days, students are digital natives; they use their smartphones, tablets or computers to get informed (Chindia & Wawire, 2024). Responding to both the ubiquity of technology in young people's lives, and the power of technology to enhance the learning process specifically (Almufarreh & Arshad, 2023), methods of learning have undergone a transformation. Teachers have recognized that gamified learning without the use of technology will be soon obsolete (Luo et al., 2021). For this reason, they have adapted

technologies to the learning context, as well as aligning pedagogical methodologies with those technologies (Janssen et al., 2019). In this way, learning is adjusted to meet students' needs (Zourmpakis et al., 2022) and tailor-made to fit in to the 21st century digital world (Ayastuy et al., 2021).

Learning English as a Second Language with Gamification

English language teaching as a second language has its challenges (Fauziningrum et al., 2023) as students usually try to maintain their interest and motivation due to mundane exam-oriented lessons (Ningsih & Sari, 2024). Students find it difficult to memorize lists of new vocabulary and grammar rules (Montero Perez et al, 2018). They have reported that when they do not remember vocabulary their confidence is thwarted resulting in decreased motivation, interest and engagement in learning English (Huang et al, 2019). Nevertheless, introducing gamification in English language teaching classes have opened opportunities to create more interactive lessons (Wulanari et al., 2023). Using gamification is considered to be a prominent method to increase motivation, engagement and interest during a language learning process (Millis et al, 2017; Noroozi et al., 2016; Perry, 2015; Sundqvist & Wikstrom, 2015; Wu & Huang, 2017) due to the elements (dynamic and mechanics) which are embedded in the gamified environment (Wu & Huang, 2017). Integrating elements such as points on leaderboards and rewards create a sense of achievement in the learning progress that enhances intrinsic motivation; which is likely to assist the student to persist in learning languages showing increased effort (Wulanari et al., 2023). However, gamification in English language learning is not without challenges. Careful attention is required in assessments, pedagogical designs and technological constraints. It is vital to maintain a balance between fun, engagement and the learning objectives of the curriculum. Therefore, training and professional development of the teaching staff are necessary to assist them to incorporate gamification effectively in their teaching process (Wulanar et al., 2023). Huseinović (2024)

study indicated a high impact of gamified strategies on students' motivation to learn English as a second language; the students' performance in the four skills (speaking, listening, reading and writing) increased along with their motivation. According to Kaya and Sagnak (2022), using technology in language lessons in a gamified way increased motivation and positive attitude towards learning. Morthy and Abdul Aziz (2020) suggest that implementing games in language learning assists students to learn without feeling threatened. Gamification can be utilized at all levels and ages to improve their 21st century skills including listening, speaking, digital literacy and critical thinking (Kaya & Sagnak, 2022). Student autonomy is also enhanced since they are able to correct themselves without stress and fear of being criticized (Maloney, 2019). In line with Aydin (2024) gamified educational technology creates a meaningful collaboration in language learning that allows students to participate more effectively. Gamification may offer a partial solution to the decrease in student engagement and motivation. However, there is a lack of empirical evidence on how and whether it may improve motivation in the learning process (Luarn et al, 2023).

Summary of conceptual approaches to learning and implications for understanding the benefits of technology use in the classroom

As educators have increasingly acknowledged that children are energized and inspired by games, there has been a move to incorporate games in the classroom to scaffold students' learning (Tan et al., 2023). Technology-based gaming, inspired by the philosophy of experiential learning and gamification theory, provides a starting point to create a bond between the student and the content; i.e., to create an experiential interaction of the learner with the game (Burden et al., 2016). This can be achieved by placing the student in the role of the protagonist or the person who chooses what to do. A problem-based game can be created, where the students, as the problem-solvers, solve a problem, based on what they have been taught (Barab et al., 2010). Through different experiential activities in the form of

gamification, learners need to express themselves emotionally as they understand and accept the range of their emotions (Feldman et al., 2009). Technology is not necessary for creating these learning environments, but its appeal to students, flexibility, and immersive power makes it a possible ally for experiential interactive teaching (Fisher & Baird, 2020).

The Contribution of Technology to Learning

Technology use in the classroom orients students' interest and changes their cognitive objects into active subjects (Teng & Wang, 2021). In other words, technology puts students' deep-rooted values to use (Illeris, 2014) as it is deeply embodied in their daily life and learning culture (Beckman et al., 2014). Therefore, teachers are encouraged to utilize a diversity of devices and other state-of-the-art educational tools in class but also must understand *how* to implement them to succeed in creating more engaging and entertaining lessons for the students (Lopez-Fernandez, 2021).

These educational tools include the interactive whiteboard, a digital whiteboard operating in the same way as a touch screen. The digital whiteboard is a combination of a whiteboard, a computer tower and an overhead projector (Herawati, 2023; Kennewell & Higgins, 2007). It is the driver of digital changes in pedagogy (Yang & Teng, 2014), and is mainly used in the classroom to project a digital textbook or to show videos or internet resources to students. Herawati (2023) studied an elementary school in Indonesia to probe values, opinions, behaviors and social contexts. The results showed that the majority of the teachers used the interactive whiteboard to project the material in the publisher's e-book, to display PowerPoint presentations, and generally showed visual resources to enhance their lesson since their students preferred to be taught in a visual world. Erbas et al. (2015) found that high school students were more motivated and engaged to a greater extent in learning when the interactive whiteboard was used, as compared to students who were taught the

traditional way without technology. When teachers apply framing strategies such as collaboration activities and friendly challenges, the students' interest is sustained (Herawati, 2023). A student response system can be introduced to enable teachers to apply these strategies to *activate* their students and sustain their interest in the learning process (Goldstein & Wallis, 2023).

The Student Response System in the classroom

When a student response system (SRS; Liu et al., 2019) is connected to an interactive whiteboard it allows for interaction and feedback between teacher and students (López et al., 2023). Typically, SRS takes the form of a clicker system that incorporates two pieces of hardware: wireless handheld *"clickers"*; i.e., remote controls held by each student and the teacher, and a receiver which receives the signals from the clickers (Barber & Njus, 2007). It also has software installed on the interactive whiteboard which projects quiz-like exercises and displays and saves the students' responses on the leader board (Zhu, 2007).

The clicker system has proven helpful in lessons (Herrada et al., 2020) since it constitutes a type of gamified learning; namely, the use of games in non-gaming environments such as in education. It tends to stimulate learning and performance and enhance engagement where the goal is not to play a game but to use gaming elements to make the teaching-learning process more interactive to strengthen student motivation (Van Gaalen et al., 2021). The SRS allows the students to participate in gamified learning, which promotes engagement, excitement and fun by using game elements that they are interested in (González-Fernández & Jácome, 2016; Werbach & Hunter, 2012; Zainuddin et. al., 2020) and allows them to make an effort and demonstrate their knowledge to their teacher and peers, which generates a feeling of satisfaction and competence (O'Brien, 2016; Werbach & Hunter, 2012; Xi & Hamari, 2019).

In this thesis, the Gamified Student Response System (SRS), an experiential learning tool, is referred to as Gamified Experiential Technology (GET; David & Weinstein, 2023), which recognizes that SRS is merely one indicator that extends to other gamified educational tools such as tablets or smart phones (Burden & Kearney, 2018) that are also used as a Student Response System (when an application is downloaded; i.e., Kahoot!), and promote experiential learning (Fithriani, 2021; Kaimara et al., 2019) with greater student engagement (Turan & Meral, 2018). SRS-style applications facilitate the teacher-student relationship and enhance the socio-emotional phase in learning (Licorish et al., 2018). Applications (i.e., Socrative) enable teachers to create quizzes with true/false questions, multiple-choice questions and even open-ended questions, and can encourage students to work together and actively discuss and debate a topic before answering and being given feedback, similar to SRS (Pintado & De Cerio, 2017). These devices, however, were not used in the current set of studies as students are prohibited from possessing mobile smart phones or tablets within school premises; based on increasing norms to this end and work that suggests this can be disruptive to the classroom environment (Nikolopoulou et al., 2023). In addition, not all pupils aged 9 to 16 – the age groups of the current studies – possess a smart phone or tablet (Nikolopoulou et al., 2021). Given these restrictions, the technology already present in the classroom served as an ideal testbed for the learning principles I sought to test.

López et al. (2023) surveyed young adults' perceptions of learning with technology and the strategies they used. The results showed that the students considered that quick quizzes through an SRS system helped them master the topic and that the strategies and activities with SRS that involved peer discussions and quizzes motivated them the most. This study also tapped the social interest in learning and the characteristics of digital natives (Tuner, 2015). Using these tools, the teacher can reduce the distance between the cognitive objectives of traditional teaching, where the teacher needs to understand what to teach, teach

it, practise it with their students and give feedback (Patterson et al., 2010), to make learning more communicative while simultaneously inspiring and shaping a climate of cooperation, collaboration and teamwork by improving the learners' skills at the social level.

The learning process becomes more effective when it has a social component, since collaborative learning allows students to associate their initiatives and efforts. Here, the traditional method of drilling and automatic meaningless tasks is replaced by work where students cooperate to solve problems. This is enhanced when the problem solving is presented in a meaningful social context which allows the students to use their knowledge, and develop their skills while nurturing and developing their relationship with their peers and teachers (Domalewska, 2014).

This thesis is based on these theoretical approaches to learning, and recognizes the need for students to experience a more interactive and engaging learning context. Studies have investigated the power of games in the classroom (Deterding et al., 2011; Ryan et al., 2006; Sailer et al., 2017), and with technologies such as SRS (Freeman et al., 2017) which inherently has high motivational potential (Hense & Mandl, 2014; Przybylski et al., 2010; Rigby & Ryan, 2011). Thus, Gamified Experiential Technology (GET; David & Weinstein, 2023) has become a central theme in educational efforts (Sailer et al., 2017) to promote motivation in the classroom. Since gamified learning aligns well with theories of learning, most studies have adopted Self Determination Theory (SDT) as their prime theoretical framework. Today, SDT is the most frequently used psychological theory in gamification research (Seaborn & Fels, 2015).

The Self Determination Theory Approach: Basic Psychological Need Satisfaction for Optimizing Learning Outcomes

Self Determination Theory

Self Determination Theory (SDT) is a widely-applied theory investigating engagement and motivation (Deci & Ryan, 1985; Ryan & Deci, 2000, 2017). The theory posits that people have an inherent intrinsic motivation and curiosity for learning, which can be supported or undermined by the environment (Reeve, 2012). SDT further argues that when students are motivated intrinsically, this motivation can be observed through their higher engagement and, furthermore, that it results in long-lasting learning, memory and performance (Vansteenkiste et al., 2008). Intrinsic motivation is reflected in two educationally relevant constructs of interest in this dissertation: students' *interest* and *effort* with respect to learning (Niemiec & Ryan, 2009).

Educators contribute to students' learning when they understand and enhance their students' inherent motivation and inspire their engagement (Reeve, 2012). SDT argues that social contexts can facilitate or thwart intrinsic motivation by educating students in autonomy-supportive or controlling ways. Autonomy-supportive contexts involve motivating students by engaging their willingness and volition, whereas controlled contexts drive learning through a sense of obligation, pressure, or salient consequences (i.e., punishment; Deci et al., 2015). As described below, SDT argues that autonomy-supportive as compared to controlling contexts satisfy students' basic psychological needs in the classroom. From an SDT perspective, these basic psychological needs comprise relatedness, competence and autonomy, all three which ultimately provide students with optimal motivation to engage in the learning process (Vallerand et al., 2008). Indeed, a substantial literature shows that when children's basic psychological needs are met, they learn with greater intrinsic motivation (Ryan & Deci, 2017), which leads to greater engagement in an academic task or activity and more internal satisfaction (Deci & Ryan, 2010).

Basic Psychological Need Satisfaction

SDT posits that students are more likely to be intrinsically motivated and experience well-being when their three basic psychological needs for relatedness, competence and autonomy are met (Deci et al., 2015; Martin et al., 2017; Zhang et al., 2020). The more students exercise ownership and choice over their actions, the more they feel motivated and engaged, regardless of social status, gender or cultural context (Hoyt et al., 2012). The need for *autonomy* refers to being self-regulating and initiating, and to feel that one has a choice and the volition to act in line with one's values (Deci et al., 2008; Reeve, 2012); autonomous behaviors correspond to individuals' interests and values (Mercer, 2019). It involves a sense of having the initiative over one's own actions and is enhanced when the individual experiences interest and value. It is diminished by external control that implements either punishments or rewards. *Competence* refers to the psychological need to feel capable of achieving outcomes and pursuing challenges (Deci et al., 2008; Reeve, 2012). It involves a sense of mastery and that one can develop and succeed. Competence is enhanced in well-structured environments that support friendly challenges, friendly feedback and opportunities to develop and master a task over time. *Relatedness* refers to the psychological need to feel a connection with other people; namely, to feel that one is worthy of being respected, loved and capable of being in a meaningful relationship. Relatedness is satisfied when students feel a sense of belonging and security in a social group, and that they have bonds and attachments as well as mutual caring and understanding (Deci et al., 2008; Reeve, 2012, Skinner & Pitzer, 2012).

Activities that support these three psychological needs foster intrinsic motivation and lead to high quality learning outcomes (Carreira, 2012). In cases where the basic psychological needs are not met, activities can negatively affect intrinsic motivation and lead to low-quality learning outcomes (Ryan & Deci, 2009). SDT is a holistic theory positing that

humans are inherently prone to integrate and psychologically develop towards mastery, learning and connecting with people. However, these tendencies are not automatic and need to be supported to be robust (Ryan & Deci, 2020) in various fields such as education, psychology, health and business. SDT describes what motivates a person, how motivation can alter a person, and the ramifications of this change (Landers et al., 2015). Children's motivation is reflected in their self-reports and can be observed through other indicators such as students' observed engagement (Lee & Reeve, 2012) and perceived interest and effort in the learning process (Chen & Lee, 2023).

Summary and Research Questions

Teachers seek to create ideal engaging classroom environments for students to learn, be interested in participating, and make an effort. They enable students to find their lessons interesting and engaging (Flunger et al., 2022). Self-determination theory argues that need supportive environments are particularly beneficial for students' engagement and well-being (Ryan & Deci, 2000; Ryan et al., 2019). Specifically, self determination theory posits that three basic psychological needs - autonomy, competence and relatedness – must be supported for students to experience academic well-being as reflected in interest, effort and engagement. Teachers provide an important source of need support and can fundamentally change the learning environment for their students (Ryan & Deci, 2017). They are therefore essential to building positive academic well-being outcomes (Ahn et al., 2021; Cheon et al., 2020; Deci & Ryan, 2014; Koestner et al., 2020; Mageau et al., 2015; Ryan & Deci, 2020).

But even when supportive, traditional teaching methods – which utilize top-down instructional methods and places the student in a passive role – may not sustain an interest in learning in the same way as experiential approaches. Gamification offers a promising way to inspire students as it creates a culture of collaborative learning in the context of a student-

centered teaching approach, especially when state-of-the-art educational technologies are involved. This thesis therefore relied on self-determination theory to define *how* technology use is positively implemented to make learning more engaging and entertaining for students (Lopez-Ferandez, 2021).

There is little systematic data about gamified learning interventions involving the use of technology for school children, so that experiments in this thesis were concentrated on students aged 9 to 16. Other studies have mainly been conducted on university students (Annamalai et al., 2022; Benson et al., 2018; Çelik & Baran, 2022; Kent, 2019; Pearson, 2017; Tóth et al., 2019; Yu, 2020) and have not examined *how* motivational framing strategies (teamwork, friendly competition salience and choice) that enhance the basic psychological needs of autonomy, competence and relatedness and technology can be used together to optimize learning outcomes. Furthermore, to date, very few field experiments with children have been conducted that have manipulated technologies with autonomy supportive climates during lessons daily. Though, exploratory, I see one of the most exciting findings of the findings emerging from this thesis, the benefits observed over time when autonomy supportive climates along with motivational framing strategies of choice, teamwork and friendly competition salience – were implemented alongside technologies. Students were more engaged, interested and made more effort in class when GET use was delivered in autonomy supportive climates and with motivational framing strategies that satisfied their psychological needs of autonomy, competence and relatedness. Taken together, the literature suggests that more systematic investigation can offer further insights into motivational framings with the use of technology, and can enhance students psychological need satisfaction and academic well-being (interest and effort) and engagement. This led to the following research questions:

RQ1. How can GET make learning more fun and productive?

RQ2. Do teachers' motivational teaching styles when associated with the implementation of technology in their lessons impact students' learning outcomes?

Overview of Chapters

The work I present in my thesis incorporated insights from gamification, technology use, and experiential education literatures that highlights the importance of using and gamifiying technology in the classroom to inspire intrinsic motivation in student learning. Given the ubiquity of technology use in classrooms already and breadth of knowledge about its utility, I tested motivational framings for technology-based education tools that can shape its ability to produce the kinds of learning contexts that the literatures I review above value: one that is supportive of students and unlocks the power of technological tools.

The empirical portion of this thesis is organized as follows. Chapter 2 presents the literature on motivation in the classroom and how Gamified Experiential Technology facilitates motivation in the classroom, chapters 3 and 4 present research that addressed the first research question and present the results of in-class experiments that utilized GET with motivational framing strategies of teamwork, friendly competition salience and choice under the lens of SDT to enhance students' basic psychological needs of autonomy, competence and relatedness and in turn their academic well-being as manifested in interest, effort and engagement. More specifically, the pilot study, and Studies 1 and 2 (reported in Chapters 3 and 4) examined teamwork, the salience of friendly competition and choice through technology use in English language classes. More specifically, I used the Student Response System (SRS; Liu et al., 2019), which consists of a handheld device called a 'clicker' provided to every student and teacher by the school as it was the only equipment allowed to be utilized in lessons. This device enables the students to respond to questions projected on the interactive whiteboard simultaneously (Zainuddin et al., 2024). I based these studies on

SDT, a framework which posits that the satisfaction of three basic psychological needs (for autonomy, relatedness and competence) underlie the well-being indicators of interest and effort tested in the Pilot study and in Studies 1 and 2. My initial hypothesis was that GET would promote academic well-being to a greater extent than traditional frontal learning. In the pilot study, academic well-being as manifested in interest and effort were assessed at two time points. The findings showed that academic well-being increased over time when students used GET, but did not change when learning without GET. I then built on the conceptual model testing academic well-being to design Study 1 which compared different motivational strategies to deliver GET. More specifically, I randomly delivered GET to students in five different conditions: putting students in teams, giving them the choice to participate or not, engaging in a friendly competition, participating anonymously or the traditional classroom format. The findings showed that psychological need satisfaction could largely account for the relations between GET use and the academic well-being outcomes of interest and effort. The findings also showed that motivational framing strategies such as assigning students to using GET in teams, instilling a friendly climate of competition and helping students to feel that they had a choice further enhanced the benefits of GET use. The Pilot study tracked basic effects of GET use over time, and Study 1 examined immediate responses to motivational climates. I then integrated the methodological approaches of both studies to test the cumulative and long-term effects of a positive motivational framing strategy and psychological need satisfaction via GET in Study 2 (Chapter 3), alongside observational and behavioral data which were triangulated and aimed to show convergence with the self-reported student responses. In Study 2 the intervention utilized teamwork, made friendly competence-enhancing competition salient and created choice, compared to using GET without these additional enhancements.

The students were surveyed and observed at three time points throughout an academic semester. They reported increased psychological need satisfaction of autonomy, competence and relatedness and greater academic well-being. The observer ratings indicated more classroom behaviors of engagement and excitement indicative of intrinsic motivation as compared to the no-GET condition. Studies 1 and 2 were built on these motivational approaches as they relate to interactive learning and gamification in education. The findings thus inform those areas by providing insights into the acquisition of academic well-being through GET use in enhancing students' perceived and observed academic well-being since they showed that students were more engaged, enthusiastic, interested and willing to make an effort in class when GET was delivered in supportive motivational framings that satisfied their psychological needs.

Research Question 2 was explored in Chapter 5. Teachers' and students' reports were assessed to examine which teaching styles, when paired with using technology, related to greatest academic well-being of students. Although studies have shown that technologies in the classroom can facilitate learning, little is known about how the motivational framing strategy defined by teachers shapes its impact on students. Teaching traditionally – through lectures – may be ultimately undermining to intrinsic motivation. The SDT perspective on education posits that when teachers use autonomy-supportive styles; namely, 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 (Patall et al., 2010). Teaching can be made more fun through game play by utilizing technology since students are more accustomed to using technology as a basis for exploration (Haleem et al., 2022). Therefore, technology seems to contribute to learning, particularly when delivered with positive autonomy-supportive and structuring teaching styles that can enhance learning.

Autonomy-supportive teachers strengthen students' sense of choice, personal volition and curiosity. These teachers seek to develop their students' innate interest, feelings and preferences (Bartholomew et al., 2019). A structuring teaching style is defined as involving communication and other steps by teachers to guide (i.e., provide structure for) students. Highly structuring teachers strive to understand their students' abilities and enable them to feel competent and able to master the activities they assign in class (Vansteenkiste et al., 2019). In Study 3 (Chapter 5) I explored technology use in English language classes to better understand how autonomy-supportive and structured teaching styles influenced positive outcomes through classroom technology use. By evaluating nested models of students and their teachers, Study 3 provided insights into the antecedents of psychological need satisfaction and academic well-being as manifested through interest. Specifically, the findings showed that the benefits of technology use on learning outcomes did not depend solely on *how often* technology was used, but rather on whether frequent use of technology was delivered in an autonomy-supportive teaching style context. Both were additive in that technology use engaged students' intrinsic motivation, especially when students felt deeply supported by teachers. Teachers who incorporated technologies more frequently in their lessons and engaged in more autonomy-supportive behaviors were able to better meet their students' psychological needs for autonomy, relatedness, and competence, and the students reported more interest in learning

Hence, the broader teacher context also seemed to matter, which implies that the behaviors observed in Studies 1 and 2 should not be taken out of context. This finding is consistent with studies on motivational orientation in teaching which have suggested that autonomy support and structure can each result in positive outcomes for students (Curran & Standage, 2017; Jang et al., 2010; Jang et al., 2016; Jang et al., 2024; Sierens et al., 2009; Vansteenkiste et al., 2012), but extends them by suggesting that it is not the integration of

technology that matters but *how* it is utilized. Teachers benefit their students when they satisfy their students' psychological needs of relatedness, autonomy and competence (Reeve & Halusic, 2009; Ryan & Deci, 2017). A substantial body of research has shown that satisfying these psychological needs is also linked to academic well-being, and both sets of experiences are linked to teachers' autonomy-supportive teaching styles (Ryan & Deci, 2017; Vansteenkiste & Ryan, 2013; Wedell & Malderez, 2013).

