



Research paper

Satisfying students' psychological needs in the classroom: Benefits of an online intervention to help primary school teachers during a pandemic academic year

Pedro Javier Conesa^{a,*}, Jon Andoni Duñabeitia^{b,c}, Iban Onandia-Hinchado^d, David González-Cutre^e

^a Facultad de Educación, Universidad de Murcia, Murcia, Spain

^b Centro de Investigación Nebrija en Cognición, Universidad Antonio de Nebrija, Madrid, Spain

^c The Arctic University of Norway, Tromsø, Norway

^d Psicología Amorebieta, Amorebieta, Spain

^e Department of Sport Sciences, Sports Research Centre, Miguel Hernandez University of Elche, Spain

ARTICLE INFO

Keywords:

Autonomy support
Motivational style
Elementary school
Online intervention
COVID-19
Academic achievement

ABSTRACT

Using a self-determination theory framework, this quasi-experimental study focused on designing and implementing online training for primary school teachers to help them develop a motivating style, reduce their burnout and support their students' psychological needs, autonomous motivation, agentic engagement, and academic achievement during the COVID-19 pandemic. Forty-two teachers and their students ($N = 682$) were randomly assigned to an experimental or a control group. Teachers who participated in the intervention increased their motivating style and reduced their controlling style compared to the control group. The intervention for teachers increased students' autonomy and competence satisfaction, autonomous motivation, and agentic engagement.

1. Introduction

The COVID-19 pandemic has disrupted education systems around the world since its outbreak. On March 14, 2020, the Spanish government declared a state of emergency, closing schools across the country. Several researchers have indicated that prolonged periods of school closure could have negative consequences on pupils' satisfaction of basic psychological needs, motivation, learning and engagement (e.g., Holzer et al., 2021; Kuhfeld et al., 2020). With all the demands placed on teachers, such as increased workloads and adapting to a new teaching model in record time, numerous studies have shown that levels of teacher stress, anxiety, burnout and amotivation have increased during the pandemic (e.g., see Westphal, Kalinowski, Hoferichter, & Vock, 2022). In addition to the consequences that teachers themselves may suffer, previous research has found that teacher burnout and exhaustion affects student motivation, engagement and student academic success (de la Fuente et al., 2020; Shen et al., 2015; Sutchter, Darling-Hammond, & Carver-Thomas, 2019). With the challenges teachers faced during the COVID-19 pandemic, it was vital to consider what tools and techniques

could facilitate their mental health and improve the quality of their work.

Notably, for educators, the COVID-19 pandemic has been a transformational and adaptive challenge par excellence for which there was no ready-made manual to guide appropriate responses. Education managers needed to design responses quickly - and with specific contexts in mind - as the pandemic ran its course. The question was how students and teachers became motivated after the consequences resulting from school closures. Research on how to adequately apply relevant motivational theories to develop pedagogical techniques that satisfy students' psychological needs and promote learning in such a complex context for mental health remains relatively under-researched, especially in primary education. In order to investigate which tools could be useful for improving students' motivation, engagement and performance as well as teachers' motivational style and well-being, this study was designed to carry out a self-determination theory-based online training of primary school teachers.

* Corresponding author. Faculty of Education, University of Murcia, Murcia, 30100, Spain.

E-mail address: pj.conesacervera@um.es (P.J. Conesa).

<https://doi.org/10.1016/j.tate.2023.104281>

Received 11 January 2023; Received in revised form 26 July 2023; Accepted 27 July 2023

Available online 10 August 2023

0742-051X/© 2023 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1.1. Self-determination theory and teachers' interpersonal styles

Self-determination theory (SDT, Ryan & Deci, 2000; 2017) has proved to be one of the most important motivational approaches in the educational context. This theory establishes that the fundamental motivational energy comes from a set of basic psychological needs that are essential for people to experience, maintain, and foster well-being, personal growth and different positive outcomes. According to SDT principles, teachers' interpersonal styles may differ in the degree to which they support students' basic psychological needs for autonomy, competence and relatedness. *Autonomy* refers to the feeling of willingness and freedom in carrying out activities or actions (e.g., when students experience a feeling of task choice) (Ryan & Deci, 2006). The need for *competence* involves feelings of efficacy in one's interactions with the environment (e.g., when students feel able to carry out the activities set by the teacher effectively). *Relatedness* is defined as the need to interact with others, caring about and at the same time being understood by them (e.g., when students experience an attachment to their teacher or classmates) (Ryan, 1991).

Taking into consideration the teacher's influence on student outcomes, recent studies based on SDT (Aelterman et al., 2019; Vermote et al., 2020) defined four main interpersonal motivational styles by different levels of "support vs. control" and "structure vs. chaos" that teachers provide to their pupils. As for the *autonomy-supportive* style, the teacher develops attitudes and behaviours based on understanding, trying to nurture the students' interests, opinions and feelings, with the aim of making the students the centre of the teaching-learning process (Cheon, Reeve, & Moon, 2012; Mouratidis, Vansteenkiste, Sideridis, & Lens, 2011; Reeve & Cheon, 2021). A number of interventions have been conducted during the past years, which confirm that teachers can learn to support autonomy, and when they do, students benefit from it in many different ways (Cheon et al., 2012, 2018, 2020; Reeve & Cheon, 2021). With regards to the main strategies that foster support for autonomy in the classroom, scholars differentiate seven main "autonomy-supportive instructional behaviours" (ASIB) (Reeve & Cheon, 2021). These are: (1) to take into consideration the perspective of the students (Patall et al., 2018; Todd & Galinsky, 2014); (2) to encourage students to explore their personal interests, such as, asking the students what they find more interesting in a given activity (Jang, Kim, & Reeve, 2016; Patall, Dent, Oyer, & Wynn, 2013, 2017); (3) to prepare learning activities that satisfy their needs, for example, give them the possibility to choose (Patall, Cooper, & Robinson, 2008); (4) to provide rational explanation, showing the students the personal relevance and benefits from making this effort or learning these particular contents (Vansteenkiste et al., 2018; Wigfield & Eccles, 2020); (5) to acknowledge negative feelings and opinions when learners show any experience of anxiety, frustration or boredom in tasks they find uninteresting or difficult, as this is the only way to dispel these feelings and subsequently prepare learners to participate and internalise the task (Deci, Eghrari, Patrick, & Leone, 1994); (6) to use invitational language, encouraging initiative and behavioural change through language that is rich in determination ("You might want to ...") together with the prosody of the voice in a more engaging tone (Vansteenkiste, Simons, Lens, Soenens, & Matos, 2005; Zougkou, Weinstein, & Paulmann, 2017); and (7) to show and build patience, both in teachers and students, giving them time and space to allow thinking, actions and behaviour to develop from support for autonomy (Reeve & Jang, 2006).

In contrast, when the teaching style is more *controlling*, teachers embrace a mindset that prioritizes their interests and perspectives, leading them to pressure students to behave, think or feel in certain ways. Teachers may apply this pressure in a diversity of forms, with some strategies that involve external control; such as punishment, yelling, intimidation, and providing contingent rewards (De Meyer, Soenens, Aelterman, De Bourdeaudhuij, & Haerens, 2016; Deci, Koestner, & Ryan, 1999; Ryan, 1982) and other strategies that involves internal control; triggering feelings of shame, anxiety or guilt-induction in

pupils (De Meyer et al., 2016; Soenens, Sierens, Vansteenkiste, Dochy, & Goossens, 2012; Soenens & Vansteenkiste, 2010). A more controlling teaching style has been associated with greater frustration of the students' basic psychological needs and various negative consequences and experiences in the classroom, such as boredom, anxiety, contingent self-esteem, avoidance of challenges or fear of involvement (Assor & Tal, 2012; Bartholomew et al., 2018; Jang et al., 2016). In addition, the feelings of pressure experienced by teachers with a controlling motivational style can take an emotional and psychological cost that is reflected in an increased burnout syndrome (Fernet, Guay, Senécal, & Austin, 2012; Pelletier, Séguin-Lévesque, & Legault, 2002).

A *structure-based teaching style* is the interpersonal tone of guidance from teachers who appreciate and actively support the need for competence in the classroom (Aelterman et al., 2019). Whenever teachers support competence, they are taking a number of actions such as: (1) clear communication of expectations about what students should do and how they should function (Cheon, Reeve, & Song, 2019) and (2) provide step-by-step guidance on how to do this, offering feedback that makes learners reorganise their strategies, behaviours and actions in order to meet these expectations (Aelterman, Vansteenkiste, Van den Berghe, De Meyer, & Haerens, 2014, 2019; Jang, Reeve, & Deci, 2010; Sierens, Vansteenkiste, Goossens, Soenens, & Dochy, 2009). There are numerous experimental studies that have shown that teachers can modify their behaviour and support competence in the classroom with numerous benefits for their students (Aelterman et al., 2019; Carpentier & Mageau, 2013; Cheon, Reeve, & Vansteenkiste, 2020; Mouratidis, Michou, Aelterman, Haerens, & Vansteenkiste, 2018). However, a lack of effect has also been observed in other studies (Eckes, Großmann, & Wilde, 2018; Guay, Valois, Falardeau, & Lessard, 2016; Jang et al., 2010). This seems likely to happen since the structure must be provided in a way that supports autonomy and therefore implies that teachers have prior knowledge of how to support autonomy, avoiding falling into taking on the position of a more controlling teaching style (Curran, Hill, & Niemiec, 2013; Reeve & Cheon, 2021).

Given this problem, in recent years several researchers have expanded the established conditions of instructional behaviours to provide structure "in an autonomy-supportive way" (e.g., see Aelterman et al., 2019; Cheon, Reeve, & Song, 2019; Cheon et al., 2020), that is, satisfying competence in a way that is guided towards autonomy. The strategies carried out in order to promote structure in an autonomy-supportive way are characterized by introducing any elements that support structure, through the seven autonomy-supportive instructional behaviours (Cheon et al., 2020; Cheon, Reeve, & Song, 2019). For example, when introducing classroom rules, teacher should take the students' perspective (e.g., asking the group: "What rules do you consider important to improve our coexistence in the classroom?"), providing an explanatory rationale ("One of them could be respectful language as this creates a warm and safe classroom environment"), acknowledging any negative feelings (e.g., saying "You are right. I am aware of the difficulty involved"), and using inviting language ("Can you think of a way we can improve this?").

On the other hand, a *chaotic teaching style* is characterized by a state of continuous waiting, permissiveness or disengagement towards the activity of guiding the teaching-learning process (Aelterman et al., 2019; Baumrind, 2012). In these cases, chaotic teachers are characterized by a laissez-faire attitude and unclear in their expectations.

1.2. Consequences and antecedents of teachers' interpersonal styles

The 'autonomy-supportive' and 'structuring' styles are considered motivating, whereas the 'controlling' and 'chaotic' styles are considered demotivating as students feel that the teacher has abandoned them, which can make them feel that they are ineligible, incompetent and insignificant. Current research has identified the positive consequences of teachers' adoption of styles that encourage autonomy and structure on their students' basic psychological need satisfaction, autonomous

motivation, engagement and achievement, and the possible negative consequences of controlling and chaotic styles (Cheon & Reeve, 2015; Collie, Granziere, & Martin, 2019; Jang et al., 2016; Reeve & Cheon, 2021; Reeve, Ryan, Cheon, Matos, & Kaplan, 2022).

When teachers adequately address the psychological needs of their students, students develop autonomous motivation (with a more internal origin, enjoyment and personal value; in contrast with controlled motivation that is reflected by feelings of guilty or search for rewards) and they are more engaged in learning activities (Cheon et al., 2012; Vansteenkiste et al., 2005). *Student engagement* is a multidimensional concept which refers to the students' active participation in a learning task, whether or not they engage in the learning opportunities provided by the teacher (Christenson, Wylie, & Reschly, 2012). Researchers have observed that this *engagement* can be characterized as *agentic*, that is, proactive in order to improve their own learning conditions by providing suggestions or offering and communicating their interests (Patall et al., 2019; Reeve, 2013; Reeve et al., 2021). *Student agentic engagement* can have several educational benefits, such as; (a) developing a supportive learning climate where pupils feel safe to speak up and express their interests and preferences, changing the way the teacher interacts with them (Matos, Reeve, Herrera, & Claux, 2018; Patall et al., 2018, 2019); (b) greater perceived motivational satisfactions, satisfying their curiosity, developing their interests and achieving their personal goals (Patall et al., 2019, 2022; Reeve, Cheon, & Yu, 2020); (c) greater effective functioning by taking control of their learning, and therefore, achieving higher achievement through grades (Patall et al., 2019; Reeve, 2013; Reeve, Cheon, & Jang, 2020).

