Effects of a homework implementation method (MITCA) on self-regulation of learning

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Abstract

The MITCA method (Homework Implementation Method) was developed with the purpose of turning homework into an educational resource capable of improving students' self-regulated learning and school engagement. In this paper, following current theoretical frameworks, we evaluate the effect of the MITCA method on students' self-regulated learning. In general, MITCA includes the assignment of diverse, concrete and valued by the students tasks which are completed on a weekly basis. We analyze the differences in self-regulation strategies in a sample of 533 fifth (n=270) and sixth graders (n=262) with an age range of 10–12 years old (47.5% boys and 52.5% girls), who were about equally distributed to an experimental and a control group. Trained teachers used MITCA to prescribe homework in the experimental group for twelve weeks. The students of the experimental group reported significantly higher time management and environmental management. However, there were no significant differences observed in other aspects of self-regulation, and the experimental group did not perceive a deficit in these areas. Our results indicate the effectiveness of MITCA on students' self-regulation of learning and discussed in light of current theories and evidence in the field.

Keywords Homework · Intervention · Primary school · Self-regulation

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Introduction

Homework, defined as teacher-prescribed tasks to be completed by students after school hours (Cooper et al., 2012), is in the spotlight of actors involved in the learning and teaching processes. Especially in the field of education and psychology, homework is a topic of interest not only due to its interaction with students' academic performance (Cooper, 1989; Cooper et al., 2006; Corno & Xu, 2004; Fan et al., 2017; Zimmerman & Kitsantas, 2005), but also due to its contribution in developing study habits and promoting self-regulatory skills (Cooper, 1989; Corno, 1996; Corno & Xu, 2004; Epstein, 1983; Martínez-Vicente et al., 2020; Suárez et al., 2019; Warton, 2001).

Recognizing that the successful completion of homework necessitates students' commitment and the potential utilization of self-regulatory skills, homework can be perceived as an educational tool that may contribute to the cultivation of self-regulation. For example, homework requires context regulation skills such as distributing and organizing time, seeking and asking for help, as well as motivational and emotional regulation skills like identifying and sustaining task value, developing perceived competence, and regulating homework-associated emotions. Time management during homework completion is one of the factors best associated with academic engagement and performance (Núñez et al., 2015; Xu, 2010, 2011). Thus, the potential benefits of homework are not only quantitative (e.g., knowledge and skills acquired), but also qualitative (Dettmers et al., 2010), and the student is the primary agent and director of the homework completion process. This is the main premise according to which the Homework Implementation Method (MITCA) (Valle and Rodríguez, 2020) was designed.

In general, the MITCA (*Método de Implementación de Tareas para Casa*; Homework Implementation Method) method (Valle and Rodríguez, 2020) demands the tasks assigned as homework to be perceived by the student as interesting, valuable and/or useful as well as having a concrete purpose.

The present study aims to examine the effectiveness of the implementation of MITCA method in 24 different classrooms of 5th and 6th graders. Specifically, the study aims to investigate the contribution of MITCA on students' self-regulated learning, planning and time management. For this purpose, teachers were trained on how to implement MITCA in their classrooms and an intervention study with an experimental and control group and pre-post design was carried out.

Homework and self-regulation of learning

Homework is usually assigned for a specific purpose. Many teachers assign homework because they believe that homework improves academic performance (Cooper, 1989), increases students' motivation and ability to self-regulate their learning processes (Hoover-Dempsey et al., 2001; Rosário et al., 2009; Warton, 2001), and contributes to a positive school-family relationship (Epstein & Van Voorhis, 2001; Hill & Taylor, 2004; Trautwein et al., 2009). However, the attitude towards homework, and even school engagement itself may be negatively affected and students may fail to perceive the intention and long-term benefits of doing homework; ultimately, students may complete their homework only to gain some reward or to avoid punishment (Cooper & Nye, 1994; Coutts, 2004). Likewise, homework can cause anxiety in the student and even anger or boredom (Liu et al., 2017, 2019; Xu, 2016) when, for example, an excessive amount of homework is set or the perceived difficulty is high.

In recent years, the practice of assigning a large volume of homework to students in Spain has been widely criticized. This practice is common, whereby homework is assigned as tasks to be completed outside of school, including assignments that are not completed in class and exercises that are typically due within a day or two.

Acknowledging how interesting, valuable and/or useful this kind homework is in the classroom, is a key factor to engagement at home. Further, and although the research is still open, previous work has highlighted the central role of time management in completing homework assignments and in explaining academic performance (e.g., Núñez et al., 2015; Xu et al., 2014; Xu, 2022b) opening the discussion on the relevance of self-regulation skills in homework completion. Time management is recognized as a significant aspect of academic self-regulation, as emphasized by various researchers (Corno, 2004; Pintrich, 2004; Zimmerman, 2008). Pintrich (2004) has categorized self-regulation into four phases (forethought, monitoring, control, and reflection), with each phase comprising four areas for self-regulation (cognition, motivation, behavior, and context). Within this framework, time management is conceptualized as a crucial aspect of behavior for self-regulation, involving planning, monitoring, and regulating the use of time, such as creating study schedules and allocating time for different learning activities. Xu et al. (2014) conducted a study using multilevel models to examine homework time management, and their findings revealed that at the student level, time management was positively correlated with monitoring motivation, arranging the study environment, peer and learning-oriented reasons for doing homework, and family homework help.