Positionality in the Studies

The studies in this thesis contribute new insights into utilizing technology with motivational framing strategies that tapped on basic psychological needs in an autonomy-supportive way in the classroom. Studies 1 and 2 were conducted in a school which I, the researcher, am also the head teacher. This may result in ethical concerns, particularly around the potential conflict of interest in holding both these positions. I am a white woman in my mid-fifties and the head teacher for approximately 25 years, my interest was in how to frame the lessons in order to make English learning more interesting to students. There is no doubt that holding both positions may raise concern of positionality as it may be assumed that the results in these studies may have been affected by the nature of my observations and the interpretations (Lim, 2015). Positionality is understood as a biography of a researcher that pays attention to the researcher's identity and how it may influence the way that individual understands the social world they study (Lim, 2015). It refers to a broader range of contextual factors that may shape my identity as a researcher, and the role such factors have played in interpreting my studies. Coming to reflect on the research in my thesis, it is crucial to be aware of how my position as headteacher and researcher had created specific perspectives throughout. My background being a head teacher for 25 years, my likes and dislikes of educational technology, my vested interests as head teacher and expectations could be acknowledged as taking a central role in the research process (Bukamal, 2022).

As a teacher-researcher conducting these experiments within my own school, I occupied a dual role that directly influenced my positionality. My insider status offered advantages such as familiarity with the school culture, established relationships with staff and students, and ease of access to participants. However, it also presented challenges, particularly in terms of power dynamics and potential bias. My position may have affected how openly participants engaged, especially if they perceived me as part of the school hierarchy. Additionally, the involvement of me as the head teacher, who acted as a gatekeeper by granting permission for the research, may have further shaped participant perceptions regarding the purpose or independence of the study. To mitigate these effects throughout the process, I critically examined my assumptions and potential influence on data collection and interpretation. Ethical considerations were paramount, and steps were taken to ensure voluntary participation, anonymity, and the creation of a safe space for honest responses. All participants were informed about the voluntary nature of the research, their right to withdraw at any time, and the steps taken to ensure anonymity and confidentiality. The survey questions had neutral language to avoid leading responses, and where appropriate. Member checking was used to allow participants to review and clarify the accuracy of their contributions. Data triangulation further supported a balanced interpretation of findings. Finally, I made a conscious effort to distinguish my researcher role form my teaching responsibilities during all interactions, and ensured that data was securely stored and inaccessible. These measures aimed to support the credibility, trustworthiness, and ethical robustness of the research.

As a researcher, I had an active not passive role in acquiring knowledge of the research context; therefore, my position, the relation between myself and the participants, my background including gender, class, ethnicity, age, commitments and ideas (Lin, 2015).As a 55-year-old white British female teacher with extensive experience in the classroom, my

positionality has inevitably shaped this research. My identity encompasses multiple dimensions mentioned above, all of which influence how I view teaching, learning, and the educational environment in which these studies took place. My long-standing commitment to education and belief in inclusive, student-centred pedagogy underpin both my teaching practice and this inquiry. While my professional experience provided depth of understanding and credibility, it also carried the risk of interpretive bias, particularly a tendency to favour approaches that aligned with my values or teaching style.

In my studies, linguistic positionality mattered too in teaching English as a foreign language lessons like the lessons in my studies. When the researcher does not speak the same dominant language as the participants, data collection is affected. Consequently, the researcher's language becomes a form of power over the participants. Issues of power are required to be dealt with in research, especially in educational research as they are marginalized if not ignored. Most importantly, it must be acknowledged that linguistic positionality should be explored in educational research (Cormier, 2018). I attempted to address this problem by supplying surveys to the participants that were translated and back translated in Greek which was the participants' native language and age adjusted. To minimize any positionality issues data handling and results interpretations were done under the supervision of Dr Netta Weinstein, who was also a co-author of the three published studies.

Overall, the studies reported in this thesis which were published in journals (Study 1 in the European Journal of Psychology of Education; Study 2 in the Journal of Educational Technology Systems; Study 3 in the European Journal of Education) indicate that both the framing strategies and the implementation of technological tools in the classroom may work well together to enhance English learning. Thus, teachers are encouraged to invest in incorporating technology into interactive teaching to support students' well-being (Bedwell et

al., 2014; David & Weinstein, 2023, 2023a). Learning environments that are rich in technologies have proven to be useful in the interactive learning and can contribute to intrinsic motivation (Hidayat et al., 2018; Reguera & Lopez, 2021). Chapter 6 summarizes findings of all the studies and presents a triadic model of supportive education of young learners with GET, policy and school level implications, and I suggest that students would benefit if teachers could be educated about delivering experiential technology-based learning using autonomy-supportive motivational framing.

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Chapter 2

Motivation in the Classroom

Motivation

Motivation derives from the Latin verb *movere* which means to move (Metekohy et al., 2022). In other words, motivation is the incentive that prompts a person to make a specific choice to engage in an activity and to persist in a task (Ushioda, 2008). It also depends on which type of motivation is triggered by the activities used in the learning process (Borah, 2021). For instance, a distinction is made between intrinsic and extrinsic motivation to learn. Intrinsic motivation refers to the innate interest and enjoyment of participating in an activity, whereas extrinsic motivation refers to participating to achieve an external goal such as good grades or obtaining special benefits or rewards (Ryan & Deci, 2000). Early research examined motivation as a natural and emotional instinct deriving from the human unconscious mind (Freud, 1966). Motivation theories can be divided into three categories: hedonic or pleasure, cognitive or need-to-know, and growth or actualization (Roeckelein, 2006). Many theories and definitions have been developed to conceptualize the idea of motivation in mainstream psychology but there is no one theory that covers all facets of this complex notion (Ushioda, 2011). When teachers seek to nurture students' intrinsic motivation to learn, students will be more persistent and deeply engaged when their learning is driven by interest (Ryan & Deci, 2017). This claim has received support from dozens of empirical studies (Ryan & Deci, 2000a).

Need-Satisfying Motivational Climates in Education

This literature on gamified experiential learning speaks to a large body of evidence that shows students must be motivated to pursue learning in the classroom (Dabrowski &

Marshall, 2018), and healthy motivational climates drive constructive goal pursuit in educational settings (Ushioda & Dörnyei, 2017). One challenge educators face is how to keep their students motivated throughout the learning procedure, especially in an environment in which the acquisition of a foreign language worldwide occurs in a traditional setting involving long hours of exam-oriented preparation (Joe et al., 2017). Research suggests teachers do not consistently create need satisfying contexts that foster academic well-being (Gillet et al., 2012; Gnambs & Hasfstingl, 2016; Gottfried, 2009; Lepper et al., 2005; Scherrer & Preckel, 2019; Zee & Koomen, 2016). As a result, they risk losing their students' interest and engagement across time.

To mitigate this risk, researchers have applied the motivational framework of self-determination theory (SDT; Deci & Ryan, 2000). SDT defines the nature of motivation that outlines teaching practices to support students' intrinsic motivation to learn (Collie et al., 2019; Haerens et al., 2015, 2018; Vansteenkiste et al., 2012). SDT argues that teachers' teaching styles can satisfy their students' basic psychological needs - relatedness, autonomy and competence - and in turn their academic well-being (Reeve & Halusic, 2009; Ryan & Deci, 2017). Autonomy need satisfaction is the experience of the student who has a sense of choice and freedom to participate in an activity; competence involves the need to feel competent to participate in challenges given by teachers and relatedness involves the need to have meaningful relationships with classmates and teachers (Howard et al., 2021).

School interventions that have successfully satisfied basic psychological needs have increased student intrinsic motivation (Reeve & Cheon, 2021) and well-being (Tejada-Gallardo et al., 2020). One core SDT expectation in education is that need satisfying forms of motivation–when teachers understand, acknowledge and attempt to respond to their students' perspectives–increase student perceived academic well-being such as interest and effort and observed academic well-being of classroom behavior such as engagement and excitement.

Classroom interventions have understood teachers to play a key role in students' education and engagement, and argue that training teachers to adopt a more need support style encourages more student engagement and excitement (e.g., Reeve et al., 2004). Teachers also encourage students by providing purposeful and rewarding tasks and choices to engage interest (Ryan & Deci, 2020). In other words, students benefit when they are given a choice in their learning and when tasks are relevant to their interests (Dysarz, 2018; Patall et al., 2013). Research supports this view, showing need-satisfying teaching increases intrinsic motivation (Bao & Lam, 2008; Patall et al., 2008), performance (Murayama et al., 2015) and curiosity (Schutte & Malouff, 2019).

Intrinsic Motivation in the Learning Process

Intrinsic motivation involves acting out of enjoyment and interest, emerges from playing and exploring, and energizes behavior without external pressure or incentives (Ryan & Deci, 2017). Taylor et al. (2014) showed that intrinsic motivation plays a vital role in high academic performance. Froiland and Worrell (2016) found that it predicted student engagement and in turn higher school achievement. In contrast, researchers have suggested that intrinsic motivation in school activities decreases over the years (Scherrer & Preckel, 2019; Vallerand et al., 2008) and that schools do not seem to create need-supportive environments that adapt to this innate urge (Ryan & Deci, 2020). As a result, students experience depleted psychological need satisfaction (Gnambs & Hanfstingl, 2016). However, students are more active and focused when they participate in an activity with intrinsic value, and they also achieve a deeper understanding of the teaching material which they remember longer (Vansteenkiste et al., 2006), resulting in personal development, learning and adapting (Ryan & Deci, 2006).

Grading, as a motivational tool, holds students accountable for their academic performance and informs them, and others, of their achievements and performance-related

weaknesses, giving them the opportunity to set personal goals that further their academic success (Alderman, 2013). However, reliance on grades is fundamentally problematic within the self-determination theory framework used in this thesis, which sees their use as a fundamental threat to intrinsic motivation and self-regulation (Ryan & Deci, 2000). This view is supported by studies suggesting that the use of grading can thwart student motivation, and can even result in students abandoning their education completely (Chamberlin et al., 2023). In addition, students who have high grades may panic or doubt their abilities if they do not do well in one assignment (Stearns, 2023) and may not necessarily understand the material taught (Stehle & Peters-Burton, 2019). Finally, grades create unhealthy competition among peers, leading to stress and friction between students and teachers (Chun, 2024).

Gamified Experiential Technology Facilitates Motivation in the Classroom

Students' motivation is influenced by their social environment (Deci & Ryan, 2014; Weinstein et al, 2011), including by the motivational climate set by their parents and peers (Koestner et al., 2020; Mageau et al., 2015), but also very much so, by the motivational climates set by their teachers (Ahn et al., 2021; Cheon et al., 2020; Deci & Ryan, 2014; Ryan & Deci, 2020;). Less well known is how tools, such as technological tools, can work together with motivational principles to further enhance learning, despite the increasing use of these tools in the classroom (Latorre-Cosculluela et al., 2021). This thesis seeks to fill this gap in the literature by exploring *why* and *how* Gamified Experiential Technology (GET; David & Weinstein, 2023) can contribute to gamifying lessons and *motivate* students in the classroom. It builds on a nascient literature that suggests that GET acts as an incentive that can kindle students' interest in learning interacting and relating to teachers and peers, and generally makes the classroom atmosphere more harmonious (Chien et al., 2016). It also builds on work by Ryan and Deci (2006), which shows that supporting autonomy by giving informative feedback and providing the opportunity for meaningful choice facilitated intrinsic motivation.

When students can choose the tasks they prefer in GET and decide whether to participate or not, along with making friendly competition salient by informatively reporting their scores on a leader board, they will have greater intrinsic motivation to complete the activity (Schunk et al., 2012). In addition, the competitive effects experienced by playing a game that involves friendly peer interactions - with the use of GET - can enhance student engagement, and academic well-being (Burguillo, 2010).

Observed Engagement in the classroom as a Learning Outcome

Motivation is closely linked to engagement, to the extent that some scholars use these terms interchangeably. However, many researchers now insist on separating these two constructs (Ainley, 2012; Eccles & Wang, 2012; Martin et al., 2017; Philp & Duchesne, 2016). One way to distinguish engagement from motivation is to view *"engagement as the outward manifestation of motivation"* (Skinner & Pitzer, 2012, p.22) where motivation is conceptualized as the quality of one's energy, drive, intention, intensity and direction, while engagement is seen as the quality of one's energy in action (Appleton et al., 2006; Martin et al., 2017; Reschly & Christenson, 2012). In other words, motivation is an innate underlying perceived personal psychological tendency which cannot be observed, whereas engagement is more active and is a more observable behavior (Ainley, 2012; Martin et al., 2017; Reeve, 2012).

Studies have found strong correlations between engagement in the classroom and students' psychological need satisfaction (Aelterman et al., 2012). This multidimensional construct can be divided into emotional, and behavioral cognitive, and agentic engagement (Christenson et al., 2012; Reeve, 2013). Emotional engagement is said to be present when students show positive emotions such as interest while taking part in an activity and do not show anxiety or any other negative feelings. Behavioral engagement occurs when students

are involved in an activity and manifest interest, persistence and effort. Cognitive engagement refers to the sophisticated strategic approach students employ to learn rather than a superficial approach. Agentic engagement takes place when students actively contribute to the flow of learning by telling their teacher what they are interested in and what they need and want during the learning process. These four facets are inter-correlated and are strong predictors of students' academic development and well-being (Reeve, 2013; Reeve & Tseng, 2011).

Perceived Academic Well-Being Indicators: Interest and Effort as Learning Outcomes

Interest involves internal engagement with specific topics and activities, where the students are focused because the activities are closely connected to what they are interested in learning; the more interested students are in an activity or topic, the more willing they are to learn (Rotgans & Schmidt, 2014). Interest is conceptualized as a motivation variable which includes valuing the process and perceiving the importance of obtaining knowledge (Dohn et al., 2016). Interest is also seen as the motivational structure of a person; i.e., the tendency to want to be occupied with something (Renninger & Hidi, 2011) or the psychological state that can be observed by a teacher, for instance, which was created by an external factor (Krapp & Prenzel, 2011). When interest is triggered by an external factor, students are influenced by their environment. If this interest is maintained, they become more committed and can create a more meaningful context for the activity because they realize its importance (Abrahams & Reiss, 2012).

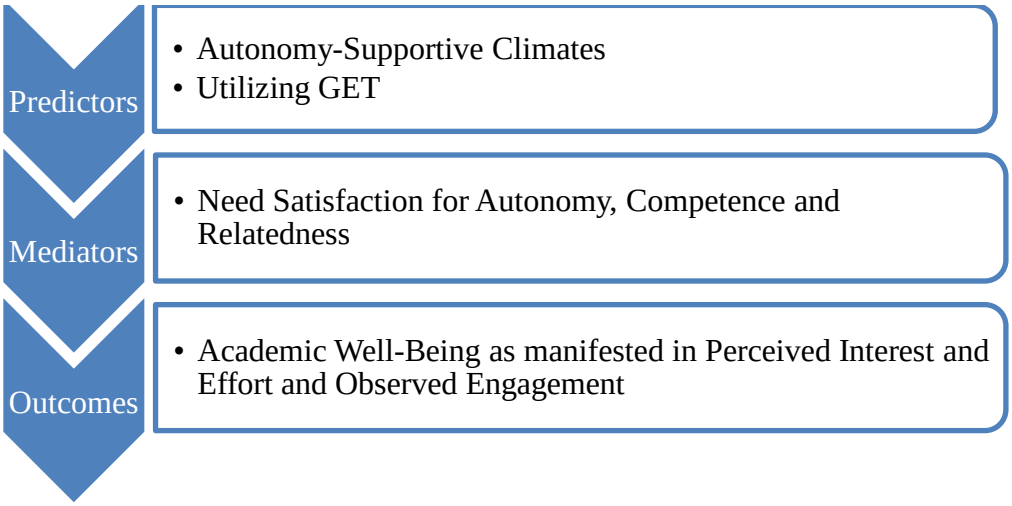
Effort refers to the willingness to engage in an activity; for example, when students perceive its importance for their learning development (Dunlosky et al, 2020). Students benefit when they understand the significance of the task, which can then contribute to their interest and intrinsic motivation to succeed (Malone & Lepper, 2021). Students' self-efficacy

determines their motivation level in terms of how much effort they put into an activity or task and how persistent they are when facing difficulties. If students believe in their capability, the more effort they invest in the task (Bai & Wang, 2023). Thus, self-efficacy is defined as individuals' judgement of their capability to execute and organize the steps needed for task accomplishment (Bandura, 2001). It also refers to the motivational goals as sustained by expectations. These expectations are important from a motivational standpoint since students behave in such a way that they can achieve what they value most (Dohn et al., 2016). Empirical research shows that the nature of the learning environment impacts students' academic well-being; teachers are encouraged to shape classroom climates and activities through their choices, pedagogies, communicative and interactive styles and feedback (Jang, 2019; León et al., 2015; Patall et al., 2008; Reeve et al., 2004; Vansteenkiste et al., 2006).

How to Design Classroom GET Climates to Maximize Engagement and Academic Well-Being Indicators of Interest and Effort by Satisfying Psychological Needs

The classroom climate plays a vital role since students' academic well-being is enhanced if their basic psychological needs of autonomy, relatedness and competence are met. Therefore, teachers are encouraged to foster autonomy supportive climates that can improve classroom environments by facilitating academic well-being (Wang et al., 2021; Wang & Degol, 2016). This thesis proposes a motivational model of academic well-being that consists of three pillars: predictors, mediators and outcomes. Students' autonomy support and the utilization of GET in autonomy supportive climates in the learning process constitute the predictors. Mediators consist of supporting students' basic psychological needs of autonomy, competence and relatedness. The outcomes are student high academic well-being as manifested in interest, effort and engagement. Integrating these interlinked motivational conditions in a coherent and theoretical approach are needed to comprehend students' academic well-being (Figure 1).

Figure: 1. Motivational Model of Learning Outcomes



Motivational Framing Strategies with Gamified Experiential Technology

In this thesis, I tested three motivational strategies framed the use of experiential classroom technologies: *teamwork, friendly competition salience and choice*. These were selected because each can be utilized by teachers to engage their students in Gamified Experiential Technology (GET; David & Weinstein, 2023; David & Weinstein, 2023a) to enhance their basic psychological needs (Girelli et al., 2018; Jang et al., 2016; Ryan & Deci, 2020) of autonomy (through salience and choice; Niemiec & Muñoz 2019), competence (through friendly competition; Jeno et al., 2018) and relatedness (through teamwork; David & Weinstein, 2023), and in turn their academic well-being operationalized as interest, effort and engagement (David & Weinstein, 2023a). These framing strategies utilize technology to inspire students to be intrinsically motivated during the learning process.

To promote autonomy need satisfaction, teachers could take the opportunity to encourage choice so that the students have the experience to opt in volitionally to an activity (Leo et al., 2022; Rissanen et al, 2023, Ryan & Deci, 2017) connected with technology that will assist their learning. *Choice* is associated with meaningful options as to what and when to participate and study, irrespective of any special requirements (Anderson, 2016). Research

on choice has shown that it is closely connected to motivation, task value, engagement and students' decisions to learn (Patall et al., 2008; Patall et al., 2010).

To support relatedness need satisfaction, students are encouraged to cooperate and collaborate with peers and teachers (Sailer et al., 2017); *teamwork* provides students with the reassurance of a proximal contextual factor to work together for their mutual success (Groh, 2012). Encouraging students to collaborate before responding to a question with the use of "clickers" for instance, increases active engagement and improves academic performance in the learning process (Shadiev & Yang, 2020).

Lastly, to enhance competence need satisfaction, students can be engaged in salient *friendly competition* by being shown their points and position on the leader board (Bai et al., 2021); technology gives feedback on students' progress over time and performance (Rigby & Ryan, 2011). To succeed in keeping the competition amiable and not egocentric, technology should be implemented like a board game that lets students challenge themselves, have fun, and be given positive encouraging feedback about their engagement regardless of their performance (Akram & Abdelrady, 2023; Triantfyllakos et al., 2011). Intangible rewards which are task-contingent can also provide positive feedback to encourage students to gradually improve and master a task (Davis & Singh, 2015).

These three pedagogical strategies of choice, teamwork and friendly competition salience can be mapped onto the three psychological needs of satisfaction of autonomy, relatedness and competence. The freedom of choice to participate in activities with technology supports autonomy, teamwork establishes the experience of peer connection and satisfies relatedness, and friendly competition provides constructive and enjoyable performance feedback that satisfies competence (Stroet et al., 2013; Vasconcellos et al., 2020). Aldemir et al, (2018) and Özdener (2018) found that gamification improved learning

outcomes with friendly competition and teamwork. Çakıroglu et al. (2017) showed that being involved in friendly competition meant more engagement. Abundant research has been conducted on autonomous instructions and the positive impact they have on learners' engagement in terms of emotion, behavior and cognition and by extension well-being. (Çakıroglu et al., 2017; da Rocha Seixas et al., 2016; Ding et al., 2017; Ding et al., 2018; Göksün & Gürsoy, 2019; Hassan et al., 2019; Huang & Hew, 2018; Huang et al., 2019; Lo & Hew, 2018; Sánchez-Martín et al., 2017; Tsay et al., 2018; Zatarain Cabada et al., 2018). Finally, gamified quiz-based tasks completed either at the beginning or the end of a lesson were shown to reinforce the learners' mastery of the lesson and made them feel competent, enhanced their motivation during the activities and improved their agentic, behavioral and cognitive engagement (Göksün & Gürsoy, 2019; Huang & Hew, 2018; Huang et al., 2019; Jo et al., 2018; Lo and Hew, 2018; Zainuddin, 2018).