In terms of teachers' preferences for setting a motivating or demotivating style, researchers have focused particularly on socio-contextual factors (Pelletier et al., 2002; Pelletier & Sharp, 2009). In contrast, the evidence remains relatively scarce in terms of investigating which individual characteristics of teachers are relevant for the development of their motivational styles, such as teachers' own basic psychological needs satisfaction (Aelterman et al., 2019; Roth, Assor, Kanat-Maymon, & Kaplan, 2007) or burnout (Moè & Katz, 2020; Soenens et al., 2012). Several SDT researchers have shown that teacher burnout can be considered as a possible antecedent for establishing a demotivating style in the classroom (Aelterman et al., 2019; Jennings, 2015; Moè & Katz, 2020; Soenens et al., 2012). Maslach's (2003) burnout theory remains predominant, with burnout's core dimensions described as a persistent negative emotional state typified by a general sense of psychological distress and high levels of emotional exhaustion, depersonalization and lack of personal accomplishment. *Emotional exhaustion* is the main dimension of burnout and is refers to a feeling of not being able to do more, of being exhausted. *Depersonalization* relates to an apathetic or insensitive response to professional duties. The lack of *personal accomplishment* relates to the professional's feelings about their own ability to cope with professional challenges, which can result in feelings of failure, incapacity, and low self-esteem.

1.3. Online SDT-based interventions for training teachers in motivating styles

Professional development is an important means of influencing teachers' motivational styles as well as innovating their teaching strategies and ultimately increasing student academic achievement (González & Skultety, 2018; Prenger, Poortman, & Handeldalts, 2017; Tondeur, Aesaert, Prestridge, & Consuegra, 2018; S. Zhang & Liu, 2019). Through recent events and along with further development of information technology, teachers' professional development mode, learning contents, learning resources and environments has changed in recent years (Barnes, Zuilkowski, Mekonnen, & Ramos-Mattoussi, 2018; Fan, Wang, & Wang, 2011). Online learning allows teachers to access content and tasks anytime, anywhere, solving the conflict between work and learning organization in a practical way (Ching & Hursh, 2014; Prenger et al., 2017). Despite this, research related to online teacher SDT-based

training is lacking (Chen & Jang, 2010; Hsu, Wang, & Levesque-Bristol, 2019). To our knowledge, only two types of online teacher trainings based on SDT were carried out, all of them in secondary education. On the one hand, we find two autonomy-oriented interventions conducted by Perlman (2011, 2015) with preservice physical education teachers (PT) and their respective students. Both studies employed a pretest/-posttest design, considering as measures: observation of PT' instruction, PT' and their students' perception of autonomy support and students' motivation. The intervention of both studies was carried out through an online module that was hosted on the webpage of one of the subjects that these trainee teachers were taking. This module contained theoretical and practical lessons plans, mini-tasks and instructional statements on the application of principles based on autonomy support. An SDT expert was in charge of guiding the online learning, providing feedback and checking that the tasks were completed in the first two weeks. The intervention of PT with students was four weeks long (8-lesson sport-based unit). In both studies, very similar results were obtained. Compared to the control group, teachers in the experimental group significantly increased their observed autonomous instruction as well as their students' perceptions of autonomy support. In contrast, no significant differences were observed in relation to teachers' perceptions of autonomy support and students' motivation.

On the other hand, in a Web-Based Autonomy-Supportive Intervention Program (WB-ASIP) carried out by Tilga, Hein, and Koka (2019), physical education teachers were trained in autonomy-supportive techniques during four weeks. Each week began with an instructional videoconference where participants were given the study material and the tasks to be completed that week. Participants submitted assignments via a web-based platform and were also required to participate in a forum on how they had applied the knowledge acquired during the course. The students' perception of autonomy support and control, satisfaction and frustration of basic psychological needs and intrinsic motivation were measured at baseline and after nine weeks. A series of analyses of covariance (ANCOVAs) showed an increase in pupils' perceptions of all autonomy-supportive teacher behaviours and pupils' basic psychological need satisfaction in the experimental group. They also reported that WB-ASIP reduced pupils' perception of teacher controlling behaviours and pupils' autonomy frustration. In contrast, no significant differences were observed in competence and relatedness frustration and intrinsic motivation.

A new measurement of these variables was carried out 15 months later (Tilga, Kalajas-Tilga, Hein, Raudsepp, & Koka, 2020) and the results showed maintenance of changes in perceived autonomy support and autonomy satisfaction in the experimental group. Moreover, students in the experimental group showed higher scores in intrinsic motivation than the control group. The subsequent research (Tilga, Kalajas-Tilga, Hein, & Koka, 2021) compared the effects of the WB-ASIP intervention with a face-to-face autonomy-supportive intervention and a combination of them following the same variables of the previous research (Tilga et al., 2019, 2020). The main finding of this study was that the combined WB-ASIP and face-to-face intervention group showed the highest effects at one-month follow-up in comparison with the other groups. Research has also shown that the WB-ASIP intervention had positive effects on physical education teacher outcomes such as self-reported autonomy-supportive behaviour and teaching efficacy for students' engagement (Tilga, Kalajas-Tilga, Hein, Raudsepp, & Koka, 2021).

1.4. The present study

This study, named MIRADA (which is the name of regard's action in Spanish), aims to analyse the effect of an online training, based on providing different tools and techniques for teachers in order to support autonomy and provide structure in a way that guides towards autonomy to their students in primary education in the midst of the crisis generated by COVID-19. This combination of instructional behaviours has not been

analysed in a primary education context, nor has its online teacher training been developed.

Six hypotheses have been established. We hypothesized that teachers in the experimental group compared to the control group would perceive an increase in their motivating teaching style and reduce their demotivating teaching style (H1) and burnout (H2; i.e., lower scores on emotional exhaustion and depersonalization and higher scores on personal accomplishment). We also expected that the students of the teachers who participated in the online intervention would report greater basic psychological need satisfaction in the classroom (H3), autonomous motivation (H4), agentic engagement (H5) and academic achievement scores (H6; Spanish Language, Mathematics, Natural Sciences and Social Sciences) compared to the students of the teachers who were assigned to the control group.

2. Method

2.1. Participants

The eligibility conditions for teachers' participation were; (a) the administrators of each school had to agree to enrol at least two classes between 4th and 6th grade of primary school, (b) internet connection, (c) a commitment to complete the 8-h training within a maximum of two weeks and (d) the participant teacher must teach at least the subjects of Spanish Language, Mathematics, Social Sciences and Natural Sciences to the group of participating students. This last criterion is based on the fact that in the Spanish education system, tutors normally teach these subjects at the primary school stage, thus ensuring that the teachers spend a sufficient amount of time with the pupils in the classroom.

Six months before the implementation of the training, both private and public schools in several autonomous regions of Spain were asked via email if they were interested in participating in the project. In addition, the project was promoted through the social media (Twitter and Facebook) of the researchers who took part in the programme. All tutors (with the agreement of the respective school management team) who agreed to participate were sent all the information and a completed form to confirm their participation.

2.2. Research design and procedure

The MIRADA study followed a quasi-experimental design with three stages (pre-intervention, intervention and post-intervention) and two

groups (control and experimental). Both groups were required to complete two assessments (pre-test and post-test). For the distribution of groups, a clustered randomization was performed within schools (with the programme found at www.echaloasuerte.com), trying to ensure that at least one teacher per school was assigned to the intervention and one to the control group.

The manner in which the intervention was presented to the teaching staff consisted of informing them that there were two shifts for the training: one group (experimental group, with 21 classrooms) starting in January 2021 and another group (or "waiting list" control group, with 21 classrooms), starting in April 2021.

The period during which data collection was carried out coincided with the end of the first and second trimester of the Spanish educational calendar. The initial evaluation (pre-test) lasted approximately 3 weeks, followed by the training of the experimental group, which lasted 2 weeks. After twelve weeks, the teachers' questionnaire answers were recorded (motivating and demotivating teaching styles and burnout) and 1–2 weeks later the students' questionnaire answers were recorded (basic psychological need satisfaction, autonomous and controlled motivation and agentic engagement). Both groups completed the training before the end of the 2020–2021 academic year. An overall study design is shown in Fig. 1. In the case of the classes that were randomly assigned as a "control group", they taught their classes following the same routine and assumed teaching styles that were in place prior to the start of this research.

During the study period, all participants remained face-to-face in their respective classes. However, their situation differed from the non-COVID-19 times. Following the protocol proposed by the Spanish Ministry of Education, different measures were applied in the educational centres from the beginning of the school year: mandatory use of masks for the primary education, frequent hand washing, improved ventilation in the classroom, social distancing and organization of children and teachers in bubble groups whenever possible to maintain, as far as possible, the same groups of individuals.

This research was approved by the Research Ethics Committee of the University of Murcia (Ref: 2989/2020). Given that the sample was composed of under-aged participants, their respective families were asked to complete the corresponding informed consent form. Participants completed the instruments online via the Gorilla Experiment Builder platform (Anwyl-Irvine, Massonnié, Flitton, Kirkham, & Evershed, 2020). Students were informed that their survey data would be kept confidential and used for research purposes only. The

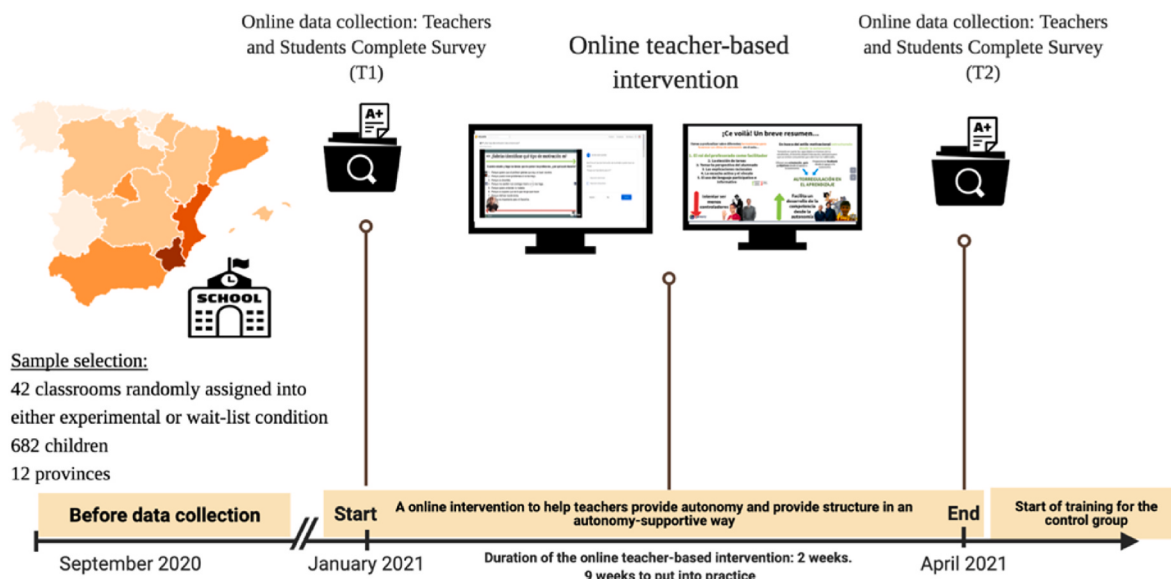


Fig. 1. Timeline of the procedure carried out in the MIRADA project.

participation in the study was voluntary and both teachers and students could resign at any time. For the students, the questionnaires that they filled in were related to the teacher participating in the study and their respective class. Teachers in both groups continued with their scheduled teaching programme and the respective syllabus throughout the academic year.