Previous reviews (e.g., meta-analyses, such as Cooper, 1989; Cooper et al., 2006; Cooper & Valentine, 2001; Walberg, 1991) provided evidence for a positive relationship between homework time and achievement, while other studies found a weak or even negative relationship (e.g., De Jong, et al., 2000; Tam, 2009; Tam, 2009; Trautwein, 2007; Trautwein et al., 2002, 2009; Walberg, 1991). Students who manage time well are more likely to get better grades (Claessens et al., 2007; Kitsantas et al., 2008; Macan et al., 1990; Panadero and Tapia, 2014). In the study by Valle et al. (2017), it was found that indeed spending more hours on homework could be evidence of both high dedication and commitment but also that students have difficulties doing their homework.

Xu (2007, 2010), one of the first authors who studied the relationship between homework time and the use of management strategies while doing homework, suggests that spending more time on homework is not necessarily associated with efficient strategic management at home but may be indicative of the use of maladaptive self-regulatory strategies (see also Rosário et al., 2009, 2013; Trautwein et al., 2009).

It is assumed that, beyond the time that each student spends doing homework (Regueiro, 2018; Regueiro et al., 2014; Rodríguez et al., 2019; Rosário et al., 2018; Trautwein, 2007; Valle et al., 2017), and even beyond the amount of homework that is assigned, the relevance of homework would be in the value and quality of the homework and in the effective management of the pupil's time at home (Núñez et al., 2015, 2019; Valle et al., 2015). In other words, the key to assessing the quality of homework will be the students' time management at home, together with other variables that fall within the self-regulation of learning; students' abilities to seek and learn information, manage the study environment, and also maladaptive regulatory behavior (self-regulatory deficit).

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Different researchers have speculated on the possibilities of homework task assignments in promoting self-regulatory processes and self-beliefs, including goal setting, time management, environmental management, sustained attention and self-efficacy (Pintrich, 2000; Trautwein & Köller, 2003). A longitudinal study with 5th-grade students indicated that homework promotes self-regulation skills and reading achievement (Xu et al., 2010). It has been also found that high-achieving students (compared with low-achieving students) were more likely to arrange their environment, manage time, handle distractions, monitor motivation, and control negative emotions during homework (Yang & Menglu, 2020). In their recent study, Corno and Xu (2022a, b) used a person-centered approach to study more variables related to self-regulation such as environment and time management, motivation and emotion regulation, cognitively reappraising information, and handling both conventional and technological distractions. They identified five distinct profiles that could be labeled: High Across All Strategies, Moderate Across All Strategies, Low Across All Strategies, Low Except for Handling Distractions, and Low Handling Distractions. Students who profiled high across all strategies outperformed the other groups on these outcome variables.

It is also worth noting that so far we are not aware of any specific studies that have addressed the relationship between homework prescription and self-regulation of learning directly. Homework prescription refers to the teacher's work when indicating which tasks must be completed at home and under what conditions (time, correction, consequences, etc.). In other words, it is the instructions provided by teachers when indicating and establishing which tasks students must complete outside of school hours.

The Homework Implementation Method (MITCA) (Valle & Rodriguez, 2020) assumes that it is students who must complete homework independently by implementing self-regulation skills related to planning, inhibiting distractions, persisting with difficult tasks, organizing their environment, overcoming unwanted emotions, and reflecting on what they have learned (Boekaerts & Corno, 2005; Xu, 2008). Homework has been considered a classic resource for promoting self-regulation of learning (Rodríguez et al., 2021; Trautwein & Köller, 2003). Thus, completing homework can improve children's aptitude towards academic work through additional practice and foster their ability to take responsibility for regulating their academic behavior and performance (Corno, 2000).

MITCA Method: A homework intervention proposal

Traditional homework is often seen by students as a boring routine and an unattractive activity and their attitudes towards it tend to become more negative as students progress through school (Bryan & Nelson, 1994; Chen & Stevenson, 1989; Cooper et al., 1998; Warton, 2001; Xu, 2004). This lack of perceived usefulness, together with the traditional low quality of homework, may at times be seen as a powerful tool that can cause significant harm to students and their education (Hong et al., 2004). We define traditional homework as the homework assigned to students for the simple purpose of practising or studying the content explained during school hours. In many cases, a large amount of homework is assigned daily that does not activate students' curiosity or increase their motivation, and frequently it is not sufficiently valued by teachers.

Rodríguez et al. (2021) propose that homework should be approached as an opportunity for active and constructive learning, where students set goals based on the teaching assignment and attempt to plan, monitor, and regulate their cognition, motivation and behavior.

This requires students to direct themselves towards these goals while considering the demands and conditions of the working environment at home.

In this context, the MITCA method, which was born to turn homework into an educational resource capable of improving, among other aspects, the self-regulation of learning, proposes that homework should: (a) be understood by students as instrumental, interesting and valuable for their progress, (b) have a clear purpose and be sensitive to the diversity of students, (c) help students to self-evaluate their strengths and weaknesses, and (d) contribute to improving planning and management of time devoted to homework.

Accordingly, the MITCA method we designed for homework prescription is summarized by five conditions: Varied, Specific, Worthwhile, Weekly, and Evaluated.

Varied: Homework should be diverse and include both post-topic (after explaining the contents in the classroom) and pre-topic tasks (before explaining the content in the classroom in order to find out the students' prior knowledge and motivate them to learn) with similar amounts of revision, organization, and production tasks. Based on a significant body of empirical research over the last ten years about the impact of cognitive strategies on encouraging learning and understanding (for example, see Dunlosky et al., 2013; Fiorella & Mayer, 2015; Novak, 2010; Sweller et al., 2011, among others), the assumption underlying MITCA is that homework should encourage more active, constructive, and interactive involvement than happens routinely.