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Chapter 3

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Using Technology to Make Learning Fun: Technology Use is Best Made Fun and Challenging to Optimize Intrinsic Motivation and Engagement

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Abstract

Educators have incorporated technologies designed to "gamify" or increase the fun and reward of classroom learning, but little is known about how these resources can be employed to create positive learning climates. Informed by self-determination theory (SDT), two experiments investigated a number of strategies teachers can use to frame one such technology, the student response system (SRS), when they use it as an educational tool to enhance its fun and contribution to positive learning environments. Participants (n=30) in a pilot experiment were randomly assigned to a 2-month experiment that showed that using SRS versus non-technology-based learning increases academic well-being. A primary study (n=120 students) experimentally manipulated the use of SRS with and without motivational framing strategies that were anticipated to enhance its effects, specifically by employing teamwork, friendly competition between students, and giving students a choice to participate. Results showed that motivational framing strategies enhanced students' need satisfaction for autonomy (sense of choice), competence (sense of efficacy in relation to learning), relatedness (to others in the classroom), and academic well-being (interest and engagement). In short, the use of interactive technology and how it was implemented in class was vital for enhancing students' learning outcomes.

Keywords: Gamifcation, Self-determination theory, Student response system, Motivational factors, Education technology, Clickers

Using Technology to Make Learning Fun: Technology Use is Best Made Fun and Challenging to Optimize Intrinsic Motivation and Engagement

Technology is increasingly used in educational contexts (Fernández & Jácome, 2016; Parra-González et al., 2020), across academic levels from early ages to university students (Parra-González et al., 2020). This is not new; games have been implemented in classrooms since the 1960s to engage students in learning (Piaget, 2013). Over time, more game structure and elements are employed when using forms of technology in formal educational environments (Fernández & Jácome, 2016). It is now recognized that technology can be used to "gamify" learning by promoting fun in the classroom (Zainuddin et al., 2020).

Gamification involves adapting game techniques and designs to non-game environments to solve problems more effectively and to increase the interest and involvement of users (Werbach & Hunter, 2012). The pedagogical practice aims to promote academic well-being in the classroom (O'Brien, 2016) through contributing to students' interest in specific classroom tasks (Perez-Manzano & Almela-Baeza, 2018) and supporting their engagement and effort in building academic knowledge (Xi & Hamari, 2019). Adapting gamification in the classroom, students are encouraged to actively engage in the learning process, to ultimately enhance academic outcomes (Groening & Binnewies, 2019). When a user voluntarily participates in the gamified activity, they experience more constructive intrinsic motivation that further shapes their learning behavior (Koivisto & Hamari, 2019).

Gamification can be incorporated into learning with or without the use of technology (Mee Mee et al., 2020). However, educators can use technological tools to provide students with more diverse and interactive learning environments (Huang & Hew, 2021) that are especially effective in engaging students (Qiao et al., 2023). Technology can therefore be thought of as a set of tools among others that can enhance the learning environment.

One gamified device that can be used in the classroom is the Student Response System (SRS; Liu et al., 2019) – a system that provides a handheld device called a 'clicker' to every student (Caldwell, 2007). This device enables students to simultaneously respond to a question that is projected on the whiteboard by the teacher who also uses a clicker. The SRS provides a form of "experiential learning" which transforms education through eliciting active engagement with materials, providing repeated practice that assists processing, and by utilizing experiences to access knowledge (Moore, 2018). In ideal conditions, it stimulates interest, the desire and predisposition to engage with specific contents like objects and tasks (Smith & Abrams, 2019).

For the purpose of this paper, the Gamified Student Response System (SRS) – a tool of Experiential Learning – will be referred to as Gamified Experiential Technology (GET), recognizing that SRS is just one indicator which we anticipated could extend to other gamified devices such as a smart phone or tablet that can be used as a Student Response System – if an app is downloaded – and equally promote Experiential Learning (Fithriani, 2021; Kaimara et al., 2019). Mobile apps are being increasingly used: In 2022, there were 255 billion app downloads as compared to 140.7 billion in 2016, an 80% increase (though the majority are used for gaming rather than educational reasons; Statista, 2023). Using a mobile app on each student's mobile instead of a clicker can reduce the cost of a classroom as SRS can be expensive and time-intensive to buy and maintain (Álvarez et al., 2017). However, for the purpose of this paper we relied on SRS to understand children's and adolescents' learning because few students aged 9 to 16 years of age own, or are permitted to bring to school, their own mobile phones (Liu & Lai, 2023).

We utilized the self-determination theory (SDT; Deci & Ryan, 1985; Ryan & Deci, 2000, 2002, 2017) a framework that postulates three basic psychological needs, for autonomy, relatedness, and competence, underly academic well-being indicators such as

interest and effort (Francisco-Aparicio et al., 2013; Peter et al., 2019; Ryan & Deci, 2002, 2020). The first of the basic psychological needs, autonomy, involves having the experience that one's behavior is driven by will or volition to perform a task based on interest and without pressure, coercion or direct incentivization by others (Deci & Ryan, 2012; Vansteenkiste et al., 2010; Vansteenkiste et al., 2012).

Second, relatedness refers to the experience that one has of closeness, trust and companionship with peers, such as with other students or a teacher. Students experience academic well-being when they feel secure learning and performing in the presence of other close and supportive peers (Deci & Vansteenkiste, 2003; Francisco-Aparicio et al., 2013). Third, competence need satisfaction refers to the experience that one is effective when undertaking tasks and challenges. Students feel competent when they take on interesting challenges within their skillset, and receive constructive performance-focused feedback in relation to their own learning goals. Such feelings of competence are vital for continued engagement in and out of the classroom (Vansteenkiste & Ryan, 2013).

Strategies in Gamified Experiential Technology

Applying SDT to the use of GET classroom technology such as the SRS, the three basic psychological needs of autonomy, relatedness and competence can be enhanced through modulating specific game elements. We posit different activity framing strategies– teamwork, friendly competition salient, choice and anonymity – that can be used by teachers as they engage children in experiential technologies to enhance the three basic psychological needs. These framing strategies are designed to *motivate* students; that is, they provide a context for technology use that inspires students to engage with and enjoy the learning activity.

Autonomy refers to the experiences of decision freedom and task meaningfulness, and is supported when students have the freedom of choice (Peng et al., 2012), and experience their participation as a volitional and meaningful engagement (Montessori et al., 2017;

Rathunde & Csikszentmihalyi, 2005; Rigby & Ryan, 2011). Using technology, educators can take the opportunity to build choice into their tasks to enhance the sense that students can opt in volitionally to the task, an important quality for promoting autonomy need satisfaction (Leo et al., 2022; Rissanen et al, 2023, Ryan & Deci, 2017). Choice allows for all students to have meaningful options about what and when to study or how they may participate, irrespective of whether they have any special requirements or not (Anderson, 2016). Research on choice provision has shown that it is associated with motivation, task performance, engagement and a preference for challenge and learning (Patall et al., 2008; Patall et al., 2010).

To support relatedness, the student can be given a meaningful collaborative role to play (Sailer et al., 2017); teamwork allows students to work together as one unit to succeed their goal (Groh, 2012). Allowing students to collaborate before responding to a question with a clicker increases active engagement and improves academic performance in the classroom (Shadiev & Yang, 2020).

Finally, the need of competence can be supported by friendly competition with the aid of the leader board, bar chart and points (Bai et al., 2021), made possible because the technology gives feedback connected directly to the students' performance, progress over time and actions (Rigby & Ryan, 2011). For this to be successful, the game should not promote ego-based competition but rather act more like a board game that helps students challenge themselves, have fun, and get positive feedback about their engagement, regardless of their performance (Akram & Abdelrady, 2023; Triantfyllakos et al., 2011). In a survey of students, for example, Pettit et al., (2015) found that friendly peer competition elicited the highest engagement in SRS learning during tiresome routine activities. In non-combative circumstances, having competition in the classroom is stimulating, and friendly peer competition is particularly engaging (Lehman et al., 2012). Research has shown that

controlling or negative feedback can thwart competence (Na & Han, 2023), but intangible rewards which are also task contingent provide positive feedback for the students to improve and master the task (Davis & Singh, 2015). Other studies have also indicated positive outcomes (Bai et al., 2021; Christy & Fox,2014; David & Weintein, 2023; Landers et al., 2017; Landers & Landers, 2014; Pettit et al., 2015).

Together, these three pedagogical strategies may map onto psychological need satisfaction. The freedom of choice to participate in GET supports autonomy, teamwork offers a sense of connection to other students that can satisfy relatedness, and friendly competition can help provide constructive and fun performance feedback that can satisfy competennce (Stroet et al., 2013; Vasconcellos et al., 2020).

Present Research

Empirical research on the effects of game elements on psychological need satisfaction is limited (Bitrián et al., 2021; although recent studies do call for more understanding of engagement with gamification; Fang et al., 2017; Ho & Chung, 2020). In the domain of education (Kasurinen & Knutas, 2018; Koivisto & Hamari, 2019; Seaborn & Fels, 2015) identify the need for more advanced classroom technology that adapts to modern students' needs (Montazami et al., 2022; Young, 2016). Further, technology should be fit for purpose. Otherwise, students may misuse the technology or may be distracted (Miller, 2012; Reichert & Mouza, 2018). Another critique of gamification apps is that they depend on the contingent and decontextualized utilization of external rewards which may reduce motivation (Ryan et al., 2021); more internalized forms of motivation should be encouraged to drive sustained learning (Kam & Umar, 2018). The SRS provides a distinct advantage as a fit-for-purpose teaching tool which offers little opportunity for distraction, but studies using SRS have to date been conducted primarily on University students (Çelik & Baran, 2021; Benson et al.,

2017; Pearson, 2017) or in one cross-sectional study (Sun and Hsieh, 2018) with seventh-grade students.

Learning methods that support need satisfaction enhance learners' academic well-being, in turn increases participation and engagement in the learning process (Lei, 2010; Nikou & Economides, 2016), enjoyment and academic performance (Li & Chu, 2021).

By evaluating GET with the lens of the SDT, we can explore ways to increase academic well-being indicators closely linked to intrinsic motivation to engage learning (Deci & Ryan, 2016). Our first indicator of academic well-being, interest in learning, refers directly to intrinsic motivation (Deci & Ryan, 1985). Utilizing adequate technologies can enhance student interest (Parong & Mayer, 2018), which motivates students from *within,* reflecting their natural instincts to learn (Dohn et al., 2016). The second, effort, refers to the willingness a student has to invest in the learning activity (Bai & Wang, 2023; Dunlosky et al., 2020; Malone & Lepper, 2021).

To understand the role of GET, we first conducted a pilot study to test the effects of GET uses on academic well-being, operationalized as students become interested in the lesson and show perceived effort in the learning activities. The main experiment (Study 1) was designed to build on the conceptual model testing academic well-being in the pilot study by exploring psychological need satisfaction as a link between GET use and academic well-being, and to compare positive motivational framing (specifically, teamwork, friendly competition, and choice) for delivering GET.

Hypotheses

Technology use in the classroom can make learning more interactive, engaging, and fun for students, but the way that technology is used by teachers – framed in gamified ways that support psychological needs or simply as another classroom activity – may drive its potential benefits. This assumptions have not been sufficiently tested, and the current

research set out to test them experimentally in classrooms randomly assigned to receiving technology-based or traditional learning (Pilot Study) and to motivationally framed learning (employing teamwork, friendly competition, and choice) or technology-based learning in the absence of motivational framing. These two naturalistic experiments provide the basis for drawing causal conclusions about the impacts of these educational tools on students' psychological needs and academic well-being. Hypotheses were pre-registered prior to Study 1 data collection, along with planned design and analytic approach (https://osf.io/phgs3/). SDT posits that supporting one psychological need (e.g., autonomy) activates another (e.g., relatedness), and indeed they show high correlations in previous research (Su & Reeve, 2011; Ryan & Deci, 2000). Therefore, we did not set specific a-priori hypotheses pitting one need against another. We hypothesized that:

H1a. When the students are assigned to Teamwork condition, they will report higher basic psychological need satisfaction as compared to Traditional Learning condition.

H1b. When the students are assigned to Teamwork condition, they will report higher academic well-being (interest and effort) as compared to Traditional Learning condition.

H2a. When the students are assigned to Friendly Competition condition, they will report higher basic psychological need satisfaction as compared to Traditional Learning condition.

H2b. When the students are assigned to Friendly Competition condition, they will report higher academic well-being (interest and effort) as compared to Traditional Learning condition.

H3a. When students are assigned to Choice condition of whether to participate or not, they will report higher basic psychological need satisfaction as compared to Traditional Learning condition.

H3b. When students are assigned to Choice condition of whether to participate or not, they will report higher academic well-being (interest and effort) as compared to Traditional Learning condition.

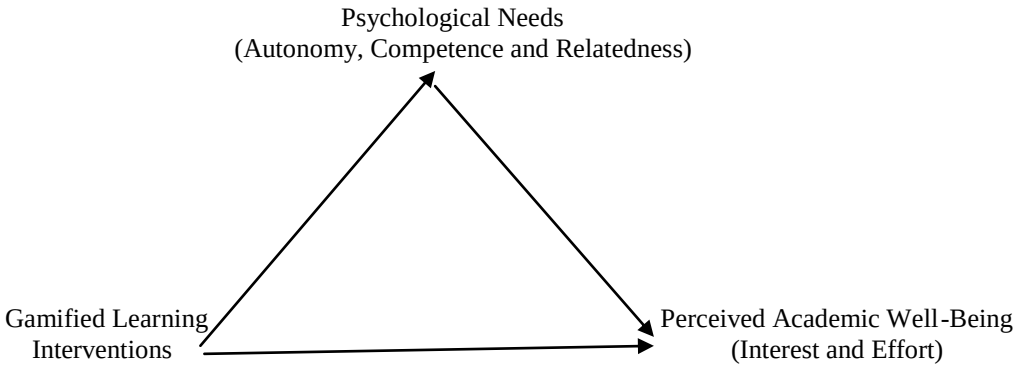
H4a. When the students are assigned to Anonymous condition, they will report higher basic psychological need satisfaction compared to Traditional Learning condition.

H4b. When the students are assigned to Anonymous condition, they will report higher academic well-being (interest and effort) as compared to Traditional Learning condition.

H5. Psychological need satisfaction would mediate the effects of condition on academic well-being (Figure 1).

Figure 1

Path diagram showing mediation



Pilot Study

A pilot study compared GET to traditional learning to examine the effects on academic well-being (in terms of interest and effort) in English lessons as a tool. Our initial hypothesis was that GET would promote academic well-being more so than a traditional learning comparison.

Method

Participants

The study involved 30 students studying at a private Foreign Language Institute in an urban area in Greece, 12 boys (40%) and 18 girls (60%) between the ages of 11 and 16 years during the school year 2019-2020, with the consent of their parents. The number of participants involved was determined by the specific classrooms to which we had access in the pilot study collection. All children (100%) had Greek citizenship, and Greek was their native language. Students in this pilot study came from an advantaged socioeconomic background and were technologically literate – they were aware of how to operate the SRS. The teacher (female, aged 50 with university degrees in English Literature and Psychology) who was responsible for both conditions had 25 years teaching experience in the private sector in a school that had a lot of technology in the classrooms. Specifically, every class had an interactive board and a student response system. The teacher was aware of how to develop the classroom-based intervention.

The English course using GET was attended by four (26.6%) boys and 11 (73.4%) girls and the traditional English course was attended by eight (53.4%) boys and seven (46.6%) girls. Students were assigned to one of two conditions: The Experimental group was taught with the aid of GET, which consisted of a transmitter, a clicker for each student and a clicker for the teacher. The Comparison group was taught through relatively traditional methods of using a whiteboard and a CD player.

Measure Instruments

Students responded to the Motivated Strategies of Learning Questionnaire (MSLQ; Pintrich et al., 1991) as it is a measure instrument designed to assess students' motivation and the use of learning strategies. The MSLQ includes two areas. The first refers to the social and motivational factors and the second to learning strategies. In this pilot study, a subset of items

from the first area was only used to evaluate outcomes of condition of interest and effort. Specifically, a total of seven items on a 5-point Likert scale where 1 is "*strongly disagree*", 2 "*disagree*", 3 "*not sure*", 4 "*agree*", and 5 "*strongly agree*" were used to measure academic well being of interest and effort. Three items measuring interest were: *'I like the subject matter of this course', 'It is important for me to learn the course material in this class'* and '*I am very interested in the content of area of this course'.* Effort was measured with four items: *'If I wanted to change, I am sure I could', 'When I have a goal, I can usually plan how to achieve it', 'I'm good at finding different ways to get what I want' and ' I can achieve goals that I have set for myself'.* In this pilot study, Cronbach's alphas for the interest items were α = .82 and for the effort items α = .64.

Condition. The class randomly assigned to the GET condition used the interactive whiteboard consisting of a computer, a projector through which the material of the digital book was projected on the whiteboard and two speakers. SRS used in the GET condition consisting of a transmitter and a clicker for each student and a clicker for the teacher (Figure 2). A second class, randomly assigned to Traditional Learning, used the traditional white board and a CD player for their lesson.

Figure 2

Student Response systems (SRS) used in the GET condition.

Procedure

The experiment took place across a period of two months. Students participated in English lessons three times a week for 90 minutes. At the start of a teaching semester, students reported on demographics and completed the questionnaire. Classes were randomly assigned to either a GET or Traditional Learning condition. The GET condition employed the interactive whiteboard as a necessary tool for the SRS. The students watched short videos based on the texts and listened to the audio parts. Exercises were also corrected with the help of the interactive whiteboard. The clickers were introduced in the final twenty minutes of every session. The teacher displayed two sets of 15 questions concerned with grammar and vocabulary. Students had 30 seconds to answer each question using their clickers. For the last 10 seconds, a sound was heard from the speakers so that the students could respond in time. At the end, a bar chart with percentages for the correct and incorrect answers was displayed and the students were informed of their points and the time they took, using a leader board and progress bars.

The Traditional Learning group received identical lessons, but through traditional means (i.e., using textbooks, written tests, whiteboard and CD player). They followed the lesson with the help of the teacher and used the traditional CD player to listen to the audio part of the lesson. The correction of the exercises was done orally.

Both conditions were based on Level B1 of the Common European Framework of Reference for Languages (Council of Europe, 2001). Consequently, the same syllabus from the same course book, grammar book, workbook and vocabulary were taught. At the end of the two months students completed the same questionnaire measuring interest and effort.

Data analytic strategy. A repeated measure analysis of variance (ANOVA) was conducted with time defined as a within-person variable with two levels: Baseline and follow-up. Condition was defined as a between-person predictor. Data were analyzed using

IBM SPSS Statistics, version 28.0.0 (190). Raw data and analysis code for this study can be sent without undue reservation by emailing the corresponding author.

Results

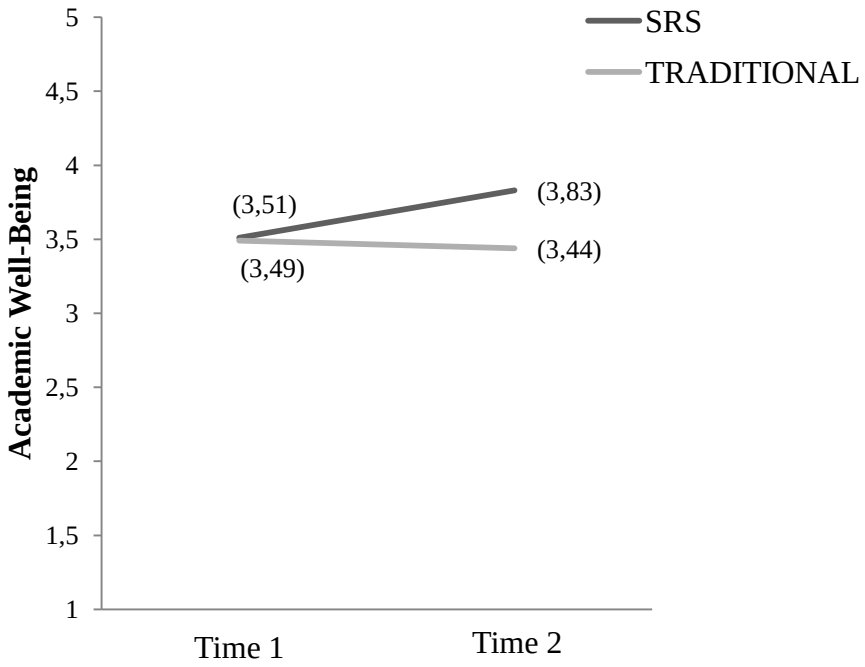
Sample Characteristics

A Shapiro-Wilk's test ($p > .05$) (Razali & Wah, 2011; Shapiro & Wilk, 1965) and a visual inspection of their histograms, normal Q-Q plots and box plots showed that academic well-being was normally distributed with a skewness of 0.157 (*SE* = 0.427) and a kurtosis of 0.370 (*SE* = 0.833) for Time 1 and a skewness of -0.427 (*SE* = 0.427) and a kurtosis of -0.113 (*SE* = 0.833) for Time 2. Inspecting academic well-being separately as interest and effort were also normally distributed, with Interest Time 1 having a skewness of -0.787 (*SE* = 0.427) and a kurtosis of -0.450 (*SE* = 0.833) and Interest Time 2 having a skewness of -0.119 (*SE* = 0.427) and a kurtosis of -1.207 (*SE* = 0.833). Effort Time 1 having a skewness of -0.074 (*SE* = 0.427) and a kurtosis of -0.295 (*SE* = 0.833) and Effort Time 2 having a skewness of 0.399 (*SE* = 0.427) and a kurtosis of 0.422 (*SE* = 0.833) (Cramer, 1998; Cramer & Howitt, 2004; Doane & Seward, 2011).

Academic well-being results. Analyses showed a significant interaction wherein the students increased in academic well-being as a function of condition (GET or traditional), $F(1, 28) = 6.45$, $p = .017$, $d = .96$. We proceeded to investigate this interaction by splitting up the two types of education. In the SRS condition academic well-being increased from baseline to follow-up ($t = 2.84$, $p = .013$, $d = 1.52$). In the Traditional condition there was no change from baseline to follow-up ($t = 0.54$, $p = .601$, $d = 0.29$) (Figure 3).

Figure 3

SRS and Traditional conditions X time interaction predicting well-being



Conclusion

Results of the pilot study showed academic well-being (students' interest and effort) increased across time when students used classroom technology but did not change when using traditional learning.

Study 1

The purpose of Study 1 was to build on the conceptual model testing academic well-being, and to compare different motivational climates for delivering GET. More specifically, we tested motivational framing for Gamified Experiential Learning (GET) by putting students in teams, giving them choice to participate or not, to be part of friendly competition or to participate anonymously. Hence, we investigated the role of GET as an educational tool and its relationship with the development of autonomy, relatedness, and competence of SDT, resulting in greater interest and effort thus academic well-being (Figure 1). In the Pilot Study we had focused on the use of technology (interactive whiteboard and SRS) throughout an

academic semester compared to traditional learning without technology to measure the academic well-being indicators of interest and effort. Study 1 built on these findings by using the interactive whiteboard with all classes to isolate only the effect of SRS in the experiment and to measure the outcome of academic well-being mediated by the three basic psychological needs of autonomy, competence and relatedness.