2.3. The MIRADA program: an online teacher training

The main objective of the teacher training programme, named MIRADA, was to offer different strategies and techniques in order to support autonomy, promote structure and provide structure in a way that guides towards autonomy (see Introduction; see [Reeve & Cheon, 2021](#), p. 71). As [Reeve and Cheon \(2021\)](#) suggest, it is most effective and desirable for teachers to learn about different autonomy-supportive instructional behaviours (block 1 of the course content plan). Once this is done, the next step would be to learn how to introduce strategies that promote structure, and finally to combine strategies that provide structure in a way that guides towards autonomy (blocks 2 and 3 of the course content plan). This programme has been developed by the authors of this manuscript following the recommendations described in well-established SDT-based teacher intervention programs ([Aelterman et al., 2019](#); [Cheon et al., 2020](#); [Reeve & Cheon, 2021](#); [Reeve et al., 2022](#)). It should be noted that as these recommendations are aimed at older students, the course contents have been adapted to the motivational profile of the students ([Guay et al., 2010](#); [Wray-Lake, Crouter, & McHale, 2010](#)) as well as the curriculum given at this educational stage. At this age, it is possible that the sense of volition has not yet been fully formed as these students are still exploring the interest and value of different academic subjects ([Šakan, Tóth-Király, & Morin, 2023](#)). They are not yet considering whether they need to go to school or not. Also, due to the maturational development of the students, the elementary school is not as oriented towards the development of autonomy, being usually more controlling environments ([Guay, Morin, Litalien, Howard, & Gilbert, 2021](#)). Therefore, the starting point for autonomy support should be oriented from simple and concrete behaviours. The table of contents of the training can be found in the supplementary material.

Due to the restrictions of mobility and interpersonal distance, it had been decided to conduct the training online. The online training course was planned based on recommended guidelines ([Kuo, Walker, Schroder, & Belland, 2014](#); [Wankel & Blessinger, 2013](#)). After an initial consultation with the participating teachers regarding their familiarity with and use of different tools for the development of the training, flipped-classroom methodology and Google Classroom and EdPuzzle were the chosen platforms (91% of participants declared to know these tools). The flipped-classroom methodology was chosen with the purpose of providing a more personalised learning environment, where the participants themselves could carry out the training at their own pace, having at their disposal all the materials and contents (videos, complementary material, participation in discussion forums, etc.). The software chosen as the main platform for accessing the training was Google Classroom. This is a free web service created by Google where the teachers involved could introduce themselves, check the messages provided by the researchers, click on the Edpuzzle links where the different videos to be watched in each training block were shown, access the reference material provided by the researchers or join discussion forums with the other participants. The compulsory content for the training included viewing the videos and participating in the resulting questions. These videos, which are between 8 and 12 min long, provided theoretical and practical information through the presentation of the contents in an evidence-based, self-paced and attractive way (e.g., metaphorical figures such as characters from Arthur Conan Doyle's work, where Sherlock Holmes represented the most common characteristics of the structure style and Doctor Watson of autonomy support). Also, following [Reeve & Cheon's](#) recommendations (2021), exemplary videos were used to support the teacher's needs in the classroom with a voice-over to

explain what he was doing and why (e.g., looking at the rule-setting situation from the autonomy-supportive versus the control style). These videos were hosted on Edpuzzle, a platform linked to Google Classroom, where participants could watch the videos in an active way, finding different questions to evoke or think about the content itself.

Through the monitoring features of both tools, a large amount of information about the teachers' participation and responses was provided, such as whether they had watched all the videos, what answers they had given to the questions asked, as well as providing feedback to these responses from the researchers. At the end of the training, the participating teachers had to fill in a qualitative questionnaire in relation to the implementation of the content provided, in order to find out whether the teachers actually developed instructional behaviours that support the needs of the students. All participants, to a greater or lesser extent, gave different examples and situations in which they had applied an autonomy-support motivational style and provided structure in an autonomy-supportive way. Finally, a short questionnaire was completed in which 88% of the participating teachers answered two questions: "What do you think of the training course?" and "Please rate from 1 to 10 the usefulness of the training course for your teaching activity". To the first question, none of the participants answered "Bad" or "Fair", with 20% answering "Good" and the remaining 80% "Very good". As for the second evaluation, no participant answered "1–3", 6.25% answered "3–5", another 6.25% reported 5–7, 37.5% answered "7–9" and the remaining 50% reported "10".

In addition, we tried to give a more interactive and experience-based approach, aligned with the principles of SDT, since, as [Aelterman, Vansteenkiste, Van Keer, and Haerens \(2016\)](#) suggests, it is important to "practice what you preach". For this purpose, in addition to the experiential examples, three 45-min online meetings between teachers and the research team were held throughout the intervention in order to create an open communication meeting for possible doubts, constructive criticism, explanations, etc. Attendance to those meetings was optional, with 31%, 40% and 35% of the participants attending to each respective session. Another measure to encourage more active reflection on the part of teachers was the creation of a discussion forum in each course module, where 86% of participants have shared some reflection with the rest of their colleagues.

2.4. Measures

Teachers' self-reported motivating and demotivating styles. This was measured through the 60-item Situations in School questionnaire (SIS; [Aelterman et al., 2019](#)). This instrument contains 15 scenarios that occur in the classroom (e.g., "At a difficult moment in the lesson, students start complaining") together with four possible responses that can be set by the teacher to handle the situation. Each of the responses is more orientated towards a motivational style and should be scored from 1 (does not describe me at all) to 7 (describes me extremely well); *autonomy* support ("Accept their negative feelings as OK. Assure them that you are open to their input and suggestions"), *structure* ("Show and teach them a helpful strategy for how to break down the problem to solve it step-by-step"), *control* ("Insist they pay attention. They must learn this material for their own good") and *chaotic* ("Just ignore the whining and complaining. They need to learn to get over the obstacles themselves"). The scores recorded for each variable were averaged across 15 items into a single score (e.g., see [Cheon et al., 2020](#)). All subscales showed an adequate level of internal consistency across the two waves of data collection, with coefficient alpha (α) ranging from 0.72 (Chaos) to 0.84 (Control) and coefficient omega (ω) ranging from 0.72 (Chaos) to 0.83 (Control). The four-factor model showed an acceptable fit to the data ($\chi^2 = 3029.91$, $df = 1704$, $p < .001$, $\chi^2/df = 1.77$, CFI = 0.93, TLI = 0.91, SRMR = 0.09, RMSEA = 0.08).

Teachers' burnout syndrome. For this variable, the Maslach Burnout Inventory (MBI; [Maslach & Jackson, 1981](#)) was chosen. This questionnaire is comprised of 22 items in the form of statements about

the feelings and attitudes of teachers at work and towards their students, consisting of three sub-scales; *emotional exhaustion* (9 items; α T1 = 0.86; ω T1 = 0.87; α T2 = 0.83; ω T2 = 0.84; e.g., "I feel tired at the end of the working day"), *depersonalization* (5 items; α T1 = 0.71; ω T1 = 0.75; α T2 = 0.72; ω T2 = 0.75; e.g., "I feel that I treat some students as if they were impersonal beings") and *personal accomplishment* (8 items; α T1 = 0.79; ω T1 = 0.81; α T2 = 0.77; ω T2 = 0.79; e.g., "I feel that I have a positive impact on the lives of others through my work"). Responses were provided on 7-point scales (0 = never and 6 = every day) and the items scores for each sub-scale were added. The Spanish version of the MBI was used, which has shown acceptable psychometric properties in an occupational sample (Seisdedos, 1987).

Satisfaction of basic psychological needs in the classroom. The Basic Psychological Needs in the Classroom Scale (BPN-CS; Conesa & Duñabeitia, 2021) was used. The 12-item self-report instrument measures the students' satisfaction of the three basic psychological needs in the classroom: *autonomy satisfaction* (e.g., "The activities I do in class match my interests"), *competence satisfaction* (e.g., "I feel able to achieve my goals in class") and *relatedness satisfaction* (e.g., "I get along well with my teachers and classmates"). Responses were ranging from 1 (strongly disagree) to 5 (strongly agree). All subscales showed an acceptable level of internal consistency across the two waves of data collection, with coefficient alpha ranging from 0.72 (autonomy satisfaction) to 0.78 (relatedness satisfaction) and coefficient omega ranging from 0.72 (autonomy satisfaction) to 0.77 (relatedness satisfaction).

Academic motivation. The Spanish version of the Academic Self-Regulation Questionnaire (SRQ-A; Ryan & Connell, 1989) was used. This shortened 17-item version measures the different types of student motivation; *intrinsic motivation* (e.g., "I do my classwork because it's fun"), *identified regulation* (e.g., "I do my classwork because I want to learn new things"), *introjected regulation* (e.g., "I try to answer hard questions because I'll feel bad about myself if I don't try") and *external regulation* (e.g., "I try to do well in school because I will get in trouble if I don't"). Each of the 17 items was scored on a five-point Likert scale (from 1 = never, to 5 = always). As suggested by some authors who advocate greater appropriateness and quality of the data obtained, the response scale was changed from the original four-point scale to a five-point scale (Revilla, Saris, & Krosnick, 2014). Following established recommendations within this area of research (e.g., see Reeve, 2013; Williams, Grow, Freedman, Ryan, & Deci, 1996), the sub-scales of external regulation and introjected regulation were grouped into the controlled motivation score (11 items; α T1 = 0.82; ω T1 = 0.83; α T2 = 0.80; ω T2 = 0.80), while identified regulation and intrinsic motivation sub-scales were grouped into the autonomous motivation score (6 items; α T1 = 0.73; ω T1 = 0.75; α T2 = 0.73; ω T2 = 0.73).

Agentic engagement. The Agentic Engagement Scale (AES; see Reeve & Tseng, 2011; Reeve, 2013) was used. This questionnaire is comprised of 5 items on a Likert-type scale ranging from 1 (strongly disagree) to 7 points (strongly agree) and measures the level of agentic engagement that students have with their respective teachers (α T1 = 0.82; ω T1 = 0.84; α T2 = 0.80; ω T2 = 0.81). This type of engagement differs from behavioural commitment or emotional engagement in proactivity and collaboration in the teaching-learning process, as it makes students express their preferences (e.g., "During this class, I express my preferences and opinions"), ask questions (e.g., "During this class, I ask questions to help me learn") and communicate to teachers what they like, need and want (e.g., "I let my teacher know what I need and want").

Academic achievement. The students' academic performance was estimated based on the grades obtained in the corresponding quarters of the academic training. The end of the first term corresponded to the pre-test measurement (December 2020) and the end of the second term (April 2021) to the post-test measurement. The grades obtained in Spanish Language, Mathematics, Social Sciences and Natural Sciences were averaged with numerical values from 1 (insufficient) to 10 (excellent). These scores are obtained through the assessment carried out by the teaching staff, following the established curricular standards.

2.5. Statistical analysis

In order to conduct the statistical analysis of this study, the open-source statistical software Jamovi v.1.6 (Jamovi project; jamovi.org) was used. An independent samples *t*-test was carried out to analyse differences between the experimental and control groups at baseline and after completing the post-test. Next, a series of repeated mixed model analysis of variance (ANOVAs) were performed to examine the effectiveness of the intervention. This analysis includes *condition* (experimental, control) as a between-person predictor, *time* (pre-test, post-test) as a within-person predictor, and the *time* $\times$ *condition* interaction being critical to determine whether the intervention resulted in a change in the dependent variables. Partial eta squared (η^2) was used as the effect size measure for the ANOVA. This is considered as a descriptive index of strength of association between an experimental factor and a dependent variable (Nouchi et al., 2013). Effect sizes were interpreted as follows: $\eta^2 = 0.01$ was considered as a small effect, $\eta^2 = 0.06$ moderate, $\eta^2 = 0.14$ large (Field, 2017).