Specific: Based on the conditions developed for setting learning goals by McCardle et al. (2016), MITCA reminds teachers to define homework assignments in terms of cognitive operations and content. Significant learning, as outlined by Mayer (1988, 1996, 2014), involves three core cognitive processes: (a) selecting the most important information (e.g., highlighting, summarizing); (b) organizing this information into a coherent mental structure that aligns with the learning material's underlying structure (e.g., categorizing and sequencing ideas); and (c) integrating the newly constructed representation into existing knowledge (e.g., explaining concepts or making persuasive arguments).

Worthwhile: The teacher communicates the usefulness, interest, importance, and/or applicability of homework s/he sets. The task value of homework is a complex construct including the level of enjoyment produced, the extent to which it contributes to meeting individual needs and personal fulfilment, and its usefulness in achieving personal short- and long-term goals (Eccles & Wigfield, 2002). There is little doubt that intrinsic interest in tasks predicts deep processing of information and encourages more self-regulated learning (Hidi & Renninger, 2006).

Weekly: Doing schoolwork tasks at home means students need to be able to organize their environment, plan and manage their time, concentrate their attention and control their motivation and emotions (Corno, 2004; Xu, 2010; Xu & Corno, 2003). Homework tasks are set weekly and the students establish the timeslots in which to do them.

Evaluated: Homework is marked/corrected weekly, in the classroom or individually, indicating weak areas and strengths (Cunha et al., 2018; Elawar & Corno, 1985; Núñez et al., 2015).

The MITCA method was developed under the conceptual umbrella of self-regulated learning, with the understanding of homework as a learning episode consisting of a preparation phase, a work phase and a final reflection phase. According to the models of self-regulation first developed by Zimmerman and colleagues (Schunk & Zimmerman, 1998; Winne & Hadwin, 1998; Zimmerman, 2000), the preparation phase includes those processes that precede actually doing the homework tasks; the work phase includes the processes related to actually doing the tasks; and the reflection phase occurs once the homework tasks are completed, directly influencing subsequent cycles or episodes.

Using these self-regulation models as a framework, the MITCA method aims to optimize the preparation phase of learning, which encompasses all the processes that are undertaken before any learning activity. The key components of the preparation phase include the definition of the task (what are we going to do?), setting objectives (how will we do it?), and planning the activity (when will we do it?). By incorporating these components, the MITCA method provides a comprehensive approach to homework assignments that promotes students' self-regulated learning and school engagement.

The present study

In order to test the effectiveness of the MITCA method on students' self-regulation skills, an intervention study with the use of a control group that continued to work with the traditional homework was implemented in the two last years of Primary School students. The experimental group included classrooms where MITCA was implemented by a group of trained teachers. More specifically, the incidence of using the MITCA method for 12 school weeks was tested on (i) information seeking and help management skills, (ii) environment management, (iii) time management and (iv) on reducing the impact of self-regulation deficits in the specific age group.

MITCA Method and Theoretical Foundation. The concrete demands of the MITCA method, as derived from the specific task condition, are expected to channel students' efforts towards more strategic learning, as suggested by previous research (McCardle et al., 2016).

The promotion of time and study environment management skills, as well as strategic information-help management, could be linked to the perceived usefulness, instrumentality, and benefits of the prescribed tasks, which are central to the valuable task status of the MITCA method. This connection is supported by well-known theoretical developments in the field (Renninger & Hidi, 2002; Renninger et al., 2004; Hidi & Renninger, 2006).

Feedback and Self-Evaluation in MITCA. Assuming prior research integrates feedback that combines criticism and praise for controllable aspects, MITCA's corrected tasks can promote self-evaluation and potentially improve learning. This approach may also boost student motivation, as studies on motivational theories suggest (Deci & Ryan, 2016; Fong et al., 2019).

Weekly Task Condition and Self-Regulatory Skills. Without discounting the impact of the specific task condition or the situational value effect triggered by the valuable task condition in the MITCA prescription, we acknowledge that the weekly task condition, which explicitly involves the individual setting of specific homework time intervals, can facilitate learning planning, time management, and potentially mitigate self-regulatory deficits. This is supported by previous studies (Liu et al., 2009; MacCann et al., 2012; McCardle et al., 2016; Zimmerman, 2008) on the benefits of structured homework assignments for enhancing students' self-regulatory skills.

Comparison with Traditional Homework. In this sense, it is hypothesized that the experimental group, which receives the MITCA method as the homework prescription, will exhibit significant differences compared to the control group, which continues with a traditional homework prescription. Traditional homework can be described as repetitive assignments or exercises that are not completed during school hours, but are instead done at home. This type of homework may also involve reviewing content already covered in class.

Our exploratory hypotheses were set as follows: (1) students in the experimental group were expected to improve their information-seeking and help management skills since they perform a variety of tasks and know the cognitive operation required to perform them during the intervention (Dunlosky et al., 2013; Fiorella and Mayer, 2015; Novak, 2010; Sweller et al., 2011). (2) Students in the experimental group, compared to those in the control group, were expected to better manage their environment and time because the MITCA method establishes a weekly assignment that forces students to set goals and estimate the time to complete tasks (Liu et al., 2009; MacCann et al., 2012; McCardle et al., 2016; Zimmerman, 2008). (3) The MITCA intervention was expected to decrease, or at least not to increase, the self-regulation deficits of the experimental group given that with MITCA the value of the tasks is explained and the teachers provide informative and motivating feedback (Deci & Ryan, 2016; Fong et al., 2019).