Method

Participants and Design

The study involved 120 students studying in a private Foreign Language Institute in an urban area in Greece, including 65 boys (54.2%) and 55 girls (45.8%) during the school year 2020-2021. Students varied in ages from nine to sixteen years old (M = 12.58, SD = 2.4). The number of participants involved was determined by the specific classrooms to which we had access in the study 1 collection. Students in Study 1 came from an advantaged socioeconomic background and were technologically literate – they were aware of how to operate the SRS. The teacher who was responsible for both conditions was the same teacher who conducted the Pilot Study.

Transparency and Openness

Because we were testing young children and using a relatively subtle manipulation of GET, we anticipated a small effect size across all measures. Therefore, based on a power analysis anticipating f=.20, and setting power at .90 for an omnibus effect across groups (which required n = 36). We aimed to recruit n = 40 per age group (9-11 years, 12-14 years, 15-16 years). There were no exclusion criteria set.

The study received Ethics approval from the University Research Ethics Committee of the University of (masked) (num. 2020-175-NW) and was pre-registered

(https://osf.io/phgs3/) prior to data collection, along with planned design and analytic approach. Raw data and analysis code for this study can be sent without undue reservation by emailing the corresponding author.

An email was sent to the parents of the students with the details of the experiment. Both parent and student consented prior to the start of the experiment. All students took part in four experimental conditions using GET, as well as one comparison condition that used traditional learning to compare the different motivational climates. As such, this study involved a 5-factor within-subjects design presented in a random order.

GET conditions involved a clicker for each student and a clicker for the teacher as in the Pilot Study. The difference in Study 1 is that the GET conditions made one of four motivationally-relevant framing salient:

1) Teamwork, in which students were allowed to collaborate in teams of three before clicking on the answer.

2) Friendly Competition Salient, where the students worked alone and after answering all the questions in each set, were shown their scores on the leader board.

3) Choice, where the students were allowed to choose whether to participate or not.

4) Anonymous, where the students participated without revealing who they were on the leader board as only numbers were shown.

As a Comparison condition, the students also took part in a Traditional Learning condition where they answered the same set of questions on paper instead of using GET; nevertheless, the condition was matched in terms of the duration of the manipulation, and the general content of learning was identical.

At the end of each procedure the students answered the Intrinsic Motivation Inventory (IMI; Deci & Ryan, 1985) which was delivered through Qualtrics Survey Solutions after the

survey was translated into Greek and back-translated (see on https://osf.io/phgs3/). The data were analysed using IBM SPSS Statistics 24.

Procedure

The experiment was conducted in five lessons. One lesson was used for each condition (Teamwork, Friendly Competition salient, Choice, Anonymity and a comparison Traditional Learning condition). Students in a classroom received the same order of condition, but the order across the five conditions was randomized across classrooms to avoid confounding effects of time. In all condition (Experimental and Comparison) the students used the interactive whiteboard to project the textbook as in the Pilot Study. Students watched short videos based on the texts and listened to the audio parts. Exercises were also corrected with the help of the interactive whiteboard.

In the last 20 minutes of each lesson the students were introduced to the condition into which they had been randomly assigned. In the experimental condition, the teacher, with the help of the transmitter and clicker, displayed two sets of 15 questions on the interactive board. The former related to previously-taught grammar and the latter related to vocabulary. Students answered within 30 seconds by using their clickers in groups or individually – depending on the condition. For the last 10 seconds a sound was heard from the speakers so that they responded in time. Then a bar chart with percentages of correct and incorrect answers was displayed and the students were shown their scores and time on a leader board. In the Traditional Learning condition, instead of being given a clicker, the students were assigned to sit a written test of two sets of 15 multiple choice questions related to grammar and vocabulary to match the experimental conditions. After each condition, students responded to the questionnaire.

Measure Instruments

Academic well-being and psychological need satisfaction. Academic well-being and psychological need satisfaction were both measured with the Intrinsic Motivation Inventory (IMI; Deci & Ryan, 1985). This research is relatively new to Greece so we do not have indicators of validity in Greek sample. However, the surveys were translated and back-translated by researchers and students were invited to ask for clarification if confused. The IMI was used because its multiple subscales tap at these constructs well and it is suitable for use in academic settings (De Lima et. al., 2015; Raes et al., 2020). Items described below were paired with a 7-point Likert scale ranging from 1 *"not at all true"*, to 4 *"somewhat"*, to 7 *"very true"*.

Need satisfaction. Perceptions that psychological needs were satisfied were measured through three subscales. Autonomy was measured with seven items including *"I believe I had some choice about doing this activity"* and *"I did this activity because I had no choice"* (R)(α = .78). Competence included 6 items including *"I think I did pretty well at this activity, compared to other students"* and *"I am satisfied with my performance at this task"* (α = .90). Relatedness included six items including *"I felt close to my classmates"* and *"I felt really distant to my classmates"* (R)(α = .81).

Academic well-being. Academic well-being was measured through self-reported interest and effort. Interest included seven items including *"I enjoyed doing this activity very much"* and *"I thought it was a boring activity"* (R)(α = .69). Effort involved five items including *"I put a lot of effort into this"* and *"I did not put much energy into this"* (R)(α = .90).

Data analytic strategy. A repeated measure analysis of variance (ANOVA) was conducted with five within-subject levels: four GET conditions (Teamwork, Choice, Friendly Competition, Anonymity) and one Traditional Learning condition. Conditions were defined

as a between-person predictor. Data were analyzed using IBM SPSS Statistics, version 28.0.0 (190). Raw data and analysis code for this study can be sent without undue reservation by emailing the corresponding author. Means and standard errors for each condition are summarized in Table 1. In addition, pre-registered indirect effects were tested with PROCESS, which allows researchers to identify the combined effects of predictors to mediators and ultimately, to outcomes controlling for direct effects and multiple mediators (Hayes, 2018). Each of the three motivational conditions that showed increased need satisfaction were compared to two comparison conditions: Traditional Learning and Anonymous GET. The three mediators were defined separately in models, to test each of their independent effects. Students reported interest and effort were tested as two separate outcomes. Findings of these models are summarized in Table 3.

Results

Sample Characteristics

A Shapiro-Wilk's test ($p > .05$) (Razali & Wah, 2011; Shapiro & Wilk, 1965) and a visual inspection of their histograms, normal Q-Q plots and box plots showed that the outcomes were normally distributed for both males and females, with a skewness of -0.587 ($SE = 0.299$) and a kurtosis of 0.123 ($SE = 0.590$) for the males and a skewness of -0.554 ($SE = 0.319$) and a kurtosis of -0.205 ($SE = 0.628$) for the females (Cramer, 1998; Cramer & Howitt, 2004; Doane & Seward, 2011).

Basic Psychological Needs

Condition predicted autonomy need satisfaction, $F(4, 468) = 217.74$, $p < .001$, $\eta_p^2 = .65$. Posthoc comparisons are presented in Table 2. The Choice condition predicted the greatest self-reported autonomy ($M = 6.28$, all $ps < .001$), followed by Friendly Competition ($M = 4.72$, $p < .001$) and Teamwork ($M = 4.67$, $p < .001$) conditions, which were not significantly different from one another. Participants in the Anonymous condition reported

feeling slightly less autonomous (M = 4.05, p < .001), followed by even less autonomy in the Traditional condition (M = 3.05, p < .001).

Condition predicted competence, $F(4, 468) = 26.47$, p < .001, η_p^2 = .18 (Table 2). The Teamwork condition predicted the greatest self-reported competence (M = 6.20, all ps < .001), followed by Choice condition (M = 6.05, vs. Friendly Competition, Anonymous, and Traditional: ps < .01). Participants in the Friendly Competition condition reported feeling more competent (M = 5.43, p < .001) than those in the Traditional (M = 5.36, p < .001) and Anonymous (M = 5.28, p < .001) conditions. There was no significant difference between the Anonymous and Traditional conditions predicting competence (p = .14).

Condition predicted relatedness, $F(4, 468) = 62.24$, p < .001, η_p^2 = .35. See Table 2 for posthoc comparisons. The Teamwork condition predicted the greatest self-reported relatedness (M = 6.38, all ps < .001), followed by the Choice condition (M = 6.11, vs. Friendly Competition, Anonymous, and Traditional: ps < .01). Participants in the Friendly Competition condition reported feeling more relatedness (M = 5.87, p < .001) than those in the Anonymous (M = 5.46, p < .001) and Traditional (M = 5.34, p < .001) conditions. There was no difference between the Anonymous and Traditional conditions predicting relatedness (p = .14).

Academic Well-being

Condition predicted interest, $F(4, 468) = 150.06$, p < .001, η_p^2 = .56. Posthoc comparisons are presented in Table 2. The Teamwork condition (M = 6.48, all ps < .001), and the Choice condition (M = 6.38, vs. Friendly Competition, Anonymous, and Traditional: ps < .01), predicted the greatest self-reported interest. Participants in the Friendly Competition condition reported feeling more interested (M = 6.03, p < .001) than those in the Anonymous (M = 4.73, p < .001) and Traditional (M = 4.26, p < .001) conditions.

Condition predicted perceived effort, $F(4, 468) = 59.92$, $p < .001$, $\eta_p^2 = .34$. The Choice condition predicted the greatest self-reported effort ($M = 5.92$, all $p < .001$), followed by the Teamwork condition ($M = 5.89$, all $p < .001$). Participants in the Traditional and Friendly Competition conditions reported making a similar effort ($M = 5.61$, $p < .001$) and ($M = 5.59$, $p < .001$), respectively. Participants in the Anonymous condition self-reported the least effort ($M = 4.25$, $p < .001$ as compared to other conditions). Analyses are presented in Table 2.

Table 1

Descriptive statistics (M, SE) for outcome variables within each condition.

	Teamwork		Competition		Choice		Anonymous		Traditional	
	M	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*
Relatedness	6.38_A	.09	5.87_C	.08	6.11_B	.08	5.46_D	.07	5.34_D	.08
Competence	6.20_A	.10	5.43_C	.10	6.05_B	.11	5.28_D	.09	5.36_D	.12
Autonomy	4.67_C	.09	4.72_B	.09	6.28_A	.08	4.05_D	.10	3.05_D	.12
Interest	6.48_A	.06	6.03_C	.07	6.38_B	.07	4.73_D	.11	4.26_D	.12
Effort	5.89_B	.12	5.59_C	.10	5.92_A	.12	4.25_D	.11	5.61_C	.11

Table 2

Study 1 condition pairwise comparisons.

	Relatedness		Competence		Autonomy		Interest		Effort	
	t	*p*	*t*	*p*	*t*	*p*	*t*	*p*	*t*	*p*
Teamwork	--	--	--	--	--	--	--	--	--	--
Competition	6.11	<.001	6.51	<.001	-0.55	.580	6.51	<.001	2.66	<.009
Choice	4.30	<.001	2.17	.033	-13.35	<.001	2.17	.069	-0.31	.756
Anonymous	11.01	<.001	9.09	<.001	6.80	<.001	9.09	<.001	11.60	<.001

Traditional	11.90	<.001	7.88	<.001	16.10	<.001	7.88	<.001	2.26	.025
Competition	--	--	--	--	--	--	--	--	--	--
Choice	-3.56	<.001	-4.63	<.001	-12.81	<.001	-4.63	<.001	-3.09	<.003
Anonymous	5.89	<.001	1.18	.241	6.83	<.001	1.18	<.001	10.03	<.001
Traditional	6.28	<.001	0.48	.634	13.86	<.001	0.48	<.001	-0.21	.832
Choice	--	--	--	--	--	--	--	--	--	--
Anonymous	8.72	<.001	6.16	<.001	19.14	<.001	6.16	<.001	12.80	<.001
Traditional	9.34	<.001	6.04	<.001	22.73	<.001	6.04	<.001	2.21	.029
Anonymous	--	--	--	--	--	--	--	--	--	--
Traditional	1.48	.141	-0.59	.556	8.99	<.001	-0.59	.003	-9.52	<.001

Notes: Comparisons between each pair of conditions with the bolded condition compared against each one listed in rows below it.

Indirect Analyses

Predicting interest. A first set of three models defined students' self-reported interest as the outcome variable. Results of models testing which of the three needs satisfactions would mediate the effects of the Teamwork and Choice conditions contrasted against our two comparison conditions showed similar results. Namely, all three psychological needs (autonomy, relatedness, and competence) mediated the effect of the Teamwork and Choice conditions on greater interest in comparison to the Traditional learning condition. (Teamwork: relatedness satisfaction, b = .12, se = .04, 95% *CI* [.05, .20], competence satisfaction, b = .39, se = .06, 95% *CI* [.27, .51], autonomy satisfaction, b = .34, se = .05, 95% *CI* [.24, .45]; choice: relatedness satisfaction, b = .09, se = .03, 95% *CI* [.03, .14], competence satisfaction, b = .31, se = .07, 95% *CI* [.18, .45], autonomy satisfaction, b = .82, se = .10, 95% *CI* [.64, 1.03]).

Autonomy and relatedness need satisfaction, but not competence need satisfaction, mediated the effect of the Competition (versus Traditional Learning) condition on greater

interest (relatedness satisfaction, *b* = .06, *se* = .02, 95% *CI* [.02, .10], autonomy satisfaction, *b* = .35, *se* = .06, 95% *CI* [.25, .47]).

Predicting effort. The effects of Teamwork and Choice on effort were driven by indirect effect through competence satisfaction only, (Teamwork: competence satisfaction, *b* = .44, *se* = .07, 95% *CI* [.30, .58], relatedness satisfaction *b* = .08, *se* = .07, 95% *CI* [-.06, .21] and autonomy satisfaction *b* = -.09, *se* = .06, 95% *CI* [-.20, .02]; choice: competence satisfaction, *b* = .35, *se* = .08, 95% *CI* [.21, .51], relatedness satisfaction *b* = .06, *se* = .05, 95% *CI* [-.05, .15], and autonomy satisfaction *b* = -.09, *se* = .06, 95% *CI* [-.20, .02]). The effect of Competition Salient on effort was not driven by indirect effect through any of the need satisfactions: competence satisfaction, *b* = .04, *se* = .06, 95% *CI* [-.08, .17], relatedness satisfaction *b* = .04, *se* = .03, 95% *CI* [-.03, .10] and autonomy satisfaction *b* = -.09, *se* = .06, 95% *CI* [-.21, .02].

Table 3

Results of Indirect Effects Linking Condition – Interest (Left Columns) and Effort (Right Columns) through Competence, Autonomy, and Relatedness Need Satisfactions.

	Interest			*Effort*		
	b	*se*	95% CI	*b*	*se*	95% CI
Teamwork						
Competence	0.39	.06	0.27, 0.51	0.44	.07	0.30, 0.58
Autonomy	0.34	.05	0.24, 0.45	-0.09	.06	-0.20, 0.02
Relatedness	0.12	.04	0.05, 0.19	0.08	.07	-0.06, 0.21
Direct effect	1.12	.10	0.92, 1.32	0.50	.15	0.21, 0.78
Competition						
Competence	0.04	.06	-0.07, 0.15	0.04	.06	-0.08, 0.17
Autonomy	0.35	.06	0.25, 0.47	-0.09	.06	-0.21, 0.02
Relatedness	0.06	.02	0.02, 0.10	0.04	.03	-0.03, 0.10
Direct effect	1.06	.10	0.87, 1.24	0.63	.14	0.36, 0.90
Choice						
Competence	0.31	.07	0.18, 0.45	0.35	.08	0.21, 0.51
Autonomy	0.82	.10	0.64, 1.03	-0.21	.14	-0.49, 0.05
Relatedness	0.09	.03	0.03, 0.14	0.06	.05	-0.05, 0,15
Direct effect	0.63	.12	0.39, 0.87	0.76	.18	0.42, 1,11

Notes: Psychological need satisfactions were modelled as three separate mediators in these analyses. Direct effects reflect the effect of condition on outcome (interest or effort) when controlling for the mediating effects of competence, autonomy, and relatedness.

Discussion

The current research was designed to test the effects of Gamified Experiential Technology (GET) on academic well-being and explore whether positive motivational framing could further enhance any effects. Findings of the Pilot and full Study 1 suggested that when using GET in the classroom, students experienced more academic well-being compared to traditional learning. Study 1 conceptually replicated the findings of the Pilot Study that GET use leads to more positive student outcomes than traditional learning. Furthermore, in this study we observed that need satisfaction largely explains the relations between GET use and the academic well-being outcomes of interest and effort, and we also saw that building motivational framing strategies such as assigning students to use SRS in teams, using a friendly competition climate and helping students feel that they have a choice to participate or not, could further enhance GET use benefits. Notably, despite being given choice, no students in the study opted out of the activity, suggesting that perhaps the activity itself motivated engagement.

Although we anticipated that each motivational framing strategy would elicit a corresponding psychological need (i.e., learning as a team would foster relatedness, friendly competition would foster competence, and choice would foster autonomy), results did not support these ‘clean’ relationships between strategy used by teachers during interactive learning and specific corresponding needs. Instead, each of these three motivational strategies was found to broadly support psychological need satisfaction across needs. When students received GET as a team they felt a sense of relatedness with others, a sense of competence, and a sense of having choice in what they did, and psychological need satisfaction helped, in part, to explain how learning as a team fostered their interest in the learning task. When

students were given the choice whether to participate or not or when they were encouraged to engage in friendly competition with classmates, they felt more autonomy in relation to the task and more relatedness with their classmates, and for these reasons reported greater interest in the task. In addition, while they were working in a team and given the choice to participate, they felt competent which in turn led to greater effort in GET. Both Teamwork and Choice motivational framing strategies also supported a sense of competence need satisfaction, which in turn led to greater effort and interest in the activity.

By comparison, when GET was implemented anonymously and without these supportive motivational framings, students reported lower autonomy, competence and relatedness and as a result, their interest and effort in the task were relatively low and comparable to those of traditional learning.

Implications

Overall, the use of gamified experiential technology (GET) produced better learning outcomes than traditional learning. The results of our study expand previous research showing that learning conditions that support relatedness, competence and autonomy needs enhance students' academic well-being (i.e., students' interest in the task and the effort they put into it; David & Weinstein, 2023; Nikou & Economides, 2016). Condition effects are also in line with studies identifying benefits of positive motivational framing strategies on learning outcomes, both directly and indirectly through supporting these basic psychological needs. In our findings, students felt more related to one another when GET use was implemented through teamwork, friendly competition and when they received choice.

Teamwork not only enhanced relatedness, but also supported competence and autonomy needs – suggesting more global benefits for students learning together with classmates. The sense of relatedness, in turn, led to more interest, building on previous work

that academic well-being is enhanced when the students feel secure working with peers (Francisco-Aparicio et al., 2013; Shadiev & Yang, 2020).

Friendly competition supported competence, conceptually replicating a previous experiment that concluded that leader board points enhance competence (Bai et al., 2021), and research showing that friendly competition stimulates high interest by providing informational feedback and positive challenge (Lehman et al., 2012).

Interestingly, providing students choice on engaging in the activity (all students chose to participate in the experiment) supported all three basic needs, and like previous research (Patall et al., 2008; Patall et al., 2010) was associated with more interest and effort. This finding suggested that gamified learning is most beneficial when students can decide on their actions following their interest and values (Deci & Ryan, 2012). It corresponds with the Montessori method, which promotes choice and autonomy to increase high intrinsic motivation and positive learning outcome (Montessori et al., 2017; Rathunde & Csikszentmihalyi, 2005).

In all, the results suggest that educators who have the aim of inspiring intrinsic motivation within a learning environment could benefit by incorporating interactive technologies into their education (Pilot Study and Study 1), and moreover that they should carefully consider how they frame technology use in terms of instructional strategies. Here we observed that multiple motivational strategies can be used by teachers to increase need satisfaction and improve interest and effort of students. But others likely exist that were not tested here, and we recommend that along with additional research designed to explore these, educators can consider how they, personally, prefer to enrich learning with fun or playful approaches that engage students in active learning.

Although the pilot study tracked basic effects of GET use across time, Study 1 was a within-subject experimental design that examined only immediate responses to motivational

framing strategies (employing teamwork, friendly competition, and choice). As such, future research building on these experiments can integrate the pilot and Study 1 methodological approaches to test cumulative and long-term effects of positive motivational framing strategies and need satisfaction in gamified learning contexts. There is reason to believe students exposed to supportive motivational framing strategies would engage in more learning over time, since repeating interesting tasks builds interest over time (Krapp, 2002; Silvia, 2001). Repeated quizzes with the use of gamification may therefore result in a lasting interest (Topîrceanu, 2017). The gamification literature, more broadly, would benefit from such an approach, since most of the previous experiments last just one or very few sessions (Boudadi & Gutiérrez-Colón, 2020; Sun and Hsieh, 2018). This study conceptualized basic psychological need satisfaction as a spectrum from neutral to positive, but SDT recognizes the difference between need satisfaction and need frustration, each with specific implications for well-being and behavioral outcomes (Vansteenkiste et al., 2020). Additional research by Burgueño et al. (2023) has similarly shown that both satisfaction and frustration are relevant for predicting learning and well-being outcomes in education. We suggest future research define both for a better understanding of experiential and motivational predictors of need experiences.

Limitations

In the pilot study the GET condition was different from the comparison condition; The students not only used SRS but also the interactive whiteboard that is a necessary tool for the SRS. Therefore, we could not isolate only the effect of SRS in the experiment. Having this in mind we used the interactive board and digital book in Study 1 in all lessons before introducing the conditions.

It is also worth noting that Study 1 was conducted immediately after the reopening of school, and after a six-month period of online lessons during COVID-19 lockdown. The

timing may have affected the results positively across all conditions, since the students were happier and felt refreshed returning to the classroom. It may have been that additional enthusiasm enhanced the effects of GET on student outcomes. In this case, GET may be considered as a positive education approach to help children combat distress or disinterest (Waters et al., 2021), but more research is needed to examine its effects across life circumstances.