3. Results

3.1. Participant flow

In this experimental study, named MIRADA, a total of 42 primary education teachers ($M_{age} = 40.81$, $SD = 6.1$, 59.52% women) and their 682 primary education students aged 9–13 years ($M_{age} = 10.32$, $SD = 0.88$, 49.85% girls) from 21 Spanish public and private schools in the 2020–2021 academic year finally participated in this study. Although the initial sample was slightly larger, children with special educational needs ($n = 78$) and students who did not undertake the post-test measurement ($n = 55$) were excluded from the analysis. There were no differences in the pre-treatment measures between the students who completed the post-test measurement and those who did not. The socioeconomic status of the students' families was measured with the MacArthur Scale of Subjective Socioeconomic Status (Adler, Epel, Castellazzo, & Ickovics, 2000). This instrument presents a 10-step ladder and asks participants to think about how they represent themselves socio-economically within their community. In the present sample, it averaged 6.29 ($SD = 1.47$). The average teaching experience was 14.88 years ($SD = 9.20$, range = 1–36). All teachers were certified as full-time, answered the different questionnaires and successfully completed the SDT-based online training.

A flow diagram for the selection of participants is shown in Fig. 2. Given that the interest in carrying out the intervention may differ depending on the teachers, management team or the pupils themselves, one experimental and one control group was selected for each of the participating schools. The distribution of the groups by gender and grades are shown in Table 1. No significant differences were found between the experimental and control groups in teachers' gender, age, grade taught and years of teaching experience and students' gender, age and socioeconomic status.

3.2. Baseline data

In terms of teachers' perceptions, results of the independent samples *t*-test revealed no significant differences in any of the study outcomes between the control and experimental group at baseline ($t = -2.12$ – 2.05 ; $p > .05$). Regarding students' perceptions, similar results were observed at baseline ($t = -0.09$ – 2.77 ; $p > .05$) except for agentic engagement and Language and Social Sciences scores. Students in the control group showed significantly higher agentic engagement ($t = 4.19$; $p < .001$; $SD = 0.08$) and higher grades in Language and Social Sciences ($t = 3.70$ – 4.08 ; $p < .001$; $SD < 0.15$) than the experimental group at baseline.

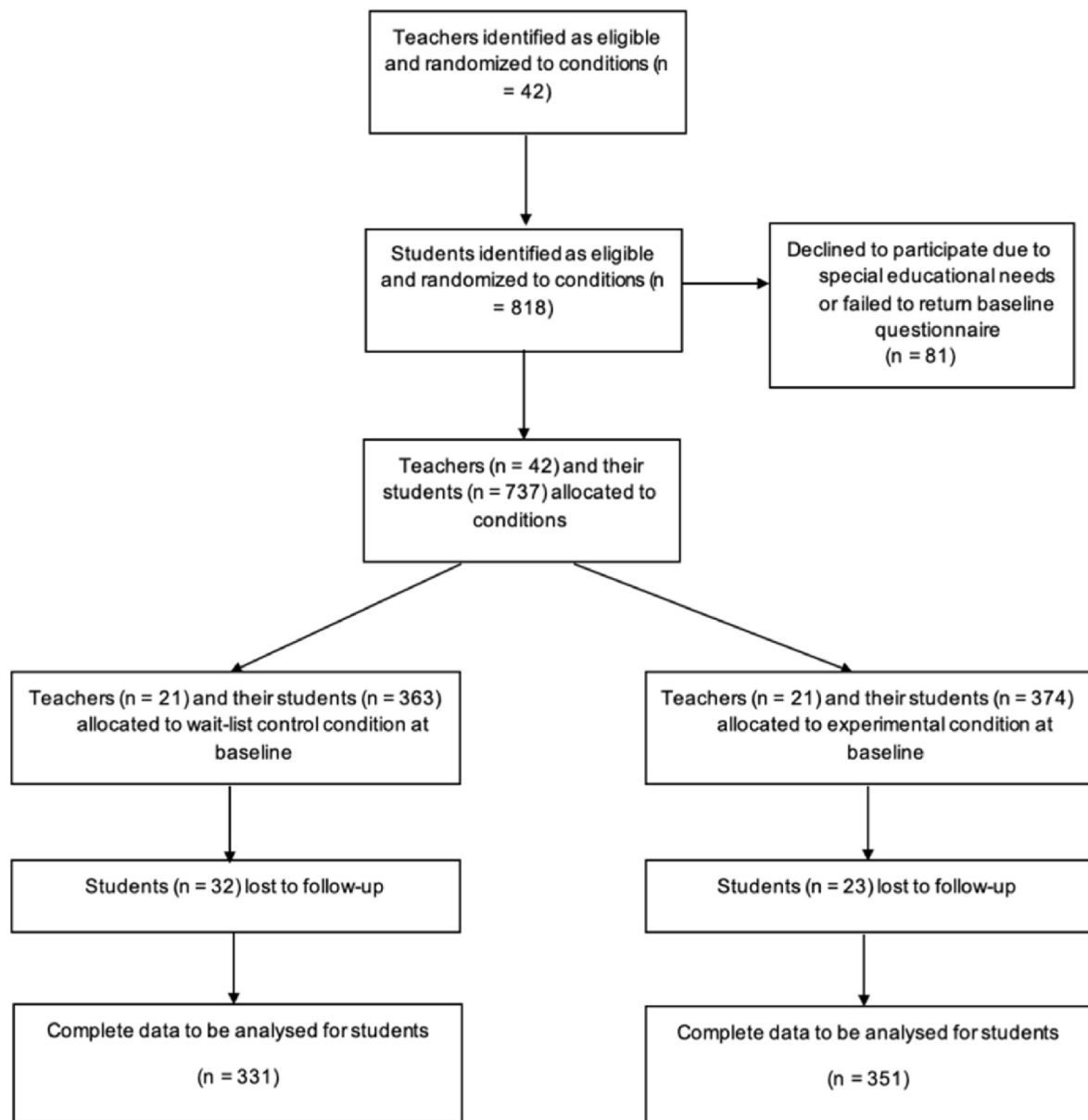


Fig. 2. Participant flow chart.

Table 1

Participants' distribution by gender and grades at baseline.

Baseline characteristic	Control		Training group		Full sample	
	n	%	n	%	n	%
Teachers	21	50.00	21	50.00	42	
Gender						
Women	13	61.90	12	57.14	25	59.52
Men	8	38.10	9	42.86	17	40.48
Grade						
Grade 4	7	53.85	6	46.15	13	30.95
Grade 5	7	46.67	8	53.33	15	35.71
Grade 6	7	50.00	7	50.00	14	33.33
Classrooms	21	50.00	21	50.00	42	
Gender						
Girls	168	50.75	172	49.0	340	49.85
Boys	163	49.25	179	51.0	342	50.15
Grade						
Grade 4	103	31.12	70	19.94	173	25.36
Grade 5	118	35.65	150	42.74	268	39.30
Grade 6	110	33.23	131	37.32	241	35.34

3.3. Outcomes and estimation

With regards to the teacher's perceptions, after completing the post-test, the results of the independent samples *t*-test revealed no significant differences in any of the study outcomes between the two groups ($t = -0.71$ – 0.90 ; $p > .05$) except perceptions of a controlling motivational style. Teachers in the control group reported a significantly higher controlling motivational style than the experimental group ($t = 3.03$; $p = .004$). In terms of student's perceptions, the results of the independent samples *t*-test revealed no significant differences in any of the study outcomes between the control and experimental groups after completing the post-test ($t = -1.68$ – 2.08 ; $p > .05$) except autonomy satisfaction and autonomous motivation. In both cases, the experimental group showed significantly higher autonomy satisfaction ($t = -4.30$; $p < .001$) and autonomous motivation ($t = -3.13$; $p = .002$) than the control group after completing the post-test.

Mean scores, standard deviations and ANOVA results are shown in Table 2. Skewness and kurtosis values were all between -1.70 and $+1.90$, and were, therefore, considered acceptable regarding normal

Table 2

Mean scores, standard deviations and ANOVA results.

Variables		Mean T1 (SD)		Mean T2 (SD)		Condition × Time Interaction	Partial η^2
	Range	Experimental	Control	Experimental	Control		
Teachers							
Motivating and demotivating style							
Autonomy Support	1–7	5.24 (.79)	5.25 (.68)	5.68 (.84)	5.36 (.62)	3.90	0.07
Control	1–7	2.96 (.94)	3.05 (.96)	2.27 (.90)	3.05 (.94)	12.88***	0.21
Structure	1–7	5.81 (.58)	5.91 (.54)	6.11 (.63)	5.87 (.62)	6.26*	0.11
Chaos	1–7	1.91 (.49)	2.03 (.64)	1.88 (.55)	2.19 (.70)	1.90	0.04
Burnout syndrome							
Emotional exhaustion	1–54	12.81 (9.48)	15.04 (9.48)	12.23 (9.15)	17.48 (10.08)	3.14	0.06
Depersonalization	1–30	2.73 (3.03)	2.20 (2.22)	2.65 (3.61)	2.76 (2.11)	1.05	0.02
Personal accomplishment	1–48	41.27 (4.36)	41.36 (5.14)	42.12 (4.88)	38.96 (5.73)	14.39***	0.23
Students							
Satisfaction of basic psychological needs							
Autonomy	1–5	3.36 (.80)	3.43 (.83)	3.48 (.80)	3.21 (.81)	27.78***	0.04
Competence	1–5	3.97 (.65)	4.09 (.66)	4.14 (.67)	4.06 (.71)	17.14***	0.02
Relatedness	1–5	4.38 (.69)	4.42 (.65)	4.35 (.69)	4.29 (.67)	2.75	0.00
Academic motivation							
Autonomous motivation	1–5	4.01 (.71)	4.06 (.70)	4.03 (.66)	3.87 (.71)	19.75***	0.03
Controlled motivation	1–5	2.94 (.85)	2.94 (.82)	2.86 (.88)	2.83 (.86)	0.10	0.00
Agentic engagement	1–7	4.83 (1.02)	5.16 (1.03)	5.08 (1.26)	4.95 (1.25)	30.03***	0.04
Academic achievement							
Language	1–10	6.92 (1.79)	7.42 (1.57)	7.20 (1.69)	7.30 (1.64)	12.35***	0.04
Maths	1–10	6.87 (1.79)	7.26 (1.72)	7.03 (1.82)	7.31 (1.66)	1.49	0.00
Social Sciences	1–10	7.01 (1.90)	7.60 (1.77)	7.16 (1.89)	7.39 (1.74)	16.10***	0.02
Natural Sciences	1–10	7.06 (1.73)	7.49 (1.57)	7.36 (1.73)	7.36 (1.32)	25.13***	0.04

* $p < .05$; ** $p < .01$; *** $p < .001$ Note: In the variable "Personal accomplishment", the higher the score, the lower the perception of burnout.

univariate distribution (George & Mallery, 2007). The results at post-test indicated that teachers who participated in the online training showed a significantly lower perception of a controlling motivational style, $F(1, 49) = 12.88$, $p < .001$, partial $\eta^2 = 0.21$, and a higher perception of a structure-based motivational style, $F(1, 49) = 6.26$, $p = .016$, partial $\eta^2 = 0.11$, compared to the teachers in the control group. Although no significant differences were found in the perception of an autonomy-supportive style, $F(1, 49) = 3.90$, $p = .054$, the effect size was moderate (partial $\eta^2 = 0.07$). No significant effects were found on teachers' perceptions of a chaos-based motivational style, $F(1, 49) = 1.90$, $p = .175$, partial $\eta^2 = 0.04$. In terms of burnout scores, teachers in the experimental group reported significantly higher personal accomplishment, $F(1, 49) = 14.39$, $p < .001$, partial $\eta^2 = 0.23$, at the post-test results. In contrast, no significant differences were found between the groups after completing the post-test on emotional exhaustion, $F(1, 49) = 3.14$, $p = .083$, partial $\eta^2 = 0.06$, and depersonalization scores, $F(1, 49) = 1.05$, $p = .311$, partial $\eta^2 = 0.02$.