Method

Sample and procedure

The sample consisted of 43 teachers from 5 and 6th grades (23 from 5th and 20 from 6th grade) and 964 students aged between 10 and 12 years attending 5th and 6th grade (469 boys and 495 girls). These participants were selected from 20 primary education schools located in the Autonomous Community of Galicia. The participants were then divided into two groups: a control and a experimental group.

The division was dependent on the teachers' willingness and availability to engage in the study after a call for participation to the study. Those who volunteered to undergo training as per the MITCA method parameters formed the experimental group. In contrast, those who opted to adhere to conventional teaching methodologies constituted the control group. Given the impossibility of working with the entire population of teachers and schools, convenience sample was used. The sample was selected through different routes; through contacts with different schools and teachers in Galicia, through the official social networks of the Regional Ministry of Education and through the network of the research group. Initially, information about the study and MITCA was sent to interested teachers who were invited either to implement the method or to participate in the control group.

The control group of teachers was asked to continue assigning the traditional homework without incorporating any changes to their usual practice during the twelve weeks of the method implementation. The experimental group of teachers was asked to modify the way they used to assign homework to their students following the MITCA principles.

To elaborate, the selection procedure for the control group teachers at every school was influenced by their availability during the time of data acquisition, concerning both teaching staff and students. Conversely, the selection of teachers for the experimental group was predominantly determined by their readiness to participate in the study.

Control condition A group of teachers with their respective pupils who assign and perform homework based on their personal knowledge, beliefs and experience without prior training. The control group consisted of 19 teachers (11 teaching 5th graders and 8 teaching 6th graders) and 431 students (263 from 5th graders and 168 from 6th graders).

Experimental condition A group of teachers with their respective pupils who assign and perform homework following the characteristics of the MITCA method, with previous training in this method and weekly follow-ups by the researchers. Their training included a series of twelve-week workshops to familiarize and train them with the principles of the MITCA Method. To ensure consistent progress, we implemented weekly online monitoring to track task completion and corrections. Additionally, we organized a training seminar to gather feedback from those who used the MITCA method.

As explained in the introduction, the MITCA method has been designed based on previous studies (Cooper et al., 2006; Cunha et al., 2018; Eccles & Wigfield, 2002; McCardle et al., 2016; Xu, 2010) setting out five principles to guide its implementation (Varied, Specific, Worthwhile, Weekly, and Evaluated tasks). The experimental group consisted of 24 teachers (12 teaching 5th graders and 12 teaching 6th graders) and a total of 533 students (271 5th graders and 262 6th graders).

Demographic measures, such as gender, grade, classroom, and school, along with measures of self-regulation skills, are collected both before and after the intervention (pre-test and post-test).

Pilot study

Firstly, during the 2018/19 academic year, a pilot study was conducted with 284 students to initially test the effectiveness of MITCA and to include possible necessary implementation modifications. The results were compared with a total of 432 control students. No changes were made to the theoretical principles of the method after the pilot study. However, modifications were required in the teacher training program and support during the twelve-week implementation of MITCA. The implementation lasted twelve weeks due to the academic year being divided into three terms in Spain, with each term serving as a single assessment period. This sequencing allowed for uninterrupted application of the method, without being affected by school holidays.

The method was applied to compulsory school subjects because they are taught more hours of classes per week. These subjects included Spanish language, Galician language, and mathematics, all of which are core school subjects in the Galician curriculum. Teachers could choose one or two subjects to implement the method, and the implementation was carried out in the same way with no differences between the subjects. Understanding homework performance as a learning episode, the MITCA method introduces the tasks' characteristics that are prescribed, the frequency of assignment and the type of correction.

Following the pilot study, in which homework correction was urged to be done every Monday, in the final study, teachers were given more flexibility to choose the day of correction as long as it was done after one week. The training sessions and follow-up support from the teachers were more rigorous and continuous, with greater support from the research group.

MITCA implementation

The implementation process began in the 2019/20 academic year, with initial training seminars for the teachers of the experimental group so that all the necessary guidelines and

principles of the homework assignment following the MITCA Method to be explained and taught (Valle & Rodríguez, 2020).

It is worth mentioning that in the middle of the intervention (six weeks after starting the implementation of the method) a "reinforcement" day was organized for the teachers of the experimental group. The main objectives of this meeting were, on the one hand, to know the teachers' perspective on the suitability of the MITCA Method in their teaching practice. In other words, to explore how the method was articulated in their habits, routines and particular characteristics. And, on the other hand, to resolve any implementation doubts and concerns on behalf of the teachers.

In order to monitor the development of the assignment of the tasks and provide feedback to the teachers during the twelve weeks of implementation, individualized online monitoring was carried out separately for each teacher. Teachers had been asked to send (i) a report card with the homework they had designed, indicating the type of task (revision, organization, and production tasks) and its value (usefulness, interest, importance, and/or applicability of homework), and (ii) the homework correction document from the previous week, specifying the type of feedback they had provided to their students. The implementation of the homework assignment was supervised by contacting teachers weekly to learn about the intervention development and resolve any potential problems or doubts during MITCA implementation.

In addition, a weekly online monitoring checked the completion of the tasks and their correction.

In addition, all dependent variables related to self-regulation of learning were measured in all class groups before (pre-test) and after the intervention (post-test).

The data referring to the variables under study were collected during school hours by research collaborators. Informed consent was obtained from the school management team and the students' families. That is, the pre-test questionnaire was provided to the students before implementing the MITCA method in the classrooms of the experimental group and the control group, and the same questionnaire was provided to the students of the control group and the experimental group after the twelve weeks of MITCA intervention. The choice of classrooms for the control group in each school was made according to the availability of both teachers and students at the time of data collection. The variables relating to homework were obtained in the 2020–2021 academic year.