To expand on the current work, GET use needs to be tested alongside observational or behavioral data, which can be used to triangulate and to seek convergent with self-reported student responses as we used in these studies. Future work taking this approach can provide more robust evidence about the use of GET in relation to learning outcomes. Adding to this, we should also mention that there was no external assessment to ensure the fidelity of the pedagogical model in question in either study (Hastie & Casey, 2014) which should also be considered in future. Incorporating an observer to triangulate data can greatly improve the quality and trustworthiness of future studies by addressing the researcher's positionality. As researchers, our perspectives, backgrounds, and assumptions inevitably influence how we interpret data (Holmes. 2020). By involving an independent observer, we introduce a complementary viewpoint that can help mitigate biases (Lim, 2025). This form of triangulation not only adds depth to the analysis but also enhances reflexivity, ensuring that interpretations are not solely shaped by the researcher's positionality. Ultimately, it leads to a more balanced and credible understanding of the research context (Meydan & Akkas, 2024).

Finally, we recognize that the reliability was lower in some measurements than some recommend (Viladrich et al., 2017) (in particular, effort in the Pilot Study had $\alpha = .64$; and interest in Study 1 had $\alpha = .69$), but interpret these findings understanding some see $\alpha = .60$ as an acceptable benchmark (Cohen et al., 2011). We should consider in future experiments that effects might be different, and possibly more robust, when using more reliable measures.

Conclusion

The current research has provided a number of notable insights into the acquisition of English grammar and vocabulary by means of Gamified Experiential Technology (GET) use to enhance student academic well-being. Two in-class experiments showed that implementing GET significantly enhances learning environment. Further, students are all the more interested and willing to put some effort into the lesson when GET use is delivered in supportive motivational framing strategies that satisfy basic psychological needs. Taking it all together, technology use can enhance classroom experiences, and even more so when students experience choice, feel related to peers, and are encouraged to feel effective at the tasks they undertake.

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

Declarations

Ethics approval The study received Ethics approval from the University Research Ethics Committee of the University of Reading (num. 2020–175-NW) and was pre-registered (https://osf.io/phgs3/) prior to data collection, along with planned design and analytic approach.

Competing interests The authors declare no competing interests.

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Chapter 4

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A Gamified Experiential Learning Intervention for Engaging Students Through Satisfying Needs

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Abstract

A field experiment conducted across an academic semester tested the impact of a gamified experiential learning intervention strategically framing a student response system (SRS) to maximize student engagement through their technology use in class. Participants (n=123) aged 9–16 years received an experimental intervention designed to foster intrinsic motivation through optimally challenging engagement. To achieve this, the intervention utilized teamwork, made friendly competence-enhancing competition salient, and created choice. In a comparison condition, students used SRS without these additional enhancements. Students were surveyed at three time points. The experimental intervention reported increasing psychological need satisfaction for autonomy, competence, and relatedness and greater academic well-being. An observer rating demonstrated more classroom behaviors indicative of intrinsic motivation as compared to the comparison condition. The effects of the intervention increasing student-reported and observer-rated academic well-being were due to more immediate beneficial effects of the gamified experiential condition fostering basic psychological needs for autonomy, relatedness, and competence.

Keywords: need satisfaction, gamification, learning, technology, education

A Gamified Experiential Learning Intervention for Engaging Students Through Satisfying Needs

Fun and optimally challenging learning climates that support students' engagement are vital for academic well-being and student achievement (Chodkiewicz & Boyle, 2017; Patall & Zambrano, 2019), and they underly well-being in the classroom (Frawley, 2015; Nakata et al., 2022). Responding to students' desire to use technology, and the growing technological resources available, educators increasingly use classroom technologies to engage students (Martin, 2019; Stockwell, 2022). While the goal of using technological resources is to engage students and increase their intrinsic motivation (Leitão et al., 2022), it may be that the optimal classroom climate – one that engages and enthuses students – is crucial for achieving the desired educational and wellness outcomes that they are designed to achieve (Cardenas et al., 2022).

Gamified experiential learning approaches offer a framework for developing strategies that engage and excite students (Isabelle, 2020) particularly when used in conjunction with technological advances that open creative avenues for engaging students (Moseikina et al., 2022). We focus on one – the Student Response System (SRS; Liu et. al., 2019) as a proof of concept for the gamified use of these experiential technologies. Further, we integrate these approaches with a separate literature based on self-determination theory (SDT; Deci & Ryan, 2000), and explore how educators can optimally enhance students' academic well-being (i.e., engagement, excitement, interest and effort) through supporting their psychological needs for autonomy (i.e., perceived choice) relatedness (connection with others), and competence (i.e., sense of efficacy; Ryan & Deci, 2017).

The experiment, conducted during an academic semester, contrasted the repeated use of a gamified experiential learning intervention with a neutral comparison that held the

learning technology constant to identify the role of a gamified learning climate on forming the success of classroom technology manipulation on academic well-being. Further, we tested an SDT-based mediation model that anticipated effects on observed academic well-being by a rater (i.e., engagement and excitement) and perceived academic well-being by students' self-report (i.e., interest and effort) are due to the more immediate beneficial effects of motivation on basic psychological needs for autonomy, relatedness, and competence.

Technology Use in the Classroom

Combining technology with interactive teaching styles has been shown to play an important role in engaging and developing their strengths (Bedwel et al., 2014). These student-oriented approaches in which education assists social, academic and emotional development are increasingly used to make learning more fun and exciting (McCombs, 2004), support student participation, involvement and attention, set up team environment, stimulate responses, discussions and practical experiences (Senthamarai, 2018).

Such Gamified Experiential Technologies (GET; David & Weinstein, 2022) engage students through interactive learning in the classroom (Pearson, 2017). For example, one such form of classroom technology, the Student Response System (SRS; Liu et. al., 2019) – a system that consists of a handheld device named a 'clicker' (Barber, 2007; Caldwell, 2007), is an increasingly popular way (Brown et al., 2014) to use game elements (Fernández & Jácome, 2016) to promote fun and engagement (Zainuddin et. al., 2020), interest and effort (Werbach & Hunter, 2012), educational knowledge (Xi & Hamari, 2019), and broadly, academic well-being (O'Brien, 2016). More specifically, SRS is a clicker system that consists of three components: wireless handheld transmitters that look like remote controls held by each participant and teacher, a receiver which receives the signals from these wireless clickers and software which is installed on the classroom interactive whiteboard that projects the exercises and records, displays and manages the students' responses (Zhu, 2007). The

SRS provides an excellent opportunity to explore gamified learning because it opens a world of interactive learning in the classroom (Tóth et al., 2019) where students can test their knowledge dynamically with teachers and peers and receive instant feedback that supports conceptual understanding (Jones et. al., 2012).

Initial research suggests the social context that frames it matters when predicting children's reactions to technology use. For example, a study of 24 university students in Korea showed that SRS with an interactive technique can provide an active learning environment, especially when peer interaction is involved (Kent, 2019). Pearson (2017) also conducted one such experiment on 127 university students to compare teamwork with individual anonymity and found that all clicker use increased academic performance but students preferred teamwork over individual clickers and found teamwork more fun and engaging. Pearson (2017) concluded that a team-based clicker model allowed students to work with peers in a fun and engaging environment which enhanced the learning outcome.

Teamwork can be enhanced through creating friendly information-focused competition between teams. For example, Sun and Hsieh (2018) conducted an experiment on 118 junior high school students and two teachers and found that making friendly competition salient can increase intrinsic motivation and engagement. Similar findings for friendly competition were identified in a brief classroom experiment with younger students (David & Weinstein, 2022).

Need-Satisfying Climates in Education

This literature on gamified experiential learning speaks to a large body of evidence that shows students must be motivated to pursue learning in the classroom (Dabrowski & Marshall, 2018), and healthy motivational climates drive constructive goal pursuit in educational settings (Ushioda & Dörnyei, 2017). One challenge educators face is how to keep their students motivated throughout the learning procedure, especially in an environment in

which the acquisition of a foreign language worldwide occurs in a traditional setting involving long hours of exam-oriented preparation (Joe et al., 2017). Research suggests teachers do not consistently create need satisfying contexts that foster academic well-being (Gillet et al., 2012; Gnambs & Hasfstingl, 2016; Gottfried et al., 2007; Lepper et al., 2005; Scherrer & Preckel, 2019). As a result, they risk losing their students' interest and engagement across time.

To mitigate this risk, researchers have applied the motivational framework of self-determination theory (SDT; Deci & Ryan, 2000). SDT defines the nature of motivation that outlines teaching practices to support students' intrinsic motivation to learn (Collie et al., 2019; Haerens et al., 2015, 2018; Vansteenkiste et al., 2012). SDT argues that teachers' teaching styles can satisfy their students' basic psychological needs - relatedness, autonomy and competence - and in turn their academic well-being (Reeve & Halusic, 2009; Ryan & Deci, 2017). Autonomy need satisfaction is the experience of the student who has a sense of choice and freedom to participate in an activity; competence involves the need to feel competent to participate in challenges given by teachers and relatedness involves the need to have meaningful relationships with classmates and teachers (Howard et al., 2021).

School interventions that have successfully satisfied basic psychological needs have increased student intrinsic motivation (Reeve & Cheon, 2021) and well-being (Tejada-Gallardo et al., 2020). One core SDT expectation in education is that need satisfying forms of motivation–when teachers understand, acknowledge and attempt to respond to their students' perspectives–increase student perceived academic well-being such as interest and effort and observed academic well-being of classroom behavior such as engagement and excitement. Classroom interventions have understood teachers to play a key role in students' education and engagement, and argue that training teachers to adopt a more need support style encourages more student engagement and excitement (e.g., Reeve et al., 2004). Teachers also

encourage students by providing purposeful and rewarding tasks and choices to engage interest (Ryan & Deci, 2020). In other words, students benefit when they are given a choice in their learning and when tasks are relevant to their interests (Dysarz, 2018; Patall et al., 2013). Research supports this view, showing need-satisfying teaching increases intrinsic motivation (Bao & Lam, 2008; Patall et al., 2008), performance (Murayama et al., 2015) and curiosity (Schutte & Malouff, 2019).

Current Study

The current study sought to build on this nascent work by testing a need-satisfying gamified learning intervention that paired Gamified Experiential Technologies (GET) with a supportive climate. It advanced the literature by testing a gamified experiential classroom intervention using SRS that enhanced jointly students' choice, supporting collaborative teamwork and trialing friendly competition. It integrated these strategies with the theoretical framework of self-determination theory and tested whether need satisfaction for competence, relatedness, and autonomy would mediate benefits identified. It also advanced the literature by testing effects across an academic semester (Sun and Hsieh, 2018) and tested models with school children and not the samples more common to the literature, namely university students (Annamalai et al., 2022; Kent, 2019; Pearson, 2017; Tóth et al., 2019; Yu, 2020). In addition, we assessed *observed* classroom behavior of engagement and excitement during the class in addition to asking students for their perceptions of and reactions to the task, as suggested (Aljaloud et al., 2019).

Hypotheses were pre-registered prior to our study data collection, along with planned design and analytic approach (https://osf.io/vzd97/).

The study was designed to test three a-priori hypotheses (H):

H1. Students assigned to the Experimental condition would report higher basic psychological need satisfaction, perceived and observed academic well-being as compared to an anonymous Comparison condition.

H2. Need satisfaction would mediate the effects of condition on perceived and observed academic well-being (Figure 1).

H3. Condition effects of the Experimental condition benefiting students' perceived academic well-being more than the Comparison condition will extend to observed classroom behaviors of academic well-being in the classroom.

Figure 1

Note. Mediation of psychological need satisfation on perceived academic well-being and observed classroom behavior of academic well-being.

Method

Participants

The experiment involved 123 students, 56 boys (45.5%) and 67 girls (54.5%), studying in an English Language School in Greece during the school year of 2021-2022. Students varied in ages from 9 to 16 years (M = 11.65 years). All children had Greek citizenship and Greek was their native language.

Transparency and Openness

Given we were testing young children but combining multiple positive motivational framings for GET based on our previous experiment, we anticipated a moderate effect size across all measures. There was no exclusion criteria set. We aimed for minimum n = 50

students in each group for broad but equal representation of student ages. This estimation was based on an a-priori power analysis (in G*Power) that anticipated a moderate effect size of *d* = 0.50, α = .05, with power = .80, and using one-tailed tests anticipating the Experimental condition would demonstrate more positive outcomes than the Comparison condition.

The study received Ethics approval from the University Research Ethics Committee of the University of Reading (num. 2021-123-NW) and was pre-registered (https://osf.io/vzd97/). Data were analyzed using IBM SPSS Statistics, version 28.0.0 (190). Raw data and analysis code for this study can be sent without undue reservation by emailing the corresponding author.

Experimental Design

An email was sent to the parents of the students with the details of the experiment. Both parent and student consented prior to the start of the experiment. Then, students were randomly assigned to one of two conditions: an Experimental intervention or a Comparison group. Sixty-three (51.2%) students (23 girls and 40 boys) who were separated into seven smaller classes took part in an Experimental condition and 60 (48.8%) students (33 girls and 27 boys) who were also separated into seven smaller classes took part in a Comparison condition. As such, this study involved a between-subjects design. The two groups were oblivious of the existence of the other as they continued their lessons as normal with the use of technologies. Students were put in smaller classes from the beginning of the school year depending on their level of English and due to government regulations for the prevention of the spread of Covid19. The smaller group size also allowed the observer to more readily identify individual child behaviors throughout the task.

The Experimental condition jointly implemented teamwork, friendly competition salient and choice. In the Experimental condition, students were allowed to choose whether they wanted to participate or not (no participant chose not to participate) and were also

allowed to collaborate in teams of three during the task. Though they were in teams, each had their own clicker and was permitted to choose to answer differently from their group. At the end, students received feedback on their own performance and time they took to respond – which they were aware of from the beginning - this enabled them to compare themselves with all the other students if they chose to – that gave them a sense of friendly competition (Zahedi et al., 2021).

The Comparison condition involved working alone and anonymously. They were not asked if they wanted to participate or to collaborate in teams before clicking on the answer, they were given a clicker each and were told to respond as normal – they were given the feeling that it was the normal procedure of the lesson – a final game before the end of the lesson. Students in this condition could still detect their scores – which they were aware of from the beginning - on the leader board using an anonymous ID that they received for this purpose.

Procedure

Both groups followed the same teaching procedure at the beginning of each lesson. They were taught the planned syllabus which was based on specific grammar and vocabulary from their textbooks and they watched animated texts and answered questions on the interactive whiteboard. For the latter part of the lesson they were given a quiz response clicker each to participate in the GET experiment. In both conditions, the teachers - who were held consistent across conditions and had experience in using SRS to assist their lessons - displayed two sets of 15 questions (previously taught grammar and vocabulary) on the interactive board with the help of the transmitter and clicker. As soon as the teacher projected a multiple-choice question on the interactive whiteboard, students clicked on the button on their clicker. Their answer was then transmitted to the system through infrared or radio frequency signals so each student answered instantly without being scrutinized by their peers.

The system aggregated the responses with a histogram which offered the teacher the ability to show the results to the whole class though a leaderboard and bar chart (Chien et al., 2016).

Students answered within 30 seconds by using their clickers after collaborating in groups or individually, depending on the condition to which they were assigned. During the last 10 seconds, a sound was heard from the speakers so that they would respond in time. Then, a bar chart with percentages of correct answers was displayed and the students were shown their scores and time on a leader board.

GET was used in every lesson and every class throughout the first academic semester. At three time points (beginning, middle and end of the academic semester), students also responded to the Intrinsic Motivation Inventory (IMI; Deci & Ryan, 1985) which was delivered through Qualtrics Survey Solutions after the survey was translated into Greek and back-translated (see on https://osf.io/vzd97/), which evaluated their basic psychological need satisfaction and perceived academic well-being of interest and effort. An assisting teacher, blind to the nature of the study and conditions, sat in a corner of each classroom and observed student academic well-being in classroom behavior of engagement and excitement during the task at three time points (beginning, middle and end of the academic semester). The assisting teacher was trained prior to the experiment to detect gestures, facial expressions and behaviors of the students during the intervention and was told to tick specific boxes for each student. Each classroom had a maximum of ten students, allowing the assistant teacher to observe everyone taking part. The teacher reported on the students' reactions during the use of clickers up until the students saw their scores on the leaderboard (these observed behaviors are described in more detail below). Incorporating an assisting teacher as an observer to triangulate data can signicantly enhance the credibility and depth of the study by directly engaging with the issue of researcher positionality. Positionality refers to how the researcher's background, identity and perspectives influence the research process (Holmes,

2020). Because these influences are often unconscious, having an independent observer provides a valuable counterbalance, offering alternative interpretations and helping to reduce bias. Triangulation, the use of multiple data sources or perspectives, enhances the validity of findings by confirming patterns or highlighting inconsistencies (Morgan, 2024). Triangulation through observation leads to a more rigorous and trustworthy analysis, as it ensures that interpretations are not solely framed by the researcher's positional lens (Morgan, 2024).

Materials

Outcome measures employed multiple subscales of the Intrinsic Motivation Inventory (IMI; Deci & Ryan, 1985). The IMI was used as it measures the user experience within games (De Lima et. al., 2015) and is a well-validated measure used in SDT-based education research (Raes et al., 2020). Items were paired with a 7-point Likert scale ranging from 1 *"not at all true"*, to 4 *"somewhat"*, to 7 *"very true"*. Subscales of the IMI are described below.

Need satisfaction. Perceptions that psychological needs were satisfied were measured through three subscales. SDT posits that supporting one psychological need (e.g., autonomy) activates another (e.g., relatedness), and indeed they show high correlations in previous research and are often modelled together (Deci & Ryan, 2000; Su & Reeve, 2011). This was therefore the approach we took in the present study. Autonomy was measured with seven items including *"I believe I had some choice about doing this activity"* and *"I did this activity because I had no choice"* (R) (Time 1: $\alpha = .70$; Time 2: $\alpha = .94$; Time 3: $\alpha = .98$). Competence was measured with six items including *"I think I did pretty well at this activity, compared to other students"* and *"I am satisfied with my performance at this task"* (Time 1: $\alpha = .69$; Time 2: $\alpha = .89$; Time 3: $\alpha = .89$). Relatedness was measured with six items including *"I felt close to my classmates"* and *"I felt really distant to my classmates"* (R) (Time 1: $\alpha = .68$; Time 2: $\alpha = .85$; Time 3: $\alpha = .87$).

Perceived academic well-being. Academic well-being was measured through both self-reported interest and effort. Interest was measured with seven items such as *"I enjoyed doing this activity very much"* and *"I thought it was a boring activity"* (R) (Time 1: α = .74; Time 2: α = .88; Time 3: α = .91). Effort involved five items including *"I put a lot of effort into this"*, and *"I did not put much energy into this"* (R) (Time 1: α = .73; Time 2: α = .80; Time 3: α = .90).

Observed academic well-being in classroom behavior. Observed classroom behavior was measured by and assisting teacher, blind to the nature of the study and the conditions. The observer sat in a back corner of the room, and coded immediately at the end of each lesson period. Engagement included two items *"The student is engaged"* and *"The student is passive"* (R) (Time 1: α = .78; Time 2: α = .67; Time 3: α = .72). Excitement included three items *"The student is excited", "The student is smiling"* and *"The student is happy"* (Time 1: α = .83; Time 2: α = .81; Time 3: α = .81).

Results

Analytic strategy. To test pre-registered confirmatory Hypotheses 1 and 2, as well as exploratory hypotheses that effects would increase across time, a repeated measure analysis of variance (ANOVA) was conducted with time defined as a within-person factor with three levels: Time 1, Time 2 and Time 3, and condition (Experimental vs. Comparison) as a between-subject factor.

Confirmatory between-subjects effects. At the outset, our primary interest was in the between-person effect of condition averaged across time-points. Analyses showed a main effect of condition (Experimental or Comparison) averaged across the three time periods, wherein the Experimental condition resulted in greater psychological needs (autonomy $F(1, 121) = 651.35$, $p < .001$; competence $F(1, 121) = 42.00$, $p < .001$; relatedness $F(1, 121) = 187.69$, $p < .001$), greater perceived academic well-being (interest $F(1, 121) = 93.03$, $p <$

.001; effort $F(1, 121) = 58.76$, $p < .001$) and greater observed classroom behavior (excitement, $F(1, 121) = 64.34$, $p < .001$; engagement, $F(1, 121) = 109.45$, $p < .001$). Table 1 summarizes between-subject effects and effect sizes. In all, condition predicted all the outcomes measured, in the hypothesized direction.

Table 1

Descriptive statistics (M, SE) for outcome variables within each condition.

	Experimental		Comparison		Effects of Test		
outcome	*M*	*SE*	*M*	*SE*	*F*	*p*	*Effect size*
Relatedness	6.40	0.08	4.86	0.08	187.69	<.001	0.61
Competence	6.01	0.10	5.13	0.10	42.00	<.001	0.26
Autonomy	5.98	0.09	2.73	0.09	651.35	<.001	0.84
Interest	6.40	0.08	5.27	0.09	93.03	<.001	0.44
Effort	5.59	0.11	4.36	0.11	58.76	<.001	0.33
Engagement	2.88	0.04	2.32	0.04	109.45	<.001	0.48
Excitement	2.43	0.05	1.91	0.05	64.34	<.001	0.35

Within-subject effects.

Exploratory psychological need satisfaction across time. An interaction of Condition X Time was observed in nearly all outcome variables: predicting psychological needs; autonomy, $F(2, 242) = 124.76$, $p < .001$, $\eta_p^2 = .508$; competence, $F(2, 242) = 11.88$, $p < .001$, $\eta_p^2 = .089$; relatedness, $F(2, 242) = 47.34$, $p < .001$, $\eta_p^2 = .281$. We proceeded to investigate significant interaction effects by testing linear effects as a function of each of the two conditions (Experimental vs. Comparison). Predicting psychological needs, students in the Experimental condition reported increased needs linearly as a function of time (relatedness $t = 6.91$, $p < .001$; competence $t = 5.54$, $p < .001$; autonomy $t = 10.63$, $p < .001$). In contrast, students in the Comparison condition reported lower relatedness and autonomy psychological needs across time (relatedness $t = -3.63$, $p < .001$; autonomy $t = 9.91$, $p < .001$), and no change in competence need satisfaction ($t = 0.73$, $p = .465$). See Table 2 for a summary of these effects.