Students whose teachers participated in the online training, compared to students of the teachers in the control group, reported significantly greater autonomy satisfaction, $F(1, 680) = 27.78$, $p < .001$, partial $\eta^2 = 0.04$, and competence satisfaction, $F(1, 680) = 17.14$, $p < .001$, partial $\eta^2 = 0.02$. Instead, no effect size was found for relatedness satisfaction, $F(1, 680) = 2.75$, $p = .098$, partial $\eta^2 = 0.00$. In terms of academic motivation, students in the experimental group reported higher levels of autonomous motivation compared to the control group after completing the post-test, $F(1, 680) = 19.75$, $p < .001$, partial $\eta^2 = 0.03$. In contrast, no differences were observed in students' controlled motivation, $F(1, 680) = 0.10$, $p = .747$, partial $\eta^2 = 0.00$. Students whose teachers participated in the online training reported significantly greater agentic engagement compared to the control group, $F(1, 680) = 30.03$, $p < .001$, partial $\eta^2 = 0.04$. In terms of grades, it was observed that the experimental group increased their grades compared to the control group in Language, $F(1, 680) = 12.35$, $p < .001$, partial $\eta^2 = 0.04$, Social Sciences, $F(1, 680) = 16.10$, $p < .001$, partial $\eta^2 = 0.02$, and Natural Sciences, $F(1, 680) = 25.13$, $p < .001$, partial $\eta^2 = 0.04$. However, there were no differences in Mathematics scores in the two groups, $F(1, 680) = 1.49$, $p = .222$, partial $\eta^2 = 0.00$, after completing the post-test.

4. Discussion

The present study is based on the SDT framework (Ryan & Deci, 2017) to implement online training for primary teachers based on learning how to be less controlling, support autonomy, provide structure and develop all these different strategies in an autonomy-supportive way, following the recommendations of previous research (Cheon et al., 2020; Cheon, Reeve, Lee, et al., 2019; Reeve & Cheon, 2021). The objective was to analyse, through the perceptions of the teachers themselves and their students, the effectiveness of the intervention. We hypothesized that the intervention was going to generate proximal effects on teachers (H1 and H2) and more distal effects caused by teachers on students (H3, H4, H5 and H6). Although the study was done during the COVID-19 pandemic, and this situation had important implications, our intervention and results could be extrapolated to a post-pandemic context. Our findings provide useful information that could be considered and applied beyond the COVID-19 pandemic. Currently, due to the characteristics of this intervention, online training on motivational techniques can be provided to teachers as it can be more accessible, they do not have to travel, doing such training from home and whenever they want, adjusting to their time. Moreover, these teachers can maintain fluid communication with the trainers of the course, using different tools that we know today: videoconferences, discussion forums, etc. Therefore, the principles of this SDT-based intervention are perfectly applicable to this post-pandemic context.

First, we hypothesized that the online-training intervention for teachers (compared to a control group that would not receive the training until after the study) could increase teachers' perceptions of their motivating style in the classroom and reduce their demotivating style (H1). This hypothesis is partially supported in the study because teachers in the experimental group showed significantly lower perceptions of a controlling motivational style and higher perceptions of structure compared to the control group. A moderate intervention effect was also found for autonomy support but it was not significant probably due to the low sample size of teachers. It would also have been interesting to measure the teachers' interpersonal styles perceived by students to compare the results. No differences have been observed in the chaos-based style, with both groups showing low scores. More research on this motivational style is needed to elucidate the strategies

that can help to reduce it further (Aelterman et al., 2019; Escrivá-Bouley et al., 2021).

Therefore, through the training, teachers have improved their motivational teaching style based on three main actions; (a) being less controlling, what implies, as several authors state, that they have possibly decreased their authoritarian and pressuring behaviours such as shouting, threatening or offering contingent rewards, avoiding to perpetually stipulate what students should think, feel or do (Aelterman et al., 2019; Reeve et al., 2022; Soenens & Vansteenkiste, 2010), (b) supporting greater autonomy, through different strategies outlined in the training such as taking into account learners' perspectives, inviting pupils to pursue their interests, presenting activities that meet their needs, using rational explanations, acknowledging and valuing "negative" feelings, providing invitational language and cultivating patience in the classroom (Cheon et al., 2020; Reeve & Cheon, 2021), (c) promoting structure and developing it using the strategies in an autonomy-supportive way (Aelterman et al., 2019; Cheon et al., 2020; Cheon, Reeve, & Song, 2019). As demonstrated by recent studies, these changes in teachers have consistently shown a wide range of benefits for teachers themselves as well as for their students (Assor, Feinberg, Kanat-Maymon, & Kaplan, 2018; Cheon et al., 2020; Cheon, Reeve, & Song, 2019; Reeve & Cheon, 2021). The results of the present research are novel since to our knowledge no previous studies have been carried out in primary education or in contexts where the intervention was online.

Second, we hypothesized that teachers after completing the training could reduce their level of burnout compared to the control group (H2). The results revealed that teachers in the control group decreased their levels of personal accomplishment compared to the experimental group, in line with several studies that observed the psychological state of teachers in the COVID-19 crisis throughout the academic year in Spain (Collie, 2021; Ozamiz-Etxebarria, Berasategi Santxo, Idoiaga Mondragon, & Dosil Santamaría, 2021; Sánchez-Pujalte, Mateu, Etchezahar, & Gómez Yepes, 2021). Moreover, the group that undertook the training slightly maintained their emotional exhaustion and increased their personal accomplishment. This also appears to be in line with other studies that showed that being in a need-supportive environment is negatively associated with emotional exhaustion and favourably associated with personal accomplishment (Collie, Granziere, & Martin, 2018; Ferguson & de Charms, 1977; Kaplan & Madjar, 2017; Roth et al., 2007; Tilga, Kalajas-Tilga, Hein, Raudsepp, & Koka, 2021; Van den Bergh et al., 2014). Additionally, teacher burnout could indirectly influence the level of basic psychological needs satisfaction, motivation, agentic engagement or achievement of their students through the teachers' motivational style (de la Fuente et al., 2020; Shen et al., 2015; Sutchter et al., 2019). In other words, teachers with less symptoms of burnout teach more autonomy-supportive and therefore affect students' outcomes. This reveals the importance of "supporting the supporters" and encourages the development of intervention measures to preserve teachers' mental health, such as through educational policies to meet their basic psychological needs.

Third, we hypothesized that the online-training for teachers would result to significantly greater students' needs satisfaction in the classroom (H3). This hypothesis is partially confirmed. The students whose teachers participated in the training reported significantly higher perceived autonomy and competence satisfaction. Thus, students in the experimental group were able to perceive a greater regulation of their behaviours in the classroom through developing a greater sense of will and self-direction as well as a greater clarity in their desires and goals. They also perceived that were more capable to adequately develop the different tasks carried out in the classroom. These results are in line with different interventions based on supporting autonomy that have shown their effectiveness in increasing these needs (Cheon et al., 2012; Tilga et al., 2019; D. Zhang, Bobis, Wu, & Cui, 2020). In this study, it should be noted that no effect was observed on the need for relatedness, which may be due to the fact that the training has been based on supporting

autonomy and promoting structure. However, it has not focused so much on involvement, which is one of the most used elements to support relatedness (Sparks et al., 2016). Another possible reason for this was the interpersonal distance between teachers and students, as well as between students themselves (a preventive measure taken in Spanish schools during the COVID-19 pandemic), which led to more limited personal interaction and exchange at an age when they are starting to develop social relationships (Kern, Waters, Adler, & White, 2015).

Fourth, we hypothesized that the online-training intervention for teachers would increase the levels of autonomous motivation of their students (H4). This hypothesis is confirmed, as the students whose teachers participated in the training perceived a higher autonomous motivation in the classroom than the control group. This seems to show that when teachers adopt different behaviours and techniques based on supporting autonomy, providing structure and promoting structure in a way that guides towards autonomy, students may perceive a higher sense of enjoyment, interest and self-improvement for doing an activity in the classroom (e.g., see Reeve & Cheon, 2021). This result differs from previous online SDT-interventions where no significant differences between groups were found in student motivation (Perlman, 2011, 2015; Tilga et al., 2019). This may be due to the fact that the present intervention lasted 9 weeks in contrast to 4 weeks of previous interventions. Changes in teacher interpersonal style could be perceived by students quickly and, therefore, affect to their basic psychological needs satisfaction. Instead, motivation could need more time to be modified. In fact, the study of Tilga et al. (2020) showed effects on intrinsic motivation after 15 months. Moreover, previous research was done in physical education, in which levels of intrinsic motivation could be initially higher than other subjects due to sports playing and enjoyment (Tilga et al., 2019).

Fifth, we hypothesized that the online training intervention for teachers would lead to greater agentic engagement in their students (H5). This hypothesis is confirmed, what may be due to the fact that students have improved their level of autonomy satisfaction with the support of the teacher, as the teacher has provided ideal conditions for students to, for example, communicate their interests and express their suggestions in a proactive and agentic environment (Matos et al., 2018; Reeve, 2013). In fact, following the recommendations of Reeve, Cheon, and Jang (2020), this method - teacher training and its ASIB content - seems to be the most effective and natural for the development of agentic engagement. Furthermore, this study seems to show that this training can also be implemented online.

Finally, we hypothesized that the online training intervention for teachers would increase their students' grades in the areas of Spanish Language, Mathematics, Social Sciences and Natural Sciences compared to the participants in the control group (H6). This hypothesis is partially confirmed. Student whose teachers participated in the online training reported an increase in their grades in the following term in Language and Science subjects. This also seems to be in line with other studies that have shown that being in a need-supportive environment is associated with higher student's academic achievement (Cheon et al., 2012; Cheon & Reeve, 2013; Cheon, Reeve, Lee, et al., 2019; Ferguson & de Charms, 1977). In contrast, no significant increase in Mathematics scores was observed, contradicting the assumption that if students have greater need satisfaction or autonomous motivation they should increase their grades in subjects they perceive as difficult or not intrinsically interesting, such as Mathematics (Ryan & Deci, 2020). Nevertheless, the direction of this developmental association remains unclear. In line with SDT, some scholars have shown that autonomous regulation would predict mathematics achievement (Gottfried, 1985; León, Núñez, & Liew, 2015; Murayama, Pekrun, Lichtenfeld, & vom Hofe, 2013; Spinath, Spinath, Harlaar, & Plomin, 2006), but others did not (Bouffard, Marcoux, Vezeau, & Bordeleau, 2003; Garon-Carrier et al., 2016; Marsh, Trautwein, Lüdtke, Köller, & Baumert, 2005). This supports the urgent educational social need to better understand the mechanisms and processes of factors that support and motivate students to learn and achieve

in Mathematics (Singh, Granville, & Dika, 2002; Tan, Calabrese, Turner, & Varley, 2012).

Overall, this study found various benefits of supporting autonomy, providing structure and promoting structure in a way that supports autonomy in the classroom, both in the teachers themselves and in their students. According to the results obtained in this study, which are in line with previous literature, we can draw four main inferences that can support the effectiveness of this type of interventions: (a) a need-supportive climate was established, leading to improved pupils' agentic engagement and academic achievement (Reeve & Cheon, 2021), (b) the belief that motivation can be enhanced in terms of its quality, showing its importance for learning and vice versa through the teacher's role as a facilitator in teaching-learning tasks or in setting standards, (c) teachers who implement need-supportive instructional behaviours, reducing their controlling style, can improve their personal self-fulfilment and reduce their emotional exhaustion, improving their mental health in complex contexts such as the COVID-19 crisis (Brooks et al., 2020; Holzer et al., 2021; Leo, Behzadnia, López-Gajardo, Batista, & Pulido, 2022), and (d) a more self-fulfilling and less emotionally draining approach to teaching, where teachers are aware of the importance of supporting students' needs, can really be key to the development, well-being and academic success of their students.

In addition, this study presents three main new features: (a) the analysis of the aforementioned combined teacher instructional behaviours that have been recently incorporated into the literature (e.g., see Cheon, Reeve, & Song, 2019; Cheon et al., 2020), (b) the analysis of the training effectiveness in a changing environment such as the situation generated by COVID-19 and in an unusual context in this field such as online, (c) the stage and educational setting in which the participants are (in a tutored setting in primary education) since most of the literature found and referenced is related to the physical education setting (e.g., see Reeve & Cheon, 2021).