Measures

Two levels were assigned to the independent variable (homework assignment) in this study: homework assignment using the MITCA method (Experimental Group, EG), and homework assignment in traditional format (Control Group, CG). The dependent variables (self-regulation strategies) were (1) information-seeking and help management skills, (2) time management, (3) environment management, and (4) deficits in self-regulation.

To evaluate *self-regulation strategies, we used Cleary's Self-regulation Strategy Inventory* (2006), which allowed us to differentiate initially between students' strategies to seek and manage information, manage time, and study environment, and also to measure specific deficits in self-regulation. The measure utilized a five-point Likert scale ranging from one (almost never) to five (almost always).

Exploratory Factor Analysis (EFA) was conducted with varimax rotation. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was 0.861/0.865 with a Bartlett's

test of 2065/2465 ($p < 0.001$) for the pre-test and post-test, respectively. The factor structure for the sample of this study replicated the original dimensions (a) *Information seeking and help management skills*, six items (example items: "I ask my teacher about the topics that will be on upcoming tests", "I try to see how my notes from class relate to things I already know", and "I try to identify the format of upcoming science tests"; ($\alpha = 0.70$ / $\alpha = 0.74$)and (b) *Deficit in self-regulation*, five items (example items: "I lose notes or important study materials", "I give up or quit when I do not understand something, and "I forget to take home things I need to study"; ($\alpha = 0.69$ / $\alpha = 0.73$). Cleary (2006) identifies the variables environment management and time management as a single variable but the factor analysis on the dataset of the present study suggested two separate scales for time management and environmental management. Thus, we were able to discern between items measuring students' arrangement of physical environment and organization of study materials, (c) *Environment management*, three items (example items: "I try to study in a quiet place", "I try to study in a place that has no distractions—e.g. noise, people talking"; and "I make sure that no one disturbs me when I study"; $\alpha = 0.76$ / $\alpha = 0.81$) and (d) *Time management*, five items (example items: "I make a timetable to help me organize my study time", "I think about the best way to study before I start studying", and "I use folders or binders to organize my science study materials"; $\alpha = 0.66$ / $\alpha = 0.68$).

Data analysis

In addition to the descriptive analyses of the variables, factorial and reliability analyses, correlations, mean differences (*t*-test) for independent samples (CG vs. MITCA) and paired samples were performed on the data. In all cases, self-regulation strategies for learning were examined as the dependent variables (*information and help management, environment management, time management and self-regulation deficit*). Data analysis was performed using SPSS software version 24.0.

Results

Pearson correlation indicated significant correlations between the pre-test and post-test measures for information-seeking and help management skills ($r = 0.53$), environmental management ($r = 0.47$), time management ($r = 0.54$), and self-regulation deficits ($r = 0.46$). Similarly, significant positive correlations were found between information and help management and environmental management ($r = 0.47$ / $r = 0.35$) and time management ($r = 0.54$ / $r = 0.37$) for both pre-and post-measures, respectively. Test–retest reliability is moderate and significant ($p < 0.001$) (information-seeking and help management skills ICC = 0.70, environmental management ICC = 0.64, time management ICC = 0.70 and self-regulation deficit ICC = 0.63).

Table 1 reports the descriptives for the self-regulation variables in the pre- and post-measures.

As Table 2 shows, different self-regulation strategies have been significantly correlated to each other in both study phases with self-regulation deficits being negatively correlated to all other strategies.

Table 1 Descriptive statistics of the variables of self-regulation of learning

	MEAN PRE/POST	STANDARD DEVIATION PRE/POST	SKEWNESS PRE/POST	KURTOSIS PRE/POST
BEHAVIORAL AND TIME MANAGEMENT	3.50/3.53	.88/.91	-.31/-.35	-.42/-.49
ENVIRONMENTAL MANAGEMENT	4.20/4.12	.87/.97	-1.29/-1.14	1.39/.60
SELF-REGULATORY DEFICIT	1.83/1.91	.73/.79	1.04/0.99	.74/.66
INFORMATION SEEKING AND MANAGEMENT SKILLS	3.74/3.80	.79/.82	-.64/-.58	.28/.00

In order to test the incidence of the MITCA method on students' self-regulation strategies, first t-test for independent samples was applied on the data of the experimental and control group twice, one on the pre-test data and one on the post-test. As for the pre-test, the two groups were found not to significantly differ in behavioral and time management ($t=-0.646$; $p=0.518$), environment management ($t=-1.594$; $p=0.111$) and self-regulatory deficits ($t=-1.165$; $p=0.244$) except for information seeking and help management skills (t$=-2.104$, p<0.05, $d=0.14$) which was higher for the control group. Following the hypotheses of the study, significant differences between the two groups in the post-test were found in behavioral and time management ($t=2.245$, $p<0.05$, $d=0.15$), environment management ($t=3.243$, $p<0.01$, $d=0.22$) and self-regulatory deficit ($t=-2.557$, $p<0.05$, $d=0.17$) in favor of the experimental group (see Fig. 1). The hypothesised difference in information seeking and help management skills between the two groups was not confirmed. As already referred above, an initial significant difference in favour of the control group had been found in information seeking and help management skills, (t$=2.104$, p<0.05, $d=0.14$).