Table 2

Between-subject effect identifying each subject as a separate observation – condition effect for each time point

	Experimental			*Comparison*		
Outcome	*t*	*p*	*d*	*t*	*p*	*d*
Relatedness	6.91	<.001	1.74	-3.63	<.001	-0.94
Autonomy	10.63	<.001	2.68	-9.91	<.001	-2.56
Competence	5.54	<.001	1.40	-0.73	.465	-0.19
Interest	5.51	<.001	1.39	-1.53	.132	-0.40
Effort	7.21	<.001	1.82	-1.24	.218	-0.32
Engagement	1.40	.167	0.35	-3.55	<.001	-0.92
Excitement	2.82	.006	0.71	-0.88	.377	-0.23

Note. d = effect size across linear time

(Benchmarks for Cohen's *d* - 0.2 small, 0.5 medium, and 0.8 large).

Exploratory perceived academic well-being across time. Academic well-being also showed an omnibus effect of Condition X Time (Interest, $F(2, 242) = 17.04$, $p < .001$, $\eta_p^2 = .123$; effort, $F(2, 242) = 15.90$, $p < .001$, $\eta_p^2 = .116$). Following on this, linear increases were observed as a function of time in the Experimental condition (interest $t = 5.51$, $p < .001$; effort $t = 7.21$, $p < .001$). This is in contrast to the Comparison condition, where no change was observed (interest $t = -1.53$, $p = .132$; effort $t = -1.24$, $p = .218$; Table 2).

Exploratory observed classroom behavior across time. An interaction between condition and time was in evidence predicting engagement, $F(2, 242) = 24.80$ $p < .001$, $\eta_p^2 = .170$. Observed engagement did not change as a function of time in the Experimental condition, $t = 1.40$, $p = .167$. In contrast, the Comparison condition showed lower engagement across time, $t = -3.55$, $p < .001$ (Table 2).

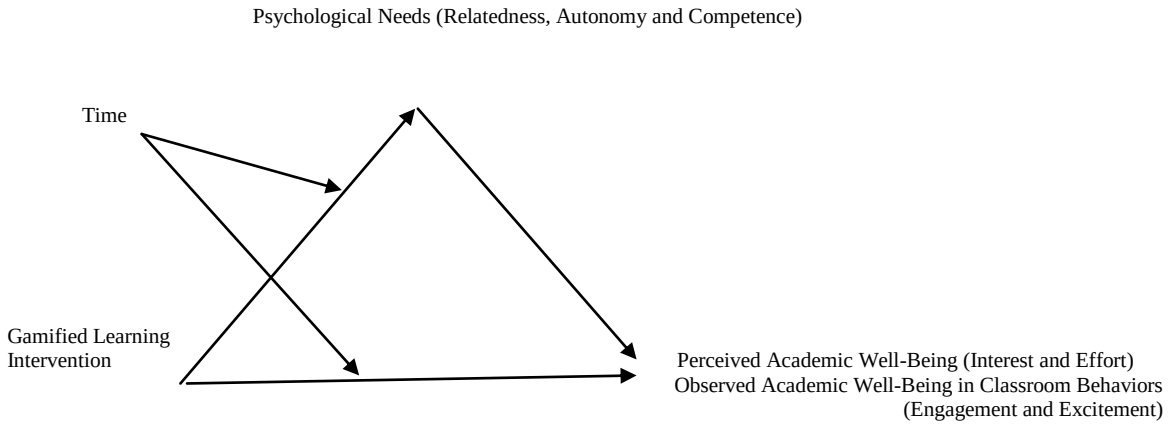
As was the case for engagement, an omnibus effect was in evidence predicting observed excitement, $F(2, 242) = 9.68$ $p < .001$, $\eta_p^2 = .074$. However, follow-up analyses did not show a linear change in either the Experimental, $t = 2.82$, $p = .006$, or Comparison condition $t = -0.88$, $p = .377$ (Table 2).

Indirect Effect Analyses.

A PROCESS model (Model 8) with 5000 bootrapped iterations (Hayes, 2018) was used to test a moderated mediation model defining time as moderator and psychological need satisfaction as mediator. Specifically, we tested the indirect effects of the intervention on perceived academic well-being and observed academic well-being in classroom behaviors through psychological need satisfaction, which we anticipated would be further moderated by time. Said another way, we anticipated that the Experimental condition (as compared to the Comparison condition) would lead to greater linear increases in psychological need satisfaction (i.e., relatedness, autonomy and competence) across time, which would mediate the effects of condition on linear increases we observed on perceived academic well-being and observed academic well-being in classroom behavior in the primary results reported above (Figure 2).

Figure 2

Path Diagram Showing Statistical Mediation model.



To examine the mediation portion of the model, all three psychological need satisfactions were defined simultaneously in PROCESS models, effectively testing each of their effects independent of one another. Self-reported interest and effort and students' observed engagement and excitement were tested as separate outcomes. The indexes of mediated moderation for these models are summarized in Table 3.

Table 3

Results of Indirect Effect Linking Condition (Experimental vs. Comparison) to Differential Change in Outcomes (Interest, Effort, Engagement and Excitement) as a Function of Time through Changes in Relatedness, Autonomy and Competence Need Satisfactions Over Time.

	Interest	Effort	Engagement	Excitement
Relatedness				
Index b	0.12	0.08	0.09	0.11
BootSE	0.05	0.06	0.03	0.04
BootLLCI	0.23	0.20	0.15	0.18
BootULCI	0.03	0.04	0.04	0.05
Autonomy				
Index	0.17	0.29	0.16	0.05
BootSE	0.09	0.12	0.05	0.06
BootLLCI	0.34	0.54	0.26	0.06
BootULCI	0.01	0.04	0.08	0.16
Competence				
Index	0.18	0.08	0.00	0.03
BootSE	0.06	0.04	0.01	0.02
BootLLCI	0.30	0.18	0.02	0.07
BootULCI	0.08	0.01	0.03	0.00

Notes: Psychological need satisfactions were modeled as three separate mediators in these analyses. Moderated mediation effects reflect the time-moderated effect of condition on outcome (interest, effort, engagement and excitement) when accounting for the time-moderated mediating effects of relatedness, autonomy and competence.

Predicting perceived academic well-being. Linear increases in all three psychological needs mediated the effect of the Experimental condition on linear increases in academic well-being across time (interest: relatedness satisfaction $b = 0.12$, se = 0.05, 95% *CI* [0.23, 0.03], autonomy satisfaction, $b = 0.17$, $se = 0.09$, 95% *CI* [0.34, 0.01], competence

satisfaction, *b* = 0.18, *se* = 0.06, 95% *CI* [0.30, 0.08] and effort: relatedness satisfaction *b* = 0.08, se = 0.06, 95% *CI* [0.20, 0.04], autonomy satisfaction, *b* = 0.29, *se* = 0.12, 95% *CI* [0.54, 0.04], competence satisfaction, *b* = 0.08, *se* = 0.04, 95% *CI* [0.18, 0.01]).

Predicting observed academic well-being in classroom behaviors. Linear increases in all three psychological needs mediated the effect of the Experimental condition on linear increases in behavioral observation (engagement: relatedness satisfaction *b* = 0.09, se = 0.03, 95% *CI* [0.15, 0.04], autonomy satisfaction, *b* = 0.16, *se* = 0.05, 95% *CI* [0.26, 0.08], competence satisfaction, *b* = 0.00, *se* = 0.01, 95% *CI* [0.02, 0.03] and excitement: relatedness satisfaction *b* = 0.12, se = 0.04, 95% *CI* [0.18, 0.05], autonomy satisfaction, *b* = 0.05, *se* = 0.06 95% *CI* [0.06, 0.16], competence satisfaction, *b* = 0.03, *se* = 0.02, 95% *CI* [0.07, 0.00]).

Discussion

The current field experiment tested a gamified experiential learning intervention in the classroom to test its effects on perceived academic well-being (i.e., self-reported interest and effort) and observed academic well-being in classroom behaviors (i.e., engagement and excitement) of intrinsic motivation on children between 9 and 16 years of age. We applied this gamified experiential learning intervention to enhance the learning benefits of Gamified Experiential Technology (GET), through the use of a Student Response System (SRS) that allowed students to answer to questions that were projected on the interactive whiteboard. In an Experimental group, GET use was optimized by giving students meaningful choice about their participation (whether or not to take part), by encouraging them to rely on teammates to discuss and debate answers, and to create friendly competition through providing feedback about groups' accuracy without judgment or global performance evaluations outside of the task. This approach was compared to a second group of students who worked independently and anonymously, but also received feedback on their accuracy in the task.

Findings showed that across time the Experimental condition, those students who received GET in a gamified approach characterized by maximizing their choice, supporting collaborative teamwork, and trialing friendly competition amongst students, experienced greater psychological needs, perceived academic well-being and more intrinsically motivated observed classroom behaviors as when compared to the Comparison condition.

These findings build on previous research (David & Weinstein, 2022), which suggested that GET enhanced the learning experience, but only when gamified experiential strategies were in use. When students engaged in GET as part of a team, had the choice to participate, or engaged in friendly competition, they felt need satisfied, which correlated with more self-reported effort and interest in contrast to using GET anonymously or when answering the same questions on paper.

The current experiment was built on several gaps in this nascent literature. As we did not have systematic knowledge about a gamified learning intervention for technology use on children, we concentrated our experiment on a broad range of students' ages between 9 and 16 years. Other research was conducted on university students (Annamalai et al., 2022; Benson et al., 2017; Çelik & Baran, 2021; Kent, 2019; Pearson, 2017; Tóth et al., 2019; Yu, 2020) and provided little understanding of how motivationally-supportive contexts – ones that enhance the basic psychological needs of autonomy, relatedness and competence – and technology can be used in parallel to optimize learning. Second, to date no field experiments with children have been conducted manipulating daily use of technology in the classroom for an entire academic semester. Previous experiments applied motivational climates just once or in very few sessions (Boudadi & Gutiérrez-Colón, 2020; David & Weinstein, 2023; Sun & Hsieh, 2018). Although those analyses were exploratory, we see one of the most exciting findings of the current work the benefits observed across time when motivationally-supportive education contexts were used.

There are vital gaps between practices and policies in educational institutions (Ryan & Deci, 2020). This study tested an intervention that allowed students to use technology in a gamified experiential structure characterized by maximizing their choice, supporting collaborative teamwork, and trialing friendly competition among students. This combined approach to supportive students' psychological needs has not been implemented together in practice. Indeed, there is recognition that more of this kind of work – theory-informed interventions in the classroom – is needed to understand optimal classroom teaching styles (Patall & Zambrano, 2019).

Students are open to new challenges and show excitement and engagement; however, they require experience to master a task (Ryan & Deci, 2020). This was evident across time in our experiment. Students who used GET in the motivationally enhanced (i.e., need-supportive) condition showed greater enthusiasm and engagement from the beginning of the experiment to the end, but needed more time to feel related to classmates, more choiceful, and more efficacious in their GET learning and in turn show interest and effort. The psychological need satisfactions led to increases in effort and interest and kept engagement and enthusiasm consistent throughout the semester.

In contrast, students who used GET without the need-supportive motivational climate showed lower enthusiasm and engagement from the onset of the manipulation at the start of the semester. Unlike those students in the Experimental condition, they reported less interest and effort across time.

Students in the Comparison condition also reported different patterns of need satisfaction across the semester in relation to the Experimental group. Specifically, throughout the semester, they reported lower relatedness to classmates during the GET activity, and felt less choiceful for the activity. These reduced psychological need satisfactions corresponded with reported decreases in effort, interest, engagement and

excitement. These results supported SDT assertions that basic psychological need satisfaction for relatedness, autonomy, and competence underlines positive learning (Ryan et. al., 2019), whereas thwarting these basic psychological needs can damage motivation and well-being (Vansteenkiste et. al., 2020). In the current study, using classroom technology (GET) in the absence of need-supportive motivation resulted in lower relatedness and autonomy need satisfaction, and less competence need satisfaction throughout the semester, suggesting that perhaps any need-satisfying benefits of GET wore off as novelty decreased. On the other hand, in the Experimental condition we observed increases in all three psychological need satisfactions, which in turn predicted corresponding increases in perceived academic well-being (interest and effort) and stability in observed academic well-being in classroom behavior (engagement and excitement) across time.

Limitations

The current findings should be viewed in light of several limitations. One limitation has to do with the infrastructure of the classrooms that were studied. Students in this study were technologically literate and taught in small groups of 10 children (max) in a class. They were students of a private school who came from a more advantaged socioeconomic background that had more access to technology at home. The private school itself also had a lot of technology in the classrooms. Specifically, every class had an interactive board and a student response system. In other schools, access to these technologies may be limited due to the high cost (DeBourgh, 2008), and teachers tend to turn to online student response systems so students can use their mobile phones instead (Chen & Yang, 2022). It would be interesting to expand future research to larger classrooms, as well as to classrooms with children from mixed or lower socioeconomic backgrounds to obtain more robust evidence on the role of motivational styles in technology-assisted teaching. Such future work is also useful for

understanding whether other devices, such as students' own mobile phones, would have learning benefits when used within similar motivational climates.

Future experiments could also explore the use of other gamified, motivational, or otherwise 'fun' enhancing teaching strategies that optimize classroom technology benefits. In this study, we used a combined intervention of students' teamwork, providing them with a sense of choice and supporting friendly competition. However, there are other ways that need-supportive teaching is conveyed. For example, some work suggests that motivational tone of voice may play a role in students' experience (Paulmann et al., 2019; Weinstein et al., 2018). Studying this, and other strategies, can help to build a deeper understanding of what need-supportive technology use looks like in the classroom.

Conclusion

Despite the merits of doing so, it is not always an easy task to promote positive students' intrinsic motivation for learning in highly-structured learning environments. Students in many developed countries show low school motivation despite substantial resources going into education (OCDE, 2016; 2019), data from the United Nations Children's Fund (UNICEF) indicates students' well-being has been on the decline (Adamson, 2013), and analyses of 6,800 assignments of schools in America showed discouraging results in motivation and engagement (Dabrowski & Marshall, 2018; Dysarz, 2018). The current field study has provided a notable insight into the acquisition of a lesson by means of Gamified Experiential Technology (GET) use to enhance student perceived academic well-being and observed academic well being in classroom behavior. The in-class experiment over a school semester indicated that implementing GET enhanced the academic environment. It showed that the students were more engaged, enthused, interested and were willing to show more effort in the learning process when GET use was delivered in supportive motivational climates that satisfied their psychological needs. All things considered, technology use is a

great way to make students want to learn, especially when technologies are implemented in a way that help them to feel supported in their psychological needs for autonomy, competence, and relatedness.

Author Note

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Chapter 5

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

2. Declarations of interest: none

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.

Key words: need satisfaction, classroom technologies, interest, effort, teaching styles, SDT

The How and How Much of Technology Use in the Classroom: A Motivational Approach to Teachers' Technology Use

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.

Teachers' Motivational Styles and Its 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 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.

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.

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 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.

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.

Method

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).

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

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).

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

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.

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.

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 Likert scale ranging from 1 *"not at all true"*, to 4 *"somewhat"*, to 7 *"very true"*.

Basic psychological need satisfaction. Students' perceptions that basic psychological needs would be satisfied were measured through three sub-scales. **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) (α = .70). **Competence** was measured with 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) (α = .75). **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"* (α = .85).

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) (α = .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"* (α = .74).

Teachers' Measures

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

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"*.

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).

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” ($\alpha = .77$).

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).

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

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

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

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.

Acknowledging that our positionality, shaped by our academic background, methodological training, and personal experiences, influences various aspects of the research process, including the formation of research questions, selection of variables, and interpretation of statistical findings; while Hierarchical Linear Modeling (HLM) provides a robust framework for analyzing nested data structures, the choices made in model specification and contextual interpretation are inherently influenced by our perspectives. In this study, I, Loukia David served as the lead analyst, I conducted the recruitment through the Pan-Hellenic Federation of School Owners in Greece. I could not anticipate how many teachers and students would participate as I opened the study to all who wished to participate. However, I sought to maximize participant numbers to support nested data modelling. I aimed to obtain at least three student data points per teacher to model between as well as within data variability. I was responsible for designing and conducting the Hierarchical Linear Modeling (HLM) to examine the nested relationship among students, teachers, and

parents. Recognizing the multilevel nature of the data, students nested within classrooms, with both teacher practice and parental inputs influencing outcomes, HLM employed to appropriately model variance across levels. My responsibilities also included specifying model structures, centering variables, and interpreting how teacher motivational strategies with the use of classroom technology intersected to shape student outcomes within the framework of Self-Determination Theory. As a researcher with a background in education, psychology and a commitment to equity in learning environments, I approached the analysis with a focus on understanding how motivation operates across social contexts. I acknowledge that my positionality, both as a researcher trained in psychology and as someone invested in advancing inclusive educational practices, shaped the questions I prioritized and the interpretations I drew. This awareness informed both the methodological decisions I made and my efforts to critically reflect on how power dynamics, access to technology, and cultural responsiveness affect the implementation of SDT, informed practices in real world classrooms. To minimize any positionality issues data handling and results interpretations were done under the supervision of Dr Netta Weinstein, who was also a co-author of the three published studies.

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).

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.

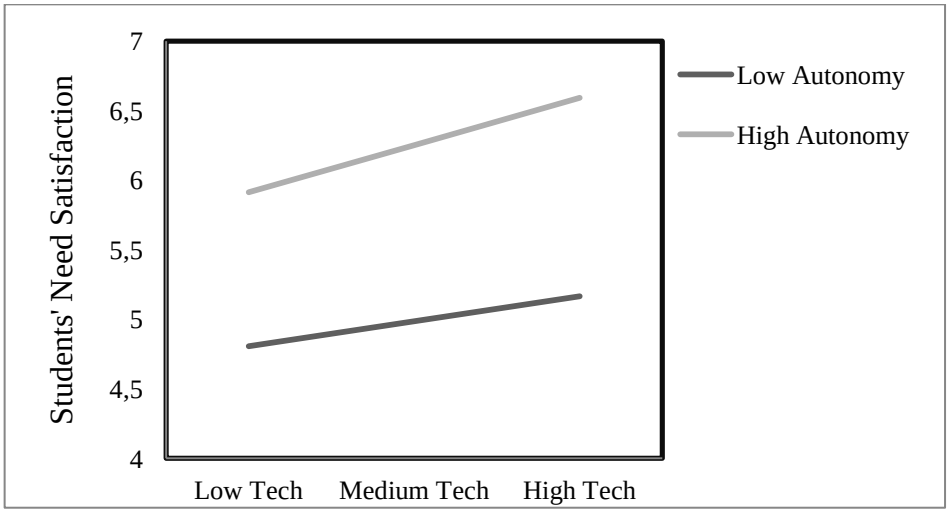
	Motivation orientation – autonomy support	Amount of Technology	Interaction orientation X technology

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).

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).

Figure 1. Autonomy-Supportive Teaching Style x 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).



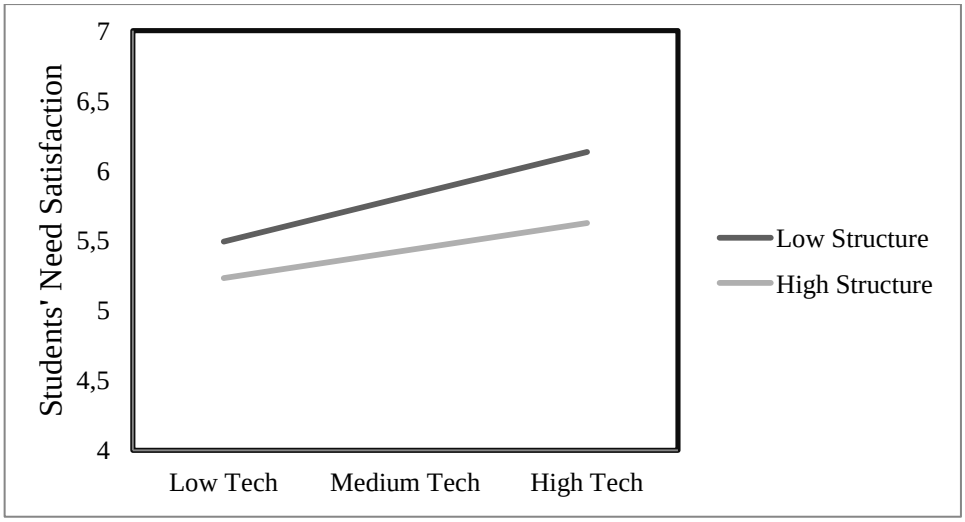
Analyses showed no main effect on teachers' structuring teaching style predicting students' need satisfaction $F(1, 96) = 3.81$, $p = .054$ (Means and effects summarised in Table 6). An interaction effect was in evidence between the amount of technology use and teachers' structuring support in relation 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).

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 – structure			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).

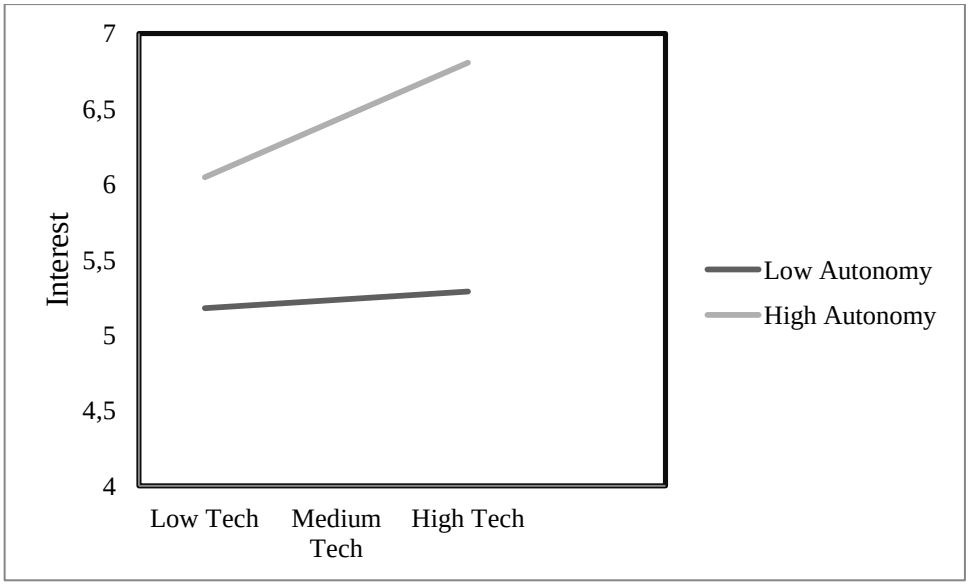
Figure 2. Structuring Teaching Style x Technology Use Effect on Need Satisfation. High Tech, high technology use in relation to other teachers in the sample; Low Tech, low technology use in relation to other teachers in the sample; Medium Tech, medium technology use. Lines represent low and high teacher structuring teaching style. Lines are plotted predicting students' need satisfaction in the classroom (*Y* axis).