5. Limitations

Several methodological limitations may restrict the conclusions that can be drawn from this study. First, all the measures used, whether teacher or student, were self-report measures. Our research would be much more robust if objective or external assessments (e.g., scores from trained raters) measuring the motivational styles developed by teachers in the classroom were added (e.g., see Cheon et al., 2012; Tessier, Sarrazin, & Ntoumanis, 2008). Second, it would be interesting to observe these developmental trajectories on several occasions over a longer period of time (e.g., one year of schooling) compared to the time observed in our study (four months). Third, the present study limited its focus to teacher-student interaction, but the supportive environment for students' needs also includes educational staff or parents. It would also be interesting to introduce greater involvement of students in the training itself, presenting their points of view and needs directly to the teaching staff, since if we are talking about taking their needs into account, the training itself could be the first starting point and, in turn, would provide valuable information for the researchers. Fourth, despite the potential benefits of online training, some studies have found that teachers who participate in online learning have an unequal distribution of behaviour, fewer interactions and less perseverance. Therefore, it would be useful in future research to combine face-to-face and online interventions (Tilga, Kalajas-Tilga, Hein, & Koka, 2021).

6. Conclusions

This study's results showed that online training for teachers to support autonomy, provide structure and promote structure through tools and techniques that facilitate autonomy had great benefits for both teachers and their students during the COVID-19 pandemic. The group that undertook the training resulted in teachers being less controlling and adopting a more motivating style in their classrooms, having less

burnout levels in comparison to the control group. The fact that the training enhanced the teachers' ability to provide opportunities to meet the needs of the learners, led to higher levels of students' autonomy and competence satisfaction in the classroom, increased levels of autonomous motivation and agentic engagement, and also improved grades in Language and Science. These results could be useful for improving the teaching-learning process, the well-being of the educational community and students' academic success.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

Acknowledgements

Research reported in this publication was partially funded by grants PGC2018-097145-B-I00 and RED2018-102615-608 T from the Spanish Government and H2019/HUM-5705 from the Community of Madrid.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.tate.2023.104281>.

References

- Adler, N. E., Epel, E. S., Castellazzo, G., & Ickovics, J. R. (2000). Relationship of subjective and objective social status with psychological and physiological functioning: Preliminary data in healthy, White women. *Health Psychology, 19*(6), 586–592. <https://doi.org/10.1037/0278-6133.19.6.586>
- Aelterman, N., Vansteenkiste, M., Haerens, L., Soenens, B., Fontaine, J. R. J., & Reeve, J. (2019). Toward an integrative and fine-grained insight in motivating and demotivating teaching styles: The merits of a circumplex approach. *Journal of Educational Psychology, 111*(3), 497–521. <https://doi.org/10.1037/edu0000293>
- Aelterman, N., Vansteenkiste, M., Van Keer, H., & Haerens, L. (2016). Changing teachers' beliefs regarding autonomy support and structure: The role of experienced psychological need satisfaction in teacher training. *Psychology of Sport and Exercise, 23*, 64–72. <https://doi.org/10.1016/j.psychsport.2015.10.007>
- Aelterman, N., Vansteenkiste, M., Van den Berghe, L., De Meyer, J., & Haerens, L. (2014). Fostering a need-supportive teaching style: Intervention effects on physical education teachers' beliefs and teaching behaviors. *Journal of Sport & Exercise Psychology, 36*(6), 595–609. <https://doi.org/10.1123/jsep.2013-0229>
- Anwyl-Irvine, A. L., Massonnié, J., Flitton, A., Kirkham, N., & Evershed, J. K. (2020). Gorilla in our midst: An online behavioral experiment builder. *Behavior Research Methods, 52*(1), 388–407. <https://doi.org/10.3758/s13428-019-01237-x>
- Assor, A., Feinberg, O., Kanat-Maymon, Y., & Kaplan, H. (2018). Reducing violence in non-controlling ways: A change program based on self determination theory. *The Journal of Experimental Education, 86*(2), 195–213. <https://doi.org/10.1080/00220973.2016.1277336>
- Assor, A., & Tal, K. (2012). When parents' affection depends on child's achievement: Parental conditional positive regard, self-aggrandizement, shame and coping in adolescents. *Journal of Adolescence, 35*(2), 249–260. <https://doi.org/10.1016/j.adolescence.2011.10.004>
- Barnes, A. E., Zuilkowski, S. S., Mekonnen, D., & Ramos-Mattoussi, F. (2018). Improving teacher training in Ethiopia: Shifting the content and approach of pre-service teacher education. *Teaching and Teacher Education, 70*, 1–11. <https://doi.org/10.1016/j.tate.2017.11.004>
- Bartholomew, K. J., Ntoumanis, N., Mouratidis, A., Katartzis, E., Thøgersen-Ntoumani, C., & Vlachopoulos, S. (2018). Beware of your teaching style: A school-year long investigation of controlling teaching and student motivational experiences. *Learning and Instruction, 53*, 50–63. <https://doi.org/10.1016/j.learninstruc.2017.07.006>
- Baumrind, D. (2012). Differentiating between confrontive and coercive kinds of parental power-assertive disciplinary practices. *Human Development, 55*(2), 35–51. <https://doi.org/10.1159/000337962>
- Bouffard, T., Marcoux, M.-F., Vezeau, C., & Bordeleau, L. (2003). Changes in self-perceptions of competence and intrinsic motivation among elementary schoolchildren. *British Journal of Educational Psychology, 73*(2), 171–186. <https://doi.org/10.1348/00070990360626921>
- Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., et al. (2020). The psychological impact of quarantine and how to reduce it: Rapid review

- of the evidence. *Lancet (London, England)*, 395(10227), 912–920. [https://doi.org/10.1016/S0140-6736\(20\)30460-8](https://doi.org/10.1016/S0140-6736(20)30460-8)
- Carpentier, J., & Mageau, G. A. (2013). When change-oriented feedback enhances motivation, well-being and performance: A look at autonomy-supportive feedback in sport. *Psychology of Sport and Exercise*, 14(3), 423–435. <https://doi.org/10.1016/j.psychsport.2013.01.003>
- Chen, K.-C., & Jang, S.-J. (2010). Motivation in online learning: Testing a model of self-determination theory. *Computers in Human Behavior*, 26(4), 741–752. <https://doi.org/10.1016/j.chb.2010.01.011>
- Cheon, S. H., & Reeve, J. (2013). Do the benefits from autonomy-supportive PE teacher training programs endure?: A one-year follow-up investigation. *Psychology of Sport and Exercise*, 14(4), 508–518. <https://doi.org/10.1016/j.psychsport.2013.02.002>
- Cheon, S. H., & Reeve, J. (2015). A classroom-based intervention to help teachers decrease students' amotivation. *Contemporary Educational Psychology*, 40, 99–111. <https://doi.org/10.1016/j.cedpsych.2014.06.004>
- Cheon, S. H., Reeve, J., Lee, Y., & Lee, J. (2018). Why autonomy-supportive interventions work: Explaining the professional development of teachers' motivating style. *Teaching and Teacher Education*, 69, 43–51. <https://doi.org/10.1016/j.tate.2017.09.022>
- Cheon, S. H., Reeve, J., Lee, Y., Ntoumanis, N., Gillet, N., Kim, B. R., et al. (2019). Expanding autonomy psychological need states from two (satisfaction, frustration) to three (dissatisfaction): A classroom-based intervention study. *Journal of Educational Psychology*, 111(4), 685–702. <https://doi.org/10.1037/edu0000306>
- Cheon, S. H., Reeve, J., & Moon, I. S. (2012). Experimentally based, longitudinally designed, teacher-focused intervention to help physical education teachers be more autonomy supportive toward their students. *Journal of Sport & Exercise Psychology*, 34(3), 365–396. <https://doi.org/10.1123/jsep.34.3.365>
- Cheon, S. H., Reeve, J., & Song, Y.-G. (2019). Recommending goals and supporting needs: An intervention to help physical education teachers communicate their expectations while supporting students' psychological needs. *Psychology of Sport and Exercise*, 41, 107–118. <https://doi.org/10.1016/j.psychsport.2018.12.008>
- Cheon, S. H., Reeve, J., & Vansteenkiste, M. (2020). When teachers learn how to provide classroom structure in an autonomy-supportive way: Benefits to teachers and their students. *Teaching and Teacher Education*, 90. <https://doi.org/10.1016/j.tate.2019.103004>. Article 103004.
- Ching, C. C., & Hursh, A. W. (2014). Peer modeling and innovation adoption among teachers in online professional development. *Computers & Education*, 73, 72–82. <https://doi.org/10.1016/j.compedu.2013.12.011>
- Christenson, S., Wylie, C., & Reschly, A. L. (2012). *Handbook of research on student engagement*. Springer.
- Collie, R. J. (2021). COVID-19 and teachers' somatic burden, stress, and emotional exhaustion: Examining the role of principal leadership and workplace buoyancy. *AERA Open*, 7. <https://doi.org/10.1177/2332858420986187>. Article 2332858420986187.
- Collie, R. J., Granziere, H., & Martin, A. J. (2018). Teachers' perceived autonomy support and adaptability: An investigation employing the job demands-resources model as relevant to workplace exhaustion, disengagement, and commitment. *Teaching and Teacher Education*, 74, 125–136. <https://doi.org/10.1016/j.tate.2018.04.015>
- Collie, R. J., Granziere, H., & Martin, A. J. (2019). Teachers' motivational approach: Links with students' basic psychological need frustration, maladaptive engagement, and academic outcomes. *Teaching and Teacher Education*, 86, Article 102872. <https://doi.org/10.1016/j.tate.2019.07.002>
- Conesa, P. J., & Duñabeitia, J. A. (2021). The basic psychological needs in the classroom scale (BPN-CS). *Behavioral Sciences*, 11(7). <https://doi.org/10.3390/bs11070096>. Article 96.
- Curran, T., Hill, A. P., & Niemiec, C. P. (2013). A conditional process model of children's behavioral engagement and behavioral disaffection in sport based on self-determination theory. *Journal of Sport & Exercise Psychology*, 35(1), 30–43. <https://doi.org/10.1123/jsep.35.1.30>
- De Meyer, J., Soenens, B., Aelterman, N., De Bourdeaudhuij, I., & Haerens, L. (2016). The different faces of controlling teaching: Implications of a distinction between externally and internally controlling teaching for students' motivation in physical education. *Physical Education and Sport Pedagogy*, 21(6), 632–652. <https://doi.org/10.1080/17408989.2015.1112777>
- Deci, E. L., Eghrari, H., Patrick, B. C., & Leone, D. R. (1994). Facilitating internalization: The self-determination theory perspective. *Journal of Personality*, 62(1), 119–142. <https://doi.org/10.1111/j.1467-6494.1994.tb00797.x>
- Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*, 125(6), 627–668. <https://doi.org/10.1037/0033-2909.125.6.627>
- Eckes, A., Großmann, N., & Wilde, M. (2018). Studies on the effects of structure in the context of autonomy-supportive or controlling teacher behavior on students' intrinsic motivation. *Learning and Individual Differences*, 62, 69–78. <https://doi.org/10.1016/j.lindif.2018.01.011>
- Escrivá-Bouley, G., Guillet-Descas, E., Aelterman, N., Vansteenkiste, M., Van Doren, N., Lentillon-Kaestner, V., et al. (2021). Adopting the Situation in School Questionnaire to examine physical education teachers' motivating and demotivating styles using a circumplex approach. *International Journal of Environmental Research and Public Health*, 18(14). <https://doi.org/10.3390/ijerph18147342>. Article 7342.
- Fan, Y.-C., Wang, T.-H., & Wang, K.-H. (2011). A Web-based model for developing assessment literacy of secondary in-service teachers. *Computers & Education*, 57(2), 1727–1740. <https://doi.org/10.1016/j.compedu.2011.03.006>
- Ferguson, E. D., & de Charms, R. (1977). Enhancing motivation: Change in the classroom. *American Journal of Psychology*, 90(2), 333–335. <https://doi.org/10.2307/1422061>
- Fernet, C., Guay, F., Senécal, C., & Austin, S. (2012). Predicting intraindividual changes in teacher burnout: The role of perceived school environment and motivational factors. *Teaching and Teacher Education*, 28(4), 514–525. <https://doi.org/10.1016/j.tate.2011.11.013>
- Field, A. (2017). *Discovering statistics using IBM SPSS statistics* (5th ed.). SAGE Publications.
- de la Fuente, J., Peralta-Sánchez, F. J., Martínez-Vicente, J. M., Sander, P., Garzón-Umerenkova, A., & Zapata, L. (2020). Effects of self-regulation vs. external regulation on the factors and symptoms of academic stress in undergraduate students. *Frontiers in Psychology*, 11. <https://doi.org/10.3389/fpsyg.2020.01773>. Article 1773.
- Garon-Carrier, G., Boivin, M., Guay, F., Kovas, Y., Dionne, G., Lemelin, J.-P., et al. (2016). Intrinsic motivation and achievement in mathematics in elementary school: A longitudinal investigation of their association. *Child Development*, 87(1), 165–175. <https://doi.org/10.1111/cdev.12458>
- George, D., & Mallery, P. (2007). *SPSS for windows step by step: A simple guide and reference: 14.0 update*. Pearson Education.
- González, G., & Skultety, L. (2018). Teacher learning in a combined professional development intervention. *Teaching and Teacher Education*, 71, 341–354. <https://doi.org/10.1016/j.tate.2018.02.003>
- Gottfried, A. E. (1985). Academic intrinsic motivation in elementary and junior high school students. *Journal of Educational Psychology*, 77(6), 631–645. <https://doi.org/10.1037/0022-0663.77.6.631>
- Guay, F., Chantal, J., Ratelle, C. F., Marsh, H. W., Larose, S., & Boivin, M. (2010). Intrinsic, identified, and controlled types of motivation for school subjects in young elementary school children. *British Journal of Educational Psychology*, 80(4), 711–735. <https://doi.org/10.1348/000709910X499084>
- Guay, F., Morin, A. J. S., Litalien, D., Howard, J. L., & Gilbert, W. (2021). Trajectories of self-determined motivation during the secondary school: A growth mixture analysis. *Journal of Educational Psychology*, 113, 390–410. <https://doi.org/10.1037/edu0000482>
- Guay, F., Valois, P., Falardeau, É., & Lessard, V. (2016). Examining the effects of a professional development program on teachers' pedagogical practices and students' motivational resources and achievement in written French. *Learning and Individual Differences*, 45, 291–298. <https://doi.org/10.1016/j.lindif.2015.11.014>
- Holzer, J., Korlat, S., Haider, C., Mayerhofer, M., Pelikan, E., Schober, B., et al. (2021). Adolescent well-being and learning in times of COVID-19—a multi-country study of basic psychological need satisfaction, learning behavior, and the mediating roles of positive emotion and intrinsic motivation. *PLoS One*, 16(5), Article e0251352. <https://doi.org/10.1371/journal.pone.0251352>
- Hsu, H.-C. K., Wang, C. V., & Levesque-Bristol, C. (2019). Reexamining the impact of self-determination theory on learning outcomes in the online learning environment. *Education and Information Technologies*, 24(3), 2159–2174. <https://doi.org/10.1007/s10639-019-09863-w>
- Jang, H., Kim, E. J., & Reeve, J. (2016). Why students become more engaged or more disengaged during the semester: A self-determination theory dual-process model. *Learning and Instruction*, 43, 27–38. <https://doi.org/10.1016/j.learninstruc.2016.01.002>
- Jang, H., Reeve, J., & Deci, E. L. (2010). Engaging students in learning activities: It is not autonomy support or structure but autonomy support and structure. *Journal of Educational Psychology*, 102(3), 588–600. <https://doi.org/10.1037/a0019682>
- Jennings, P. A. (2015). Early childhood teachers' well-being, mindfulness, and self-compassion in relation to classroom quality and attitudes towards challenging students. *Mindfulness*, 6(4), 732–743. <https://doi.org/10.1007/s12671-014-0312-4>
- Kaplan, H., & Madjar, N. (2017). The motivational outcomes of psychological need support among pre-service teachers: Multicultural and self-determination theory perspectives. *Frontiers in Education*, 2. <https://doi.org/10.3389/educ.2017.00042>. Article 42.
- Kern, M. L., Waters, L. E., Adler, A., & White, M. A. (2015). A multidimensional approach to measuring well-being in students: Application of the PERMA framework. *The Journal of Positive Psychology*, 10(3), 262–271. <https://doi.org/10.1080/17439760.2014.936962>
- Kuhfeld, M., Soland, J., Tarasawa, B., Johnson, A., Ruzek, E., & Liu, J. (2020). Projecting the potential impact of COVID-19 school closures on academic achievement. *Educational Researcher*, 49(8), 549–565. <https://doi.org/10.3102/0013189X20965918>
- Kuo, Y.-C., Walker, A. E., Schroder, K. E. E., & Belland, B. R. (2014). Interaction, Internet self-efficacy, and self-regulated learning as predictors of student satisfaction in online education courses. *The Internet and Higher Education*, 20, 35–50. <https://doi.org/10.1016/j.iheduc.2013.10.001>
- Leo, F. M., Behzadnia, B., López-Gajardo, M. A., Batista, M., & Pulido, J. J. (2022). What kind of interpersonal need-supportive or need-thwarting teaching style is more associated with positive consequences in physical education? *Journal of Teaching in Physical Education*. <https://doi.org/10.1123/jtpe.2022-0040>. Advance online publication.
- León, J., Núñez, J. L., & Liew, J. (2015). Self-determination and STEM education: Effects of autonomy, motivation, and self-regulated learning on high school math achievement. *Learning and Individual Differences*, 43, 156–163. <https://doi.org/10.1016/j.lindif.2015.08.017>
- Marsh, H. W., Trautwein, U., Lüdtke, O., Köller, O., & Baumert, J. (2005). Academic self-concept, interest, grades, and standardized test scores: Reciprocal effects models of causal ordering. *Child Development*, 76(2), 397–416. <https://doi.org/10.1111/j.1467-8624.2005.00853.x>
- Maslach, C. (2003). Job burnout: New directions in research and intervention. *Current Directions in Psychological Science*, 12(5), 189–192. <https://doi.org/10.1111/1467-8721.01258>
- Maslach, C., & Jackson, S. E. (1981). The measurement of experienced burnout. *Journal of Organizational Behavior*, 2(2), 99–113. <https://doi.org/10.1002/job.4030020205>