Next, as can be observed in Fig. 2, the means for the control group are lower for the measures of information-seeking and help management skills ($t=2.05$, $p<0.05$), environmental management ($t=3.522$, $p<0.001$) and behavioral and time management ($t=2.235$, $p<0.05$) after twelve weeks. Conversely, they are higher for the measure of self-regulatory deficit ($t=-2,478$, $p<0.05$) after twelve weeks.

Table 2 Bivariate correlations among the self-regulation strategies in the pre-and post-test phase

	1	2	3	4	5	6	7
1. Information seeking and help management skills (PRE)	.536**	.475**	-.258**	.527**	.369**	.349**	-.203**
2. Behavioral and time management (PRE)		.451**	-.260**	.373**	.541**	.365**	-.243**
3. Environmental management (PRE)			-.420**	.314**	.315**	.473**	-.298**
4. Self-regulatory deficit (PRE)				-.291**	-.275**	-.360**	.462**
5. Information seeking and help management skills (POST)					.586**	.541**	-.293**
6. Behavioral and time management (POST)						.490**	-.274**
7. Environmental management (POST)							-.416**

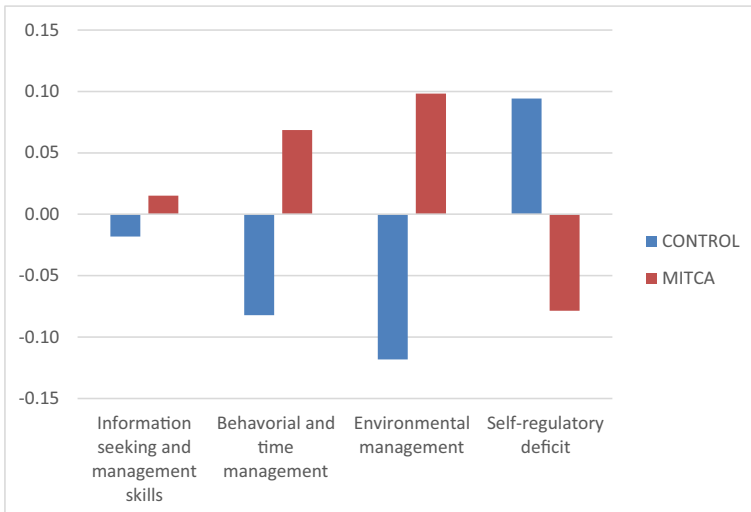**Correlation is significant at the 0.01 level

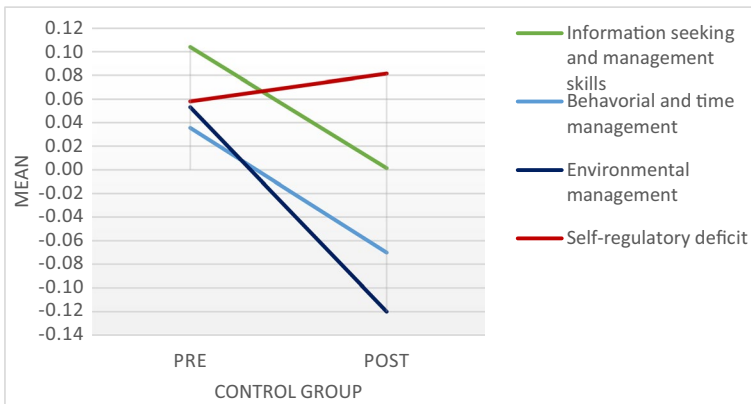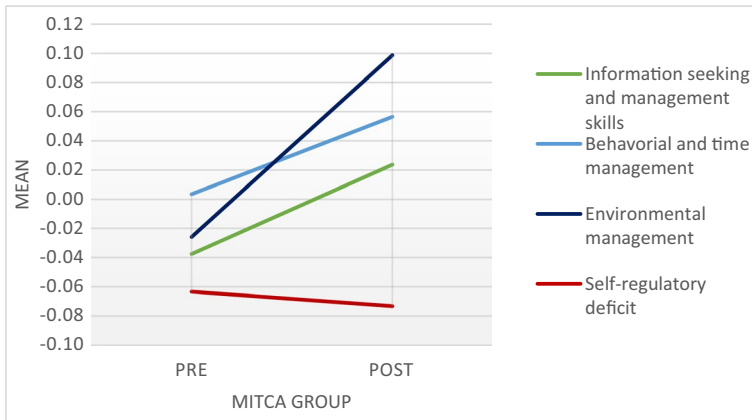**Fig. 1** Post differences in self-regulation of learning

Fig. 2 Pre-post control group differences in self-regulation of learning

Although, as can be seen in Fig. 3, the means are higher for information seeking and time management, and are lower for self-reglation defictis for the experimental group, in which the MITCA method was implemented, significant differences have only been found for environmental management ($t=-2.77, p<0.001$).

Fig. 3 Pre-post MITCA group differences in self-regulation of learning

Discussion

Assuming the potential incedence of an appropriate homework assignment on students' self-regulation processes and skills (Pintrich, 2000; Trautwein & Köller, 2003), the present study was designed to evaluate the effectiveness of the MITCA method (Valle and Rodríguez, 2020). Overall, the results of the study are in line with previous literature regarding the usefulness of homework as a tool for improving self-regulated learning (Jansen et al., 2019; Theobald, 2021). Given previous research that self-regulation, when developed in school years, does not only predict academic performance, but it is also associated with the quality of personal relationships, well-being, behavioral disorders and mental health (Pandey et al., 2018; Robson et al., 2020; Rodríguez et al., 2022), then the significance of quality homework is extended to other fields, as well.