Predicting Academic Well-Being Indicators (Interest and Effort)

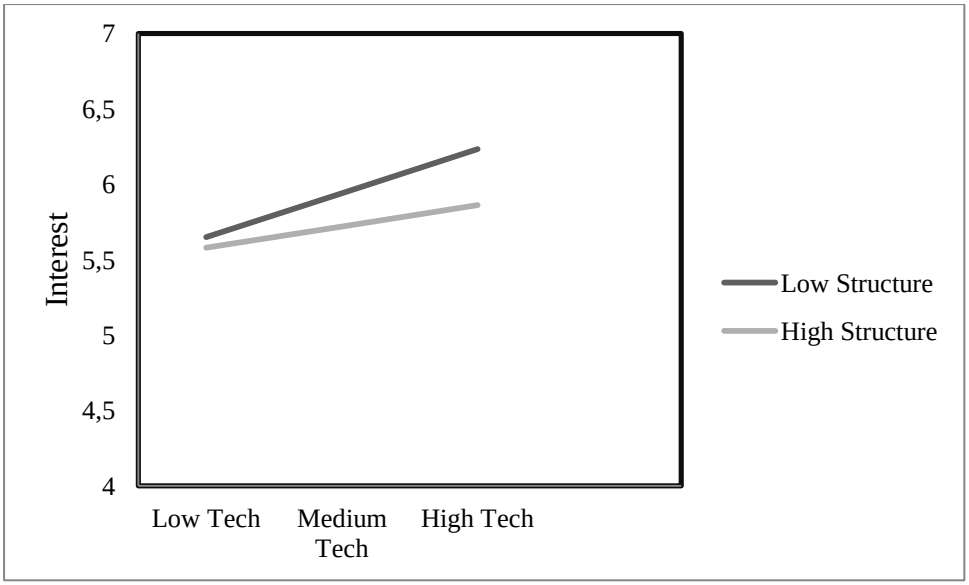
There was no main effects present between teachers' technology use and students' interest, $F(1, 99) = 2.68$, $p = .105$. However, teachers who were high in an autonomous teaching style had students who reported interest, $F(1, 97) = 53.63$, $p < .001$ (Table 5). Interaction effects showed two-way interactions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

Figure 3. Autonomy-Supportive Teaching Style x 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).



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).

Figure 4. Structuring Teaching Style x 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).



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 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.

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 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).

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.

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.

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Chapter 6

General Discussion

The studies presented in this thesis focused on topics related to utilizing technologies in the classroom in an autonomy-supportive way as defined within the framework of Self Determination Theory (SDT; Deci & Ryan, 1985; Ryan & Deci, 2000, 2017). They explored how to best utilize and frame technology to motivate and inspire students and enhance their psychological need satisfaction during language learning and augment their academic well-being.

The studies focused on enhancing these beneficial English learning experiences in a number of ways. In Study 1 (Chapter 3), I developed framing strategies that promote teamwork (supporting relatedness), make friendly competition salient (supporting competence), and provide for choice (supporting autonomy) when using technology in the classroom, and explored how these motivational framing strategies enhance students' basic needs and by extension their academic well-being as manifested in interest and effort.

In Study 2 (Chapter 4), I built on these findings by testing the need-satisfying use of technology in a supportive climate combining choice, teamwork and friendly competition over time. This study complemented Study 1 by testing effects over time and measuring perceived academic well-being as manifested in interest and effort, along with observational assessments of engagement and excitement during the whole academic semester.

In Study 3 (Chapter 5), I measured teachers' use of technology and their teaching styles during naturally occurring lessons, to examine variations in classroom motivational and technological approaches and the links these had with students' academic well-being. In this study, teachers reported on their motivational teaching styles, while students reported on their basic psychological need satisfaction and academic well-being in terms of interest and effort.

This discussion first summarizes the literature, and then discusses the findings from the empirical chapters. It then presents a triadic model of teaching, the limitations of the experiments and future directions. It closes with an overall conclusion.

Constructs and Principles Underlying the Current Research

The studies presented in this thesis relied on conceptual definitions and approaches taken from motivational, educational, and technology use literatures. First, I relied on a self-determination theory understanding that psychological need satisfactions for autonomy, competence and relatedness are important antecedents for academic well-being to function fully (Deci et al., 2015; Martin et al., 2017). Namely, the more students have control over their actions, the more they feel motivated and engaged. *Autonomy* refers to being self-regulating and initiating, and to feeling that one has a choice and the volition to act in accordance with one's values (Deci et al., 2008; Reeve, 2012). *Competence* refers to the psychological need to experience one's abilities to feel capable of succeeding in terms of achievements, outcomes and challenges and to understand what it takes (Reeve, 2012; Deci et al., 2008). *Relatedness* refers to the psychological need to feel a connection with other people, to feel that one is worthy of being respected, loved and capable of being in a meaningful relationship (Deci et al., 2008; Reeve, 2012, Skinner & Pitzer, 2012). Activities that support the satisfaction of these three psychological needs as defined in SDT foster intrinsic motivation and lead to high learning outcomes (Carreira, 2012) such as greater academic well-being as manifested in interest and effort and student engagement (David & Weinstein, 2023a). Therefore, teachers should support these needs driving motivation since if thwarted, they can undermine students' academic well-being (Ryan & Deci, 2020).

Furthermore, I started with a definition of learning as a practical and experiential procedure that shapes one's behavior, knowledge, attitudes, beliefs, skills and strategies

(Bock et al., 2005). Teachers seek methods to enhance students' academic well-being outcomes by creating engaging and interesting classroom environments where their students can engage in the learning process (Flunger et al., 2022). Engagement is an observed action within the learning environment, (Ainley, 2012; Martin et al., 2017; Reeve, 2012), which is positively correlated with psychological need satisfaction (Aelterman et al., 2012). Students who are engaged manifest this engagement through their emotions, persistence, effort, interest, and active contribution to the learning process (Reeve, 2013; Reeve & Tseng, 2011). In addition, interest has been defined in relation to specific activities, where individuals are focused and engaged since the activities are connected to what they are interested in (Rotgans & Schmidt, 2014). Students' efforts reflect a willingness to engage in activities since they understand the importance for their development (Dunlosky et al, 2020). The outcomes of academic well-being as manifested in interest, effort and students' engagement are closely related to students' basic psychological need satisfaction.

I applied these views to inform gamification – an approach to student-centered teaching (Zourmpakis et al., 2022), which offers a promising framework for developing this motivational support as it provides for communication amongst peers and teachers. Gamification involves adding game elements and techniques to non-game environments to accomplish tasks more effectively and increase interest and involvement (Werbach & Hunter, 2012).

Based on existing literature and studies, gamification in language learning has generally shown positive outcomes (Wulantari et al., 2023). Introducing gamification in English language teaching classes has opened opportunities to create more interactive lessons (Wulanari et al., 2023), and is considered to be a prominent method to increase motivation, engagement and interest during a language learning process (Millis et al, 2017; Noroozi et al., 2016; Perry, 2015; Sundqvist & Wikstrom, 2015; Wu & Huang, 2017) from an self-

determination perspective (Ryan & Deci, 2000, 2017) due to the elements which are embedded in the gamified environment (Wu & Huang, 2017). Findings that emerged from the research is that it increases motivation and engagement through game elements in language learning activities (Dehghanzadeh, 2021; Mee Mee et al., 2020). It encourages collaboration and social interaction among peers. They can work together, provide feedback to each other, engage in problem-solving and foster interpersonal skills along with language skills (Kayımbaşıoğlu & Haci, 2016) which enhance relatedness need satisfaction. Finally, giving immediate feedback enables the students to monitor their progress and motivate them to set realistic goals (Dehghanzadeh et al., 2021). The literature reveals that incorporating game elements creates a sense of achievement that enhances intrinsic motivation (Li et al., 2022) which is of utmost importance in the acquisition of English language learning as it serves as a driving force for the students to show effort and commitment throughout (Wulantari et al., 2021); when they are faced with complexities and challenges they remain active participants in language learning activities (Ningsih & Sari, 2021) which enhances the competence need satisfaction.

Huseinović (2024) indicated a high impact of gamified strategies on students' motivation to learn English as a second language; the students' performance in the four skills (speaking, listening, reading and writing) increased along with their motivation. According to Esa et al. (2021), using technology in language lessons in a gamified way increased motivation and positive attitude towards learning. Morthy and Abdul Aziz (2020) suggest that implementing games in language learning assists students to learn without feeling threatened. Gamification can be utilized at all levels and ages to improve 21st century skills of students, including listening, speaking, digital literacy and critical thinking (Kaya & Sagnak, 2022). Student autonomy need satisfactoin is also enhanced since they can self-correct without stress and fear of being criticized (Maloney, 2019). In line with Aydin (2015),

gamified educational technology creates a meaningful collaboration in language learning that allows students to participate more effectively. Gamification may offer a partial solution to the decrease in student engagement and motivation. However, there is a lack of empirical evidence on *how* and whether it may improve motivation in the learning process (Luarn et al, 2023).

One software device that can implement gamification in the class under the lens of SDT is the Student Response System (SRS; Liu et al., 2019), a system that projects quiz-like exercises on the interactive whiteboard and allows students to answer via a handheld clicker. In this thesis, it is referred to as Gamified Experiential Technology (GET; David & Weinstein, 2023), which acknowledges that SRS is just one indicator which can extend to other gamified devices such as smart phones or tablets (Burden & Kearney, 2018) that are also used as a Student Response System (when an application is downloaded; i.e., Kahoot!), and promote experiential learning (Fithriani, 2021; Kaimara et al., 2019) with greater student engagement (Turan & Meral, 2018) mediated by the basic psychological needs of autonomy, relatedness and competence (Ryan & Deci, 2017). SRS-style applications facilitate the teacher-student relationship and enhance the socio-emotional phase in learning (Licorish et al., 2018). Applications (i.e., Socrative) enable teachers to create quizzes with true/false questions, multiple-choice questions and even open-ended questions, and can encourage students to work together and actively discuss and debate a topic before answering and being given feedback, similar to SRS (Pintado & De Cerio, 2017). Mobile apps are being increasingly used: In 2022, there were 255 billion app downloads as compared to 140.7 billion in 2016, an 80% increase (though the majority are used for gaming rather than educational reasons; Statista, 2023). Using a mobile app on each student's mobile instead of a clicker can reduce the cost of a classroom as SRS can be expensive and time-intensive to buy and maintain (Álvarez et al., 2017).

Other devices, however, were not used in the current set of studies as student-participants in my research were prohibited from possessing mobile smart phones or tablets within school premises. The school-level decision is based on work that suggests that bringing phones to the classroom can be disruptive to the classroom environment (Nikolopoulou et al., 2023). In addition, not all pupils aged 9 to 16 – the age groups of the current studies – possess a smart phone or tablet (Nikolopoulou et al., 2021). Given these restrictions, the technology already present in the classroom served as an ideal testbed for the learning principles I sought to test.

The studies in this thesis were consistent with findings reported in Chien et al. (2016), which showed that GET acts as an incentive that makes students more interested in learning, increases their interactions with teachers and peers and generally makes the classroom atmosphere more harmonious. They are also in line with the Ryan and Deci (2006) findings, which showed that supporting competence by giving informative feedback and autonomy by giving the opportunity for meaningful choice encouraged intrinsic motivation. When students are able to choose their tasks in GET and decide whether to participate or not, along with being engaged in friendly competition by seeing their scores on the leader board - as in Studies 1 and 2 of this thesis - they have greater intrinsic motivation to complete the activity (Schunk et al., 2012). In addition, the competitive effect experienced by a game with friendly competition amongst peers - with the use of GET in Studies 1 and 2 - can enhance student interest, leading to greater learning motivation and better outcomes (Burguillo, 2010).

I posited three different motivational strategies termed *teamwork, friendly competition salience and choice* which can be utilized by teachers to engage their students in Gamified Experiential Technologies (GET; David & Weinstein, 2023) to enhance their basic psychological needs (Girelli et al., 2018; Jang et al., 2016; Ryan & Deci, 2020); namely, autonomy (Niemiec & Munoz, 2019), competence (Jeno et al., 2018) and relatedness and by

extension their academic well-being as manifested in interest, effort and engagement (David & Weinstein, 2023a). These framing strategies utilize technology to encourage students to engage in the learning process.

Summary of the Findings

The Pilot study, Studies 1 and 2, (reported in Chapters 2 and 3) examined teamwork, the salience of friendly competition and choice through technology use in English language classes. More specifically, I used the Student Response System (SRS; Liu et al., 2019) which consists of a handheld device called a 'clicker' provided to every student and teacher. This device enables the students to respond to questions projected on the interactive whiteboard simultaneously (Caldwell, 2007). I based these studies on SDT, a framework which posits that the satisfaction of three basic psychological needs (for autonomy, relatedness and competence) underlie the well-being indicators of interest and effort tested in the Pilot study and in Studies 1 and 2. My initial hypothesis was that GET would promote academic well-being to a greater extent than traditional frontal learning. In the Pilot study, academic well-being as manifested in interest and effort were assessed at two time points. The findings showed that academic well-being increased over time when students used GET, but did not change when learning without GET. I then built on the conceptual model testing academic well-being to design Study 1 which compared different motivational strategies to deliver GET. More specifically, I randomly delivered GET to students in five different conditions: putting students in teams, giving them the choice to participate or not, engaging in a friendly competition, participating anonymously or the traditional classroom format. The findings showed that psychological need satisfaction could largely account for the relations between GET use and the academic well-being outcomes of interest and effort. The findings also showed that motivational framing strategies such as assigning students to using GET in teams (supporting relatedness), instilling a friendly climate of competition (enhancing competence)

and helping students to feel that they had a choice (boistering autonomy) further enhanced the benefits of GET use.

The Pilot Study tracked basic effects of GET use over time, and Study 1 examined immediate responses to motivational climates. I then integrated the methodological approaches of both studies to test the cumulative and long-term effects of a positive motivational framing strategy and psychological need satisfaction via GET in Study 2 (Chapter 3), alongside observational and behavioral data which were triangulated and aimed to show convergence with the self-reported student responses. In Study 2 the intervention utilized teamwork, made friendly competence-enhancing competition salient and created choice (joining all basic psychological needs in one motivational framing strategy), compared to using GET without these additional enhancements.

The students were surveyed and observed at three time points throughout an academic semester. They reported increased psychological need satisfaction of autonomy, competence and relatedness and greater academic well-being. The observer ratings indicated more classroom behaviors of engagement and excitement indicative of intrinsic motivation as compared to the no-GET condition. Study 1 and 2 were built on these motivational approaches as they relate to interactive learning and gamification in education. The findings thus inform those areas by providing insights into the acquisition of academic well-being through GET use in enhancing students' perceived and observed academic well-being and answered my first research question on *How can GET make learning more fun and productive?* since they showed that students were more engaged, enthusiastic, interested and willing to make an effort in class when GET was delivered in supportive motivational framings that satisfied their psychological needs.

Although studies have shown that technologies in the classroom can facilitate learning under the lens of SDT, little is known about *how* the motivational framing strategy defined by teachers shapes its impact on students. Teaching traditionally – through lectures – may be ultimately undermining to intrinsic motivation. The SDT perspective on education posits that when teachers use autonomy-supportive styles; namely, 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 (Patall et al., 2010). Teaching can be made more fun through game play by utilizing technology since students are more accustomed to using technology as a basis for exploration (Haleem et al., 2022). Therefore, technology seems to contribute to learning, particularly when delivered with positive autonomy-supportive and structuring teaching styles that can enhance learning.

Autonomy-supportive teachers strengthen students' sense of choice, personal volition and curiosity. These teachers seek to develop their students' innate interest, feelings and preferences (Bartholomew et al., 2011). A structuring teaching style is defined as involving communication and other steps by teachers to guide (i.e., provide structure for) students. Highly structuring teachers strive to understand their students' abilities and enable them to feel competent and able to master the activities they assign in class (Vansteenkiste et al., 2019). In Study 3 (Chapter 4) I explored technology use in English language classes to better understand how autonomy-supportive and structured teaching styles influenced positive outcomes through classroom technology use. By evaluating nested models of students and their teachers, Study 3 provided insights into the antecedents of psychological need satisfaction and academic well-being as manifested through interest. Specifically, the findings showed that the benefits of technology use on learning outcomes did not depend solely on *how often* technology was used, but rather on whether frequent use of technology was delivered in an autonomy-supportive teaching style context. Both were additive in that

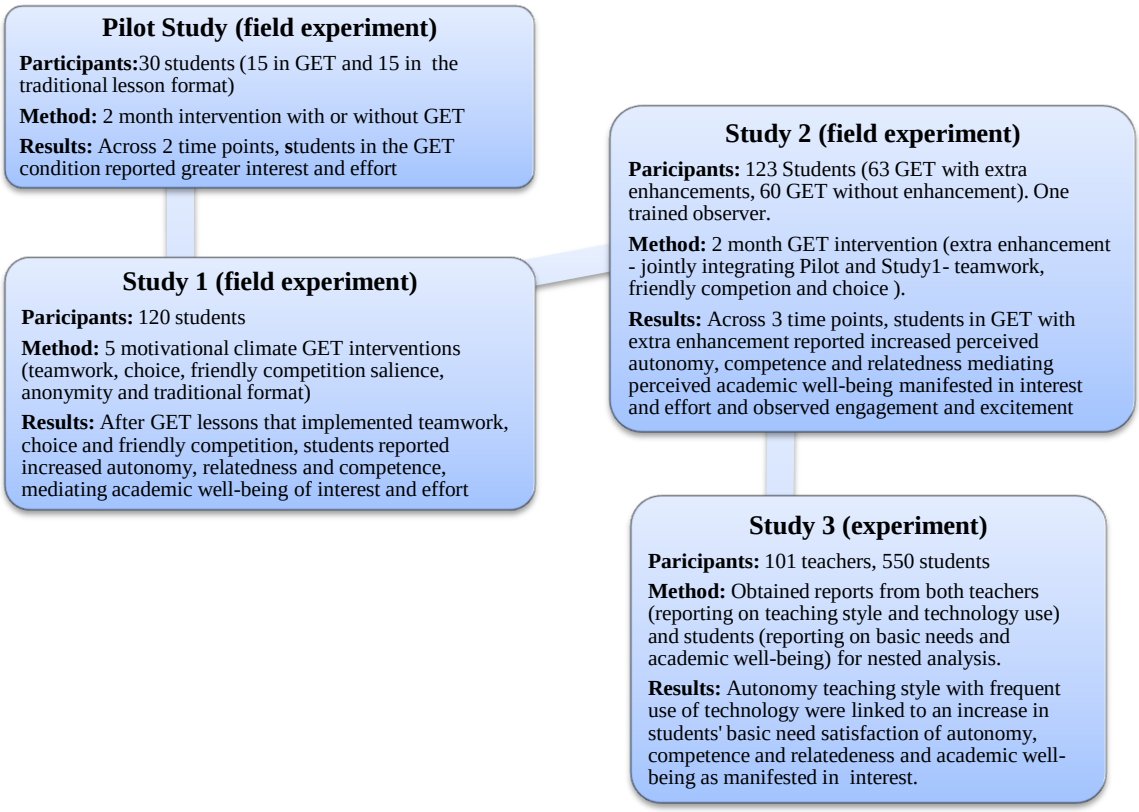
technology use engaged students' intrinsic motivation, especially when students felt deeply supported by teachers. Answering my second research question of *Do teachers motivational teaching* styles *when associated with the use of technology in their lesson impact students' learning outcomes?* Study 3 confirmed that teachers who incorporated technologies more frequently in their lessons and engaged in more autonomy-supportive behaviors were able to better meet their students' psychological needs for autonomy, relatedness, and competence, and the students reported more interest in learning

Hence, the broader teacher context also seemed to matter, which implies that the behaviors observed in Studies 1 and 2 should not be taken out of context. This finding is consistent with studies on motivational orientation in teaching which have suggested that autonomy support and structure can each result in positive outcomes for students (Curran et al., 2013; Jang et al., 2010; Jang et al., 2016; Jang et al., 2018; Sierens et al., 2009; Vansteenkiste et al., 2012), but extends them by suggesting that it is not the integration of technology that matters but *how* it is utilized. Teachers benefit their students when they satisfy their students' psychological needs of relatedness, autonomy and competence (Reeve & Halusic, 2009; Ryan & Deci, 2017). A substantial body of research has shown that satisfying these psychological needs is also linked to academic well-being, and both sets of experiences are linked to teachers' autonomy-supportive teaching styles (Ryan & Deci, 2017; Vansteenkiste & Ryan, 2013; Wedell & Malderez, 2013).

Overall, the studies reported in this thesis indicate that both the framing strategies and the implementation of technological tools may work well together to enhance learning. Thus, teachers are encouraged to invest in incorporating technology into interactive teaching to support students' well-being through enhancing their psychological needs of autonomy, relatedness and competence (Bedwel et al., 2014; David & Weinstein, 2023, 2023a). Learning environments that are rich in technologies have proven to be useful in the

interactive learning and can contribute to intrinsic motivation (Hidayat et al., 2018; Reguera & Lopez, 2021). (see Figure 1).

Figure 1: Flow chart depicting the integration of the studies presented in this thesis



Discussion of the Findings

Overall, the use of gamified experiential technology (GET) produced better learning outcomes than traditional learning. The results of Study 1 expanded previous research showing that learning conditions that supported relatedness, competence and autonomy needs enhanced students' academic well-being (i.e., students' interest in the task and the effort they put into it; David & Weinstein, 2023; Nikou & Economides, 2016). Condition effects were also in line with studies identifying benefits of positive motivational framing strategies on learning outcomes, both directly and indirectly through supporting these basic psychological

needs. In my findings, students felt more related to one another when GET use was implemented through teamwork, friendly competition and when they received choice.