- Matos, L., Reeve, J., Herrera, D., & Claux, M. (2018). Students' agentic engagement predicts longitudinal increases in perceived autonomy-supportive teaching: The squeaky wheel gets the grease. *The Journal of Experimental Education*, 86(4), 579–596. <https://doi.org/10.1080/00220973.2018.1448746>
- Moë, A., & Katz, I. (2020). Self-compassionate teachers are more autonomy supportive and structuring whereas self-derogating teachers are more controlling and chaotic: The mediating role of need satisfaction and burnout. *Teaching and Teacher Education*, 96. <https://doi.org/10.1016/j.tate.2020.103173>. Article 103173.
- Mouratidis, A., Michou, A., Aelterman, N., Haerens, L., & Vansteenkiste, M. (2018). Begin-of-school-year perceived autonomy-support and structure as predictors of end-of-school-year study efforts and procrastination: The mediating role of autonomous and controlled motivation. *Educational Psychology*, 38(4), 435–450. <https://doi.org/10.1080/01443410.2017.1402863>
- Mouratidis, A. A., Vansteenkiste, M., Sideridis, G., & Lens, W. (2011). Vitality and interest-enjoyment as a function of class-to-class variation in need-supportive teaching and pupils' autonomous motivation. *Journal of Educational Psychology*, 103(2), 353–366. <https://doi.org/10.1037/a0022773>
- Murayama, K., Pekrun, R., Lichtenfeld, S., & vom Hofe, R. (2013). Predicting long-term growth in students' mathematics achievement: The unique contributions of motivation and cognitive strategies. *Child Development*, 84(4), 1475–1490. <https://doi.org/10.1111/cdev.12036>
- Nouchi, R., Taki, Y., Takeuchi, H., Hashizume, H., Nozawa, T., Kambara, T., et al. (2013). Brain training game boosts executive functions, working memory and processing speed in the young adults: A randomized controlled trial. *PLoS One*, 8(2). <https://doi.org/10.1371/journal.pone.0055518>. Article e55518.
- Ozamiz-Etxebarria, N., Berasategi Santxo, N., Idoiaga Mondragon, N., & Dosil Santamaria, M. (2021). The psychological state of teachers during the COVID-19 crisis: The challenge of returning to face-to-face teaching. *Frontiers in Psychology*, 11. <https://doi.org/10.3389/fpsyg.2020.620718>. Article 3861.
- Patall, E. A., Cooper, H., & Robinson, J. C. (2008). The effects of choice on intrinsic motivation and related outcomes: A meta-analysis of research findings. *Psychological Bulletin*, 134(2), 270–300. <https://doi.org/10.1037/0033-2909.134.2.270>
- Patall, E. A., Dent, A. L., Oyer, M., & Wynn, S. R. (2013). Student autonomy and course value: The unique and cumulative roles of various teacher practices. *Motivation and Emotion*, 37(1), 14–32. <https://doi.org/10.1007/s11031-012-9305-6>
- Patall, E. A., Pituch, K. A., Steingut, R. R., Vasquez, A. C., Yates, N., & Kennedy, A. A. U. (2019). Agency and high school science students' motivation, engagement, and classroom support experiences. *Journal of Applied Developmental Psychology*, 62, 77–92. <https://doi.org/10.1016/j.appdev.2019.01.004>
- Patall, E. A., Steingut, R. R., Vasquez, A. C., Trimble, S. S., Pituch, K. A., & Freeman, J. L. (2018). Daily autonomy supporting or thwarting and students' motivation and engagement in the high school science classroom. *Journal of Educational Psychology*, 110(2), 269–288. <https://doi.org/10.1037/edu0000214>
- Patall, E. A., Vasquez, A. C., Steingut, R. R., Trimble, S. S., & Pituch, K. A. (2017). Supporting and thwarting autonomy in the high school science classroom. *Cognition and Instruction*, 35(4), 337–362. <https://doi.org/10.1080/07370008.2017.1358722>
- Patall, E. A., Zambrano, J., Kennedy, A. A. U., Yates, N., & Vallin, J. A. (2022). Promoting an agentic orientation: An intervention in university psychology and physical science courses. *Journal of Educational Psychology*, 114(2), 368–392. <https://doi.org/10.1037/edu0000614>
- Pelletier, L. G., Séguin-Lévesque, C., & Legault, L. (2002). Pressure from above and pressure from below as determinants of teachers' motivation and teaching behaviors. *Journal of Educational Psychology*, 94(1), 186–196. <https://doi.org/10.1037/0022-0663.94.1.186>
- Pelletier, L. G., & Sharp, E. C. (2009). Administrative pressures and teachers' interpersonal behaviour in the classroom. *Theory and Research in Education*, 7(2), 174–183. <https://doi.org/10.1177/1477878509104322>
- Pearlman, D. (2011). The influence of an autonomy-supportive intervention on preservice teacher instruction: A self-determined perspective. *Australian Journal of Teacher Education*, 36(11), 73–79.
- Pearlman, D. (2015). Assisting preservice teachers toward more motivationally supportive instruction. *Journal of Teaching in Physical Education*, 34(1), 119–130. <https://doi.org/10.1123/jtpe.2013-0208>
- Prenger, R., Poortman, C. L., & Handelzalts, A. (2017). Factors influencing teachers' professional development in networked professional learning communities. *Teaching and Teacher Education*, 68, 77–90. <https://doi.org/10.1016/j.tate.2017.08.014>
- Reeve, J. (2013). How students create motivationally supportive learning environments for themselves: The concept of agentic engagement. *Journal of Educational Psychology*, 105(3), 579–595. <https://doi.org/10.1037/a0032690>
- Reeve, J., & Cheon, S. H. (2021). Autonomy-supportive teaching: Its malleability, benefits, and potential to improve educational practice. *Educational Psychologist*, 56(1), 54–77. <https://doi.org/10.1080/00461520.2020.1862657>
- Reeve, J., Cheon, S. H., & Jang, H. (2020). How and why students make academic progress: Reconceptualizing the student engagement construct to increase its explanatory power. *Contemporary Educational Psychology*, 62. <https://doi.org/10.1016/j.cedpsych.2020.101899>. Article 101899.
- Reeve, J., Cheon, S. H., & Yu, T. H. (2020). An autonomy-supportive intervention to develop students' resilience by boosting agentic engagement. *International Journal of Behavioral Development*, 44(4), 325–338. <https://doi.org/10.1177/0165025420911103>
- Reeve, J., & Jang, H. (2006). What teachers say and do to support students' autonomy during a learning activity. *Journal of Educational Psychology*, 98(1), 209–218. <https://doi.org/10.1037/0022-0663.98.1.209>
- Reeve, J., Jang, H.-R., Shin, S. H., Ahn, J. S., Matos, L., & Gargurevich, R. (2021). When students show some initiative: Two experiments on the benefits of greater agentic engagement. *Learning and Instruction*. <https://doi.org/10.1016/j.learninstruc.2021.101564>. Article 101564.
- Reeve, J., Ryan, R. M., Cheon, S. H., Matos, L., & Kaplan, H. (2022). *Supporting students' motivation: Strategies for success*. Routledge. <https://doi.org/10.4324/9781003091738>
- Reeve, J., & Tseng, C.-M. (2011). Agency as a fourth aspect of students' engagement during learning activities. *Contemporary Educational Psychology*, 36(4), 257–267. <https://doi.org/10.1016/j.cedpsych.2011.05.002>
- Revilla, M. A., Saris, W. E., & Krosnick, J. A. (2014). Choosing the number of categories in agree-disagree scales. *Sociological Methods & Research*, 43(1), 73–97. <https://doi.org/10.1177/0049124113509605>
- Roth, G., Assor, A., Kanat-Maymon, Y., & Kaplan, H. (2007). Autonomous motivation for teaching: How self-determined teaching may lead to self-determined learning. *Journal of Educational Psychology*, 99(4), 761–774. <https://doi.org/10.1037/0022-0663.99.4.761>
- Ryan, R. M. (1982). Control and information in the intrapersonal sphere: An extension of cognitive evaluation theory. *Journal of Personality and Social Psychology*, 43(3), 450–461. <https://doi.org/10.1037/0022-3514.43.3.450>
- Ryan, R. M. (1991). The nature of the self in autonomy and relatedness. In J. Strauss, & G. R. Goethals (Eds.), *The self: Interdisciplinary approaches* (pp. 208–238). Springer. <https://doi.org/10.1007/978-1-4684-8264-5.11>
- Ryan, R. M., & Connell, J. P. (1989). Perceived locus of causality and internalization: Examining reasons for acting in two domains. *Journal of Personality and Social Psychology*, 57(5), 749–761. <https://doi.org/10.1037/0022-3514.57.5.749>
- Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55(1), 68–78. <https://doi.org/10.1037/0003-066X.55.1.68>
- Ryan, R. M., & Deci, E. L. (2006). Self-regulation and the problem of human autonomy: Does psychology need choice, self-determination, and will? *Journal of Personality*, 74(6), 1557–1586. <https://doi.org/10.1111/j.1467-6494.2006.00420.x>
- Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. Guilford Press.
- Ryan, R. M., & Deci, E. L. (2020). *Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions*. Contemporary Educational Psychology, Article 101860. <https://doi.org/10.1016/j.cedpsych.2020.101860>
- Šakan, D., Tóth-Király, I., & Morin, A. J. S. (2023). Nature, implications and determinants of academic motivation profiles among upper elementary and secondary students. In *Current psychology*. Advance online publication. <https://doi.org/10.1007/s12144-023-04687-x>
- Sánchez-Pujalte, L., Mateu, D. N., Etchezahar, E., & Gómez Yepes, T. (2021). Teachers' burnout during COVID-19 pandemic in Spain: Trait emotional intelligence and socioemotional competencies. *Sustainability*, 13(13). <https://doi.org/10.3390/su13137259>. Article 13.
- Seisdedos, N. (1987). *Inventario "burnout" de Maslach*. MBI. Ediciones TEA.
- Shen, B., McCaughy, N., Martin, J., Garn, A., Kulik, N., & Fahlman, M. (2015). The relationship between teacher burnout and student motivation. *British Journal of Educational Psychology*, 85(4), 519–532. <https://doi.org/10.1111/bjep.12089>
- Sierens, E., Vansteenkiste, M., Goossens, L., Soenens, B., & Dochy, F. (2009). The synergistic relationship of perceived autonomy support and structure in the prediction of self-regulated learning. *British Journal of Educational Psychology*, 79(1), 57–68. <https://doi.org/10.1348/000709908X304398>
- Singh, K., Granville, M., & Dika, S. (2002). Mathematics and science achievement: Effects of motivation, interest, and academic engagement. *The Journal of Educational Research*, 95(6), 323–332. <https://doi.org/10.1080/00220670209596607>
- Soenens, B., Sierens, E., Vansteenkiste, M., Dochy, F., & Goossens, L. (2012). Psychologically controlling teaching: Examining outcomes, antecedents, and mediators. *Journal of Educational Psychology*, 104(1), 108–120. <https://doi.org/10.1037/a0025742>
- Soenens, B., & Vansteenkiste, M. (2010). A theoretical upgrade of the concept of parental psychological control: Proposing new insights on the basis of self-determination theory. *Developmental Review*, 30(1), 74–99. <https://doi.org/10.1016/j.dr.2009.11.001>
- Sparks, C., Dimmock, J., Lonsdale, C., & Jackson, B. (2016). Modeling indicators and outcomes of students' perceived teacher relatedness support in high school physical education. *Psychology of Sport and Exercise*, 26, 71–82. <https://doi.org/10.1016/j.psychsport.2016.06.004>
- Spinath, B., Spinath, F. M., Harlaar, N., & Plomin, R. (2006). Predicting school achievement from general cognitive ability, self-perceived ability, and intrinsic value. *Intelligence*, 34(4), 363–374. <https://doi.org/10.1016/j.intell.2005.11.004>
- Sutcher, L., Darling-Hammond, L., & Carver-Thomas, D. (2019). Understanding teacher shortages: An analysis of teacher supply and demand in the United States. *Education Policy Analysis Archives*, 27. <https://doi.org/10.14507/epaa.27.3696>. Article 35.
- Tan, E., Calabrese, A., Turner, E., & Varley, M. (2012). *Empowering science and mathematics education in urban schools*. University of Chicago Press. <http://chicago.universitypressscholarship.com/view/10.7208/chicago/9780226037998.001.0001/upso-9780226037974>
- Tessier, D., Sarrazin, P., & Ntoumanis, N. (2008). The effects of an experimental programme to support students' autonomy on the overt behaviours of physical education teachers. *European Journal of Psychology of Education*, 23(3), 239–253. <https://doi.org/10.1007/BF03172998>
- Tilga, H., Hein, V., & Koka, A. (2019). Effects of a web-based Intervention for PE teachers on students' perceptions of teacher behaviors, psychological needs, and intrinsic motivation. *Perceptual and Motor Skills*, 126(3), 559–580. <https://doi.org/10.1177/0031512519840150>