Specifically, the results of the study support the first hypothesis. As expected, students in the experimental group improved their information seeking and help management skills since they performed a variety of tasks and learned the cognitive operation required to perform them during the intervention (Dunlosky et al., 2013; Fiorella and Mayer, 2015; Novak, 2010; Sweller et al., 2011), indicating that after 12 weeks of implementing MITCA, students in the experimental group improved their strategies to organize their study environment and complete homework under better conditions.

Participants reported that they succeeded in not being disturbed during the study (e.g., they sought a quiet place, free of noise and distractions) to a greater extent than students in the control group. Moreover, EG students, compared to CG students, reported higher skills to manage their homework time, and reduced deficits in self-regulation which are usually observed in traditional homework settings. In addition to increasing the amount of homework that would eventually be completed and possibly improving the quality of homework completion (Xu, 2022a), this provision for active environmental control would optimize the self-management effort involved in studying (Dent & Koenka, 2016; Gebauer et al., 2019) and would be conducive to learning by increasing the chances of concentration during homework (Lens et al., 2008; Pintrich, 2000).

Planning control of the environment, trying to avoid possible distractions and promoting an optimal working climate, could be linked to valuing the usefulness, instrumentality and

benefits of the tasks that are prescribed. MITCA includes a specific step for acknowledging the value, usefulness, and instrumentality of homework (Worthwhile Tasks-STEP 3 of the MITCA method). Assigning some recognition or instrumental value to the homework tasks would enhance students' motivation to cope with task requirements (Chi, 2009, Chi & Wylie, 2014; Eccles et al., 1998; Eccles & Wigfield, 2002; Fredricks et al., 2004) and, in general, their cognitive and emotional engagement with these tasks (Katz & Assor, 2006; Miller & Brickman, 2004).

The intention to maintain strategic management of study information reported by MITCA students after the twelve weeks could be associated with this initial situational interest in homework which is also attributed to the varied tasks prerequisite of the method (*Varied Tasks*- STEP 1 of the MITCA method). This strategic commitment to study and learning would be further supported by the specific tasks condition of the method (*Specific Tasks*- STEP 2 of the MITCA method). Defining the homework tasks in terms of cognitive operation channels students' attention to the learning process, the strategies to adopt and the relevant parts of the study material (McCardle et al., 2016).

Moreover, MITCA students reported better organization of their study time: they make schedules, plan the best way to study before starting, and finish study tasks before doing other things. This finding confirms the second hypothesis, according to which students in the experimental group were expected to better manage their environment and time because the MITCA method establishes a weekly assignment that supports students in setting goals and estimating the time to complete tasks (Liu et al., 2009; MacCann et al., 2012; McCardle et al., 2016; Zimmerman, 2008).

There is ample empirical evidence suggesting that prioritizing tasks, organizing time, and planning work in general decrease stress and increase perceived control and emotional well-being (Aeon et al., 2021; Häfner & Stock, 2010). On the contrary, poor time management (i.e., unsuccessful time allocation to the tasks, studying massively before exams or missing deadlines, etc.) has been found to be an important source of stress in the academic environment and is associated with poor performance (Longman & Atkinson, 2004).

Without ruling out the incidence on time management of the specific tasks or the situational value that is triggered, the improvement in the planning and distribution of time that differentiates the control from the experimental group could be also linked to the weekly assignment advocated by the MITCA method (*Weekly Tasks*- STEP 4 of the MITCA method). The weekly task assignment that explicitly includes the individual setting of specific time slots for homework facilitates goal setting, time keeping and time allocation. All these aspects have been considered critical to both individual academic performance and well-being by previous research (Liu et al., 2009; MacCann et al., 2012).

Based on the theoretical framework of self-regulated learning underlying MITCA (Schunk & Zimmerman, 1998; Winne & Hadwin, 1998; Zimmerman, 2000), the weekly assignment would increase the number and/or type of strategies to be implemented as a function of the tasks, the opportunities to monitor progress and observe potential difficulties; as well as the possibilities for task revision (McCardle et al., 2016; Zimmerman, 2008). Meanwhile, the type of correction proposed should favor self-assessment and therefore, potentially to the improvement of both current learning and future learning episodes. It should also be noted that feedback that includes both criticism and praise aimed at aspects that can be controlled, such as effort or dedication, -motivating feedback- and that complements the Evaluated Tasks condition (*Evaluated Tasks*- STEP 5 of the MITCA method), would enhance the benefits of this reflective phase and contribute to students' motivational engagement (Deci & Ryan, 2016; Fong et al., 2019).

In the same line, the MITCA method may help students dampen the tendency to show self-regulatory deficits which were observed in the control group over the twelve weeks. Indeed, in the post-test measure, the control group reported significantly more shirking their academic obligations, losing notes or materials needed to study, waiting until the last minute to do homework or giving up, to a greater extent than in the pre-test measure. This tendency was not observed among the students who participated in MITCA as the reports for the self-regualtory deficits remained at the same level. This finding confirms our third hypothesis, according to which the MITCA intervention was expected to decrease, or at least not to increase, the self-regulation deficits of the experimental group given that the value of the tasks is explained with MITCA and the teachers provide informative and motivating feedback (Deci & Ryan, 2016; Fong et al., 2019).

This finding may suggest that the weekly homework condition, together with the individual correction (informative feedback), could be promoting metacognition around learning. Thus, the students may become more knowledgeable about their strengths and weaknesses in dealing with the tasks and are more aware of their skills through motivating and informative feedback.