The findings of Study 2 built on previous research (David & Weinstein, 2023), which suggested that GET enhanced the learning experience, but only when gamified experiential strategies were in use. When students engaged in GET as part of a team, had the choice to participate, or engaged in friendly competition, they felt need satisfied, which correlated with more self-reported effort and interest in contrast to using GET anonymously or when answering the same questions on paper. The current experiment was built on several gaps in this nascent literature. As I did not have systematic knowledge about a gamified learning intervention for technology use on children, I concentrated my experiment on a broad range of students' ages between 9 and 16 years. Other research was conducted on university students (Annamalai et al., 2022; Benson et al., 2017; Çelik & Baran, 2021; Kent, 2019; Pearson, 2017; Tóth et al., 2019; Yu et al., 2021) and provided little understanding of how motivationally-supportive contexts – ones that enhanced the basic psychological needs of autonomy, relatedness and competence – and technology can be used in parallel to optimize learning. Second, to date no field experiments with children have been conducted manipulating daily use of technology in the classroom for an entire academic semester. Previous experiments applied motivational climates just once or in very few sessions (Boudadi & Gutiérrez-Colón, 2020; David & Weinstein, 2023; Sun & Hsieh, 2018). Although those analyses were exploratory, I saw one of the most exciting findings of the current work the benefits observed across time when motivationally supportive education contexts were used.

There are vital gaps between practices and policies in educational institutions (Ryan & Deci, 2020). This study tested an intervention that allowed students to use technology in a gamified experiential structure characterized by maximizing their choice, supporting

collaborative teamwork, and trialing friendly competition among students. This combined approach to supportive students' psychological needs has not been implemented together in practice. Indeed, there is recognition that more of this kind of work – theory-informed interventions in the classroom – is needed to understand optimal classroom teaching styles (Patall & Zambrano, 2019).

Students are open to new challenges and show excitement and engagement; however, they require experience to master a task (Ryan & Deci, 2020). This was evident across time in our experiment. Students who used GET in the motivationally enhanced (i.e., need-supportive) condition showed greater enthusiasm and engagement from the beginning of the experiment to the end, but needed more time to feel related to classmates, more choiceful, and more efficacious in their GET learning and in turn show interest and effort. The psychological need satisfactions led to increases in effort and interest and kept engagement and enthusiasm consistent throughout the semester.

In contrast, students who used GET without the need-supportive motivational climate showed lower enthusiasm and engagement from the onset of the manipulation at the start of the semester. Unlike those students in the Experimental condition, they reported less interest and effort across time.

Students in the Comparison condition also reported different patterns of need satisfaction across the semester in relation to the Experimental group. Specifically, throughout the semester, they reported lower relatedness to classmates during the GET activity and felt less choiceful for the activity. These reduced psychological need satisfactions corresponded with reported decreases in effort, interest, engagement and excitement. These results supported SDT assertions that basic psychological need satisfaction for relatedness, autonomy, and competence underlines positive learning (Ryan et. al., 2019), whereas thwarting these basic psychological needs can damage motivation and well-being

(Vansteenkiste et. al., 2020). In Study 2, using classroom technology (GET) in the absence of need-supportive motivation resulted in lower relatedness and autonomy need satisfaction, and less competence need satisfaction throughout the semester, suggesting that perhaps any need-satisfying benefits of GET wore off as novelty decreased. On the other hand, in the Experimental condition I observed increases in all three psychological need satisfactions, which in turn predicted corresponding increases in perceived academic well-being (interest and effort) and stability in observed academic well-being in classroom behavior (engagement and excitement) across time.

Study 3 explored the role that teachers' motivational styles as autonomy-supportive and structuring play in children's learning experiences, operationalized in terms of basic psychological needs, and academic well-being of interest, and effort. I did so by assessing teachers' reports of their own behaviors (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). My 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.

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 et al., 2022). My 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 findings of Study 3 also built on work investigating technology use in the classroom. Here, I 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).

My observations that autonomy-supportive motivational orientation enhanced 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 my expectations. When teachers were *low*, not high in structure, technology seemed to facilitate learning. However, in the current research I 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 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 my study I did not have the sufficient numbers of teachers to conduct these analyses.

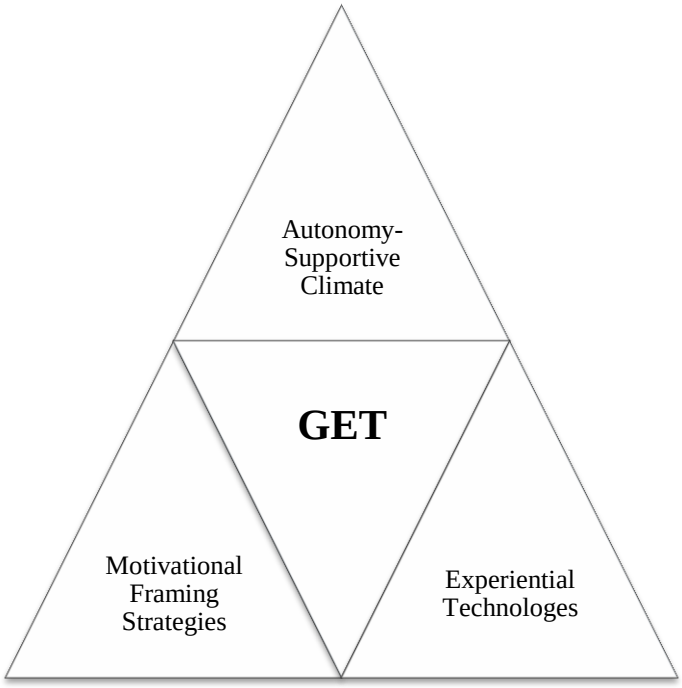
In all, my results in this study were also aligned with studies of students' experiences showing that students benefit most when they take part in digital activities without pressure (Luarn et al., 2023), and when they are involved in activities that they enjoy (Chang, 2013; Huang et al., 2012). However, 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 I 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).

The studies reported here indicated that when frequent use of technologies is delivered with supportive motivational framing strategies (teamwork, friendly competition and choice supporting relatedness, competence and autonomy respectively) by autonomy-supportive teachers, the students feel that their needs have been more satisfied and in turn are more intrinsically motivated to learn.

Figure 2 presents a triadic model of supportive education of young learners through GET. When teachers implement an autonomy-supportive climate in their gamified interactive lessons with the use of technologies, students feel more related to their peers and teachers, more autonomous and competent, and in turn are more interested, engaged, enthusiastic, and make an effort to learn. Overall, their whole learning process becomes more fun and productive.

Figure 2. A Triadic Model of Gamified Experimental Technology (GET).



Integrated triadic model of GET

The triadic model of GET approximates the practice of learning from three perspectives that depend on and interact with one another: learning in an autonomy-supportive climate in class, learning with motivational framing strategies with the use of GET and the use of frequent technology, all of which create or enhance learning experiences in which teachers develop and deepen their understanding of the relationship between technology, pedagogy and content. The model focuses on enriching learning experiences by engaging teachers in designing tasks incorporating motivational framing strategies that tap teamwork, friendly competition and choice while characterizing the usefulness of enhancing students' relatedness, competence and autonomy. This requires investment since the implementation of technology at school needs to overcome barriers to achieve positive academic outcomes, because adopting innovative state-of-the-art devices and equipment alone is not enough (Looney et al, 2022).

My research as presented in this thesis indicates that technologies that are designed to transform and improve students' learning in a gamified experiential way, assist teachers to create motivational framing strategies that enhance students' basic psychological needs. The findings here pointed to the benefits of incorporating devices with game elements that allow students to make choices, work in teams and create a friendly competition amongst themselves such as the Student Response System that was used in the field experiments described in Chapters 3 and 4 of this thesis. Future research can consider whether teachers benefit when they see what syllabus is taught in a specific lesson (i.e., English grammar) and to incorporate software with short quiz-like games that can be *"played"* in the final minutes of a lesson. Approaches to maximizing fun may be paired with quiz-like games which can be sent to parents, who are encouraged to spend quality time with their children during weekends or holidays. The results here suggest that it may be worthwhile to invest in technological devices that assist gamification in the classroom and to structure applications or

platforms designed by educators for extra gaming practice at home. Although we live in a technological era, schools may be the only place where certain children from less privileged socio-economic backgrounds and cultures have the opportunity to use them (OECD, 2010). Successful educational policies that foster children's digital skill development provide ICT in schools, teacher training, and support the integration of technologies in schools. Some countries go beyond merely accommodating students with ICT lessons. The UK teaches coding, Denmark allows the use of the internet during exams, and Norway makes students take a national digital skills evaluation test (UNESCO, 2018).

Schools may gain from having technology-savvy students and in changing teachers' attitudes to encourage them to learn with and from students while also training teachers to facilitate learning through technology (Wake & Whittingham, 2013). In future research, it may be worthwhile to evaluate reasons that the pervasive availability of technology and the growing numbers of digitally-literate teachers do not result in progress in students' learning outcomes (Kirschner & De Bruyckere, 2017; OEDC, 2010, 2016). It may be important to adopt a school culture that can change teachers' attitudes towards technology integration in their lessons (Apeanti, 2016). When teachers are valued and respected for their contribution, they are more motivated to use technology (Tondeur et al., 2016). Findings have shown that a supportive school culture generates technologically competent leaders, technical support and encouragement for technology integration (Omwenga et al., 2015).

Limitations and Future Directions

The studies in this thesis contribute new insights into utilizing technology with motivational framing strategies that tapped on basic psychological needs in an autonomy-supportive way in the classroom. However, they are not without limitations. First, Studies 1 and 2 were conducted in a school which I, the researcher, am also the head teacher. This may

result in ethical concerns, particularly around the potential conflict of interest in holding both these positions. I am a white woman in my mid-fifties and the head teacher for approximately 25 years, my interest was in how to frame the lessons in order to make English learning more interesting to students. There is no doubt that holding both positions may raise concern of positionality as it may be assumed that the results in these studies may have been affected by the nature of my observations and the interpretations (Lin, 2015). It was important to comprehend positionality and to be self-aware of how my position as headteacher and researcher had created specific perspectives throughout. I admit that my background (being a head teacher for 25 years), my likes and dislikes of educational technology, my vested interests as head teacher and expectations could be acknowledged as taking a central role in the research process (Bukamal, 2022). As a researcher, I had an active not passive role in acquiring knowledge of the research context; therefore, my position, the relation between myself and the participants, my background including gender, class, ethnicity, age, commitments and ideas require to be explicit (Lin, 2015).

Being of white British heritage and from a middle-class background, I recognize the potential of unconscious bias in how I interpret the behaviors, perspectives, and needs of students, particularly those from different cultural or socioeconomic backgrounds. I had therefore made a conscious effort to listen deeply to students' voices and experiences to understand them. Furthermore, my age and seniority within the school may have influenced how students and colleagues perceive me, potentially affecting the openness of wanting to participate or not. To mitigate this, I clearly communicated the voluntary nature of participation and ensured that all contributions were treated confidentially. I also reinforced my role as a researcher, separate from my teaching or evaluative responsibilities, during the interactions.

Acknowledging these intersecting dimensions of my identity was essential to ensuring the ethical and interpretive integrity of the studies. My goal had been not to erase my positionality, but to account for it transparently, and to use it as a lens for deeper reflection and accountability in the research process.

Regarding positionality, linguistic positionality matters too in teaching English as a foreign language lessons like the lessons in my studies. When the researcher does not speak the same dominant language as the participants, data collection is affected. Consequently the researcher's language becomes a form of power over the participants. Issues of power are required to be dealt with in research, especially in educational research as they are marginalized if not ignored. Most importantly this must be acknowledged that linguistic positionality should be explored in educational research (Cormier, 2018). I attempted to combat this problem by supplying surveys to the participants that were translated and back translated in Greek which was the participants' native language and age adjusted. To minimize any positionality issues data handling and results interpretations were done under the supervision of my supervisor Dr Netta Weinstein who was also a co-author of the three published studies. In future , I plan to actively engage in reflexive practice throughout my future studies, maintaining a reflective journal to critically examine how my own beliefs, experiences, and positional authority may influence data collection and analysis in order to increase transparency, remain aware of how my position, background and teaching values influence the participants' engagement and my findings.

Furthermore, when equipping the classroom with new technology, my first concern was to train the staff on how to use it. The teachers involved in the studies were all technology-literate with many years experience in using technologies and specifically the Student Response System; therefore, the use of SRS in the studies was routine to them and myself. My experiments were aimed at understanding how I can frame the use of SRS under

the lens of Self Determination Theory to enhance the academic outcome as I noticed the novelty wearing off soon after initial adoption of new technology. To avoid coercion and reduce bias, I gave my staff the option to participate or not and to express their view on how to integrate gamification in their own lessons without causing more pressure. They were advised to teach as normal, and at the end of the lesson to assist the experiment by giving the questionnaires to their students. The studies received Ethics approval from the University Research Ethics Committee of the University of Reading and were pre-registered. For Studies 1 and 2, teachers volunteered after being contacted via email and for Study 3 teachers and head teachers volunteered after being contacted via a community listserv to which I belong. 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. All participants (students, parents and teachers) were not aware of what to expect from my manipulations as they were not informed of the hypotheses and expectations of my studies. They were furthermore informed that their data would be kept anonymous. In all, my worldview bias based on both professional and personal experience is that technologies used wisely generally and specifically in classrooms with motivational framing strategies can be a collaborative experience for both students and teachers.

Second, future work should build on this thesis by expanding on the diversity of technologies that can be used in a motivational context. In the field experiments (Pilot Study, Study 1 and 2), I only used the Students Response System, but this could be extended to study whether other devices, such as tablets and smart phones, have learning benefits when used in similar motivational framing strategies. I attempted to do so in Study 3 but the

number of participants (101 teachers and 550 students) was not large enough to test three-way interactions or examine the effects as a function of different technological devices used by the teachers. The use of technology is more fine-grained, as is the interplay of different motivational framing strategies implemented by teachers. However, teachers no longer rely on digital tools in a generic fashion; instead, they utilize adaptive learning platforms, real-time analytics dashboards and differentiated content delivery systems such as Google Classroom to tailor instruction to individual student needs (Darling-Hammond et al., 2020). Parallel to this technological refinement is the more deliberate application of motivational framing strategies that align closely with Self-Determiantion Theory, which posits that autonomy, competence, and relatedness are key drivers of intrinsic motivation (Ryan & Deci, 2000). For example, teachers may implement gamified environments using tools like Classcraft or Quizizz to support competence and peer collaboration (Krishnan et al., 2021), while offering student choice in project formats, such as digital storytelling via Adobe Sparkor video essays through Flip, to enhance autonomy (Navas, 2025). Real-life relevance is also emphasized through problem-based learning and simulations such as Minecraft Education, helping students feel connected to broader contexts. Thereby, strengthening their sense of relatedness and purpose (Slyman, 2024). The synergy between these motivational principles and fine-grained technological use creates conditions for deeper engagement and sustained academic growth. To further improve the integration, professional development must focus on helping educators design experiences that deliberately activate all three components of SDT through technology (Reeve, 2012). Additionally, more inclusive and culturally responsive design in digital tools, such as multilingual supports, accessible interfaces, and representation of diverse identities, can insure that these benefits are equitably distributed across student population (Alim et al., 2020). In this way, SDT not only provides conceptual foundation for enhancing student motivation, but also offers a practical

framework for leveraging educational technology in meaningful student-centered ways. Thus, future well-powered research should examine these more complex relationships between motivation and technology use in larger samples; both teachers and students should be assessed, rather than relying on only one of these two sources.

Third, future studies could also measure the effects of GET in larger classrooms in state schools which have students with diverse backgrounds to obtain more robust evidence on the role of motivational styles in technology-assisted teaching with more teacher-student involvement. The students in the field experiments were taught in small groups of approximately 10 in each class which they attended twice a week to learn English as a foreign language and were from more advantaged socio-economic backgrounds. It may be that the broader socio-economic context plays a vital role in attitude formation, beliefs and effort to carry out a learning activity (Kormos & Kiddle, 2013). More inclusive and culturally responsive design in digital tools, such as multilingual supports, accessible interfaces, and representation of diverse identies, can insure that these benefits are equitably distributed across student population (Alim et al., 2020). In this way, SDT not only provides conceptual foundation for enhancing student motivation, but also offers a practical framework for leveraging educational technology in meaningful student-centred ways.

A key limitation lies in its limited exploration of the practical challenges associated with integrating technology and Self-Determination Theory (SDT) in diverse educational settings. While the theoretical alignment between SDT and digital tools is well established (Ryan & Deci, 2000; Reeve, 2012), implementing this integration in real-world classrooms presents several difficulties. First, issues of digital equity remain a major concern; not all students have equal access to devices, high-speed internet, or assistive technologies, particularly in under-resourced schools (Darling-Hammond et al., 2020). This digital divide can limit the reach and effectiveness of even the most well-designed technology-based

motivational strategies. Second, teacher preparedness varies widely, and many educators lack the training or confidence to design lessons that simultaneously meet curricular goals, leverage educational technology, and foster intrinsic motivation in line with SDT principles (Chiu et al., 2024). Third, technological tools themselves are not always designed to be autonomy-supportive, competence-enhancing, or socially engaging. Many rely on extrinsic motivators such as points and badges, which can undermine intrinsic motivation if not paired with meaningful learning (Hamari et al., 2014). Additionally, cultural and linguistic relevance is often overlooked in digital content, which may diminish students' sense of relatedness and engagement, especially among multilingual or marginalized learners (Alim et al., 2020). Finally, this study does not fully account for the complex role of teacher-student interaction in technology-mediated environments. In practice, motivation is not just a function of tool design but also of the relational dynamics in the classroom, describing how teachers frame tasks, provide feedback, and support student agency (Reeve & Tseng, 2011). Future research should investigate these challenges systematically, particularly in large, diverse classrooms, to generate robust, context-sensitive models for the effective and equitable application of SDT-informed, technology-supported pedagogy.

Forth, all the field experiments were conducted soon after the reopening of schools after a period of online lessons during the COVID-19 lockdowns, so that the timing may have affected the findings across all interventions, since the teachers and students were happy to return to the classroom setting. Future work may want to consider measuring GET again after the novelty effects diminish.

Fifth, the reliability was lower in some measurements than some recommend (Viladrich et al., 2017) (in particular, effort in the Pilot Study had $\alpha = .64$; interest in Study 1 had $\alpha = .69$; competence time 1and relatedness time 1 in Study 2 had $\alpha = .69$ and $\alpha = .68$, respectively and engagement time 2 in Study 2 had $\alpha = .67$), but certain experts consider $\alpha =$

.60 to be an acceptable benchmark (Cohen et al., 2011). Future experiments may find that the effects may be different, and possibly more robust, when using more reliable measures.

Sixth, the work conducting during my PhD focused on indicators related to intrinsic motivation, such as interest, effort and engagement, rather than focusing on academic performance to avoid undermining student motivation because of normative pressures to avoid discussing these outcomes (Wijsman et al., 2019), because measuring academic performance would enhance extrinsic motivation, directly contradicting principles of self-determination theory regarding the importance of intrinsic motivation, deep learning and sustained motivation or engagement (Ryan & Deci, 2017; Sun & Hsieh, 2018). Research has shown that controlling or negative feedback can thwart competence (Na & Han, 2023), but intangible rewards which are also task contingent provide positive feedback for the students to improve and master the task (Davis & Singh, 2015). However, I do recommend future researchers to measure academic performance if it coincides with the outcome of interest they tend to study.

Overall Conclusion

This thesis contributes to the educational technology and educational psychology literature and offers insights into teaching styles connected to *how* to utilize classroom technologies. Acknowledging the work undertaken previously, which recommended that teachers should be more autonomy-supportive as defined within the framework of Self Determination Theory (SDT; Deci & Ryan, 1985; Ryan & Deci, 2000, 2017), the findings presented here suggest how technologies could be implemented to encourage students and satisfy their basic psychological needs of autonomy, competence and relatedness in order to achieve academic well-being as manifested in interest and effort and student engagement in class. Both framing strategies and the utilization of technological tools work well together to

enhance learning. Teachers should invest in both educational technologies and motivation since they have the wherewithal to shape these practices in different ways (Darvin, 2015).

Like most industries, the education sector urgently needs to adapt to the unstoppable changes in the utilization of technology (Fernández-Gutiérrez et al, 2020). Teachers are challenged to acquire the skillsets to become digital competent and equip their classrooms with state-of-the-art technologies (Yazdami et al., 2023) because they are essential to the learning environment: they enable activities to be conducted easily and more effectively to enhance learning outcomes (Raja & Nagasubramani, 2018).

Before the pandemic, teachers made little use of technologies in many mainstream schools (Bai et al., 2021), and even if they were facilitated, they were implemented as more of an extra or novelty than really being considered as a tool that could enhance teaching (Çınar et al., 2021) and academic well-being with the use of motivational framing strategies that tap on the students' basic psychological needs to obtain the required outcome (David & Weinstein, 2023). Teachers confessed that they either had no relevant skills or had insufficient support or strict curriculum deadlines or heavy workloads which they prioritized (Bai et al., 2021). During the pandemic they were forced to use technologies which overwhelmed them, and they felt threatened by these changes. However, this situation also led to a realization of the benefits of educational technologies (Moorhouse, 2023).

Combining teachers' autonomy-teaching style with the use of technology may be the optimal approach to increasing students' interest. Students may benefit to the extent that school principals invest in teaching training programmes that keep teachers up to date on advances in technology and how to frame them in their lessons to trigger intrinsic motivation (Hosokawa & Katsura, 2018). This may make students feel more psychologically need-satisfied. This is particularly vital, since training in-service teachers and future teachers to

feel more autonomy supported themselves encourages a culture that will provide autonomy support to their students they teach. As Ottenbreit-Leftwich (2010) noted, teachers who have high self-confidence, and can make connections and see the importance of their work, are more likely to successfully integrate technologies into the classroom.

In conclusion, the studies presented here explored how to best utilize teaching styles and technology to motivate and inspire students and enhance their psychological need satisfaction during learning, while bolstering their academic well-being. The studies focused on strengthening these beneficial learning experiences in a number of ways by creating motivational framing strategies that promote teamwork, make friendly competition salient and provide choice when using technology in the classroom. They explored how these motivational framing strategies can enhance students' basic needs and in turn their academic well-being as manifested in interest and effort. These studies tested the need-satisfying use of technology in a supportive climate of joint choice, teamwork and friendly competition over time along with observations of engagement and excitement. I also measured teachers' perceptions of technology and their teaching styles and how autonomy-supportive they are during their lessons while utilizing technologies to achieve a positive outcome. The thesis highlighted the importance to integrate the triadic model of GET to shape competent, autonomous and sociable citizens of the future.

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