- Tilga, H., Kalajas-Tilga, H., Hein, V., & Koka, A. (2021). Web-based and face-to-face autonomy-supportive intervention for physical education teachers and students' experiences. *Journal of Sports Science and Medicine*, 20, 672–683. <https://doi.org/10.52082/jssm.2021.672>
- Tilga, H., Kalajas-Tilga, H., Hein, V., Raudsepp, L., & Koka, A. (2020). 15-month follow-up data on the web-based autonomy-supportive intervention program for PE teachers. *Perceptual and Motor Skills*, 127(1), 5–7. <https://doi.org/10.1177/0031512519870914>
- Tilga, H., Kalajas-Tilga, H., Hein, V., Raudsepp, L., & Koka, A. (2021). Effects of a web-based autonomy-supportive intervention on physical education teacher outcomes. *Education Sciences*, 11(7). <https://doi.org/10.3390/educsci11070316>. Article 316.
- Todd, A. R., & Galinsky, A. D. (2014). Perspective-taking as a strategy for improving intergroup relations: Evidence, mechanisms, and qualifications. *Social and Personality Psychology Compass*, 8(7), 374–387. <https://doi.org/10.1111/spc3.12116>
- Tondeur, J., Aesaert, K., Prestridge, S., & Consuegra, E. (2018). A multilevel analysis of what matters in the training of pre-service teacher's ICT competencies. *Computers & Education*, 122, 32–42. <https://doi.org/10.1016/j.compedu.2018.03.002>
- Van den Berghe, L., Soenens, B., Aelterman, N., Cardon, G., Tallir, I. B., & Haerens, L. (2014). Within-person profiles of teachers' motivation to teach: Associations with need satisfaction at work, need-supportive teaching, and burnout. *Psychology of Sport and Exercise*, 15(4), 407–417. <https://doi.org/10.1016/j.psychsport.2014.04.001>
- Vansteenkiste, M., Aelterman, N., De Muynck, G.-J., Haerens, L., Patall, E., & Reeve, J. (2018). Fostering personal meaning and self-relevance: A self-determination theory perspective on internalization. *The Journal of Experimental Education*, 86(1), 30–49. <https://doi.org/10.1080/00220973.2017.1381067>
- Vansteenkiste, M., Simons, J., Lens, W., Soenens, B., & Matos, L. (2005). Examining the motivational impact of intrinsic versus extrinsic goal framing and autonomy-supportive versus internally controlling communication style on early adolescents' academic achievement. *Child Development*, 76(2), 483–501. <https://doi.org/10.1111/j.1467-8624.2005.00858.x>
- Vermote, B., Aelterman, N., Beyers, W., Aper, L., Buysschaert, F., & Vansteenkiste, M. (2020). The role of teachers' motivation and mindsets in predicting a (de)motivating teaching style in higher education: A circumplex approach. *Motivation and Emotion*, 44(2), 270–294. <https://doi.org/10.1007/s11031-020-09827-5>
- Wankel, C., & Blessinger, P. (Eds.). (2013). *Increasing student engagement and retention in e-learning environments: Web 2.0 and blended learning technologies* (Vol. 6). Emerald Group Publishing Limited. [https://doi.org/10.1108/S2044-9968\(2013\)6_Part_G](https://doi.org/10.1108/S2044-9968(2013)6_Part_G)
- Westphal, A., Kalinowski, E., Hoferichter, C. J., & Vock, M. (2022). K–12 teachers' stress and burnout during the COVID-19 pandemic: A systematic review. *Frontiers in Psychology*, 13. <https://doi.org/10.3389/fpsyg.2022.920326>, 920326.
- Wigfield, A., & Eccles, J. S. (2020). Chapter five - 35 years of research on students' subjective task values and motivation: A look back and a look forward. In A. J. Elliot (Ed.), *Advances in motivation science* (Vol. 7, pp. 161–198). Elsevier. <https://doi.org/10.1016/bs.adms.2019.05.002>
- Williams, G. C., Grow, V. M., Freedman, Z. R., Ryan, R. M., & Deci, E. L. (1996). Motivational predictors of weight loss and weight-loss maintenance. *Journal of Personality and Social Psychology*, 70(1), 115–126. <https://doi.org/10.1037/0022-3514.70.1.115>
- Wray-Lake, L., Crouter, A. C., & McHale, S. M. (2010). Developmental patterns in decision-making autonomy across middle childhood and adolescence: European American parents' perspectives. *Child Development*, 81(2), 636–651. <https://doi.org/10.1111/j.1467-8624.2009.01420.x>
- Zhang, D., Bobis, J., Wu, X., & Cui, Y. (2020). The effects of an autonomy-supportive teaching intervention on Chinese physics students and their teacher. *Research in Science Education*, 50(2), 645–671. <https://doi.org/10.1007/s11165-018-9706-y>
- Zhang, S., & Liu, Q. (2019). Investigating the relationships among teachers' motivational beliefs, motivational regulation, and their learning engagement in online professional learning communities. *Computers & Education*, 134, 145–155. <https://doi.org/10.1016/j.compedu.2019.02.013>
- Zougkou, K., Weinstein, N., & Paulmann, S. (2017). ERP correlates of motivating voices: Quality of motivation and time-course matters. *Social Cognitive and Affective Neuroscience*, 12(10), 1687–1700. <https://doi.org/10.1093/scan/nsx064>