Additionally, the presented results of this study make a significant contribution to the current literature on self-regulated learning by demonstrating the effectiveness of the MITCA method. The findings show that implementing the MITCA method, which involves assigning concrete and valued homework tasks, can improve time and environmental management in fifth and sixth-grade students. This is particularly important because these two aspects of self-regulation are crucial for academic success Claessens et al., 2007; Eilam & Aharon, 2003; Wolters & Brady, 2021). Moreover, as the MITCA method requires training teachers to prescribe homework in accordance with the framework of self-regulated learning, it can serve as a valuable tool for improving students' self-regulated learning. Overall, these contributions provide valuable insights into effective methods for promoting self-regulated learning in students, which are significant for the self-regulation literature.

In summary, although more data are required, the Homework Implementation Method (MITCA) could be seen as a promising alternative for quality homework. It establishes three characteristics for the tasks to be prescribed (Varied, Specific and Worthwhile Tasks), the frequency of assignment (Weekly) and the type of correction (Evaluated). Diversifying the tasks prescribed in the classroom and highlighting their usefulness and benefits would predispose the learners to commit themselves to homework. This commitment may be expressed by managing home environment (e.g., trying to avoid possible distractions), seeking and managing learning information, and in general, limiting procrastination or giving up homework in the face of difficulty (Katz & Assor, 2006; Miller & Brickman, 2004). Further, an explicit description of the homework content and the cognitive operations required for homework could also be helpful for information management (McCardle et al., 2016). In addition to limiting self-regulatory deficits, the weekly assignment of homework, where the student establishes the time slots for its completion at home, would contribute to the awareness of the use of time and its organization. Finally, individual correction incorporating informative and motivational feedback could dampen the tendency to shirk obligations, procrastinate, or abandon homework in the face of difficulties by promoting the controllability of the learning process by the person. Moreover, taken into account that MITCA was implemented during COVID-19, a challenging period that posed high demands for self-regulation skills on behalf of the students during the school closure, MITCA students were better equipped than control students to respond to the self-regulation challenges during this period of time.

Conclusion and study limitations

Homework may have multiple benefits for students, both academic and non-academic, in the short and long term, including comprehension and mastery, the acquisition of study habits and the development of self-discipline (Cooper, et al., 2006; Núñez et al., 2021; Patall et al., 2008; Walker et al., 2004). However, depending on its qualitative characteristics, homework may also be associated with significant disadvantages for students such as loss of interest in schoolwork, lack of time for leisure activities or an increase in the gap between high and low achievers. For this reason, there is a growing need to assign 'quality' homework, i.e. homework that promotes the positive outcomes of homework and reduces the negative ones.

The Homework Implementation Method (MITCA) aims to improve the quality of homework assignments in order to increase student engagement in their homework and improve self-regulation of learning. In turn, MITCA may improve academic performance, increase the perceived usefulness of homework and have a positive impact on comprehension and learning. Overall, the present study suggests that, if educators prescribe homework following MITCA's premises and guidelines, students will be better supported to improve their self-regulatory skills, especially those related to environmental management.

MITCA is not a traditional homework assignment, but a theory- and evidence-based tool specifically designed to promote self-regulatory strategies in student work that responds to the needs for quality homework (Tristán et al., 2021). A novel perspective is offered for homework design through which the use of self-regulatory strategies is stimulated even from elementary school. The student, and ultimately the individual, will be able to integrate these self-regulatory skills from an early age, and these skills and strategies may be transversal beyond academics.

Previous studies such as Núñez et al. (2015) already suggested the need to rethink educational practices in the classroom to promote and maintain both student self-regulation and school engagement throughout the different educational stages. Improving the homework process is a step towards this direction.

The present study is not without limitations. First, it is an intervention study that has collected only post-test data without a follow-up study. It should be emphasized that the study took place after the lockdown of schools due to COVID-19. Despite the goodwill of teachers to continue implementing MITCA, conducting school-based studies and collecting data from students onsite during the pandemic was a very challenging task. Future studies should adopt a longitudinal design, which for the context of the present study would mean closer collaboration with schools, teachers, principals and parents. MITCA implementation should continue beyond this field intervention study and longitudinal data should be gathered. This would allow us to test the retention of the student benefits to the following educational levels (e.g., secondary school) as well as the potential transfer of the research to society and, in particular, to the educational sphere.

Second, the sample of the study was a convenience sample, not representative of the autonomous community of Galicia. Teachers and schools were selected via an open call invitation. Third, all the variables under examination were assessed using student self-reports. Other types of data such as observational data and performance indices could further clarify and support the findings of the study.

Fourth, all MITCA conditions must be addressed simultaneously, which means that all conditions should be considered when prescribing homework tasks. However, to further understand the important contribution of each MITCA condition, the research group

is planning to separately investigate each condition as well as the two-by-two combination of MITCA variables. Although previous literature has explored the contribution of the MITCA conditions, future work will empirically test the relative effectiveness of each condition. We envision designing and validating at least one condition for various types of tasks and specific assignments, as well as for valuable and corrected tasks. This quasi-experimental design will include multiple experimental groups combining the MITCA conditions in pairs.

Finally, recognizing that the successful completion of homework presupposes students' commitment and the potential utilization of self-regulatory skills, the results of the present study indicate that homework can be perceived as an educational tool that may contribute to the cultivation of self-regulation.

Data availability Databases could be made available for research purposes if necessary.

Declarations

Conflicts of interest The authors declare no conflict of interest.

Informed consent statement Informed consent was obtained from all subjects involved in the study.

Institutional review board statement The study was conducted according to the guidelines of the Declaration of Helsinki, and the Ethics Committee of the University of A Coruña, as this is research involving human participants.

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