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# Learning analytics and Flipped Learning in online teaching for supporting preservice teachers' learning of quantitative research methods

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# Abstract

Research methods, including those of a quantitative nature, are an important part of preservice teacher training in Finland. However, quantitative research methods are considered challenging, often feared, and even hated among preservice teachers. This may be due to previous negative experiences and emotions associated with their use, which also influence other aspects of learning such as self-regulation, self-efficacy, and orientations. Given such circumstances, new ways to teach and support the learning of quantitative methods are needed. Here, we investigate the self-regulation, self-efficacy, orientations, and emotions of preservice teachers (N = 38) enrolled in a quantitative methods online course incorporating learning analytics and a flipped learning approach. Dispositional learning analytics data from five measurement points were used, and data were analyzed via descriptive statistics, internal consistency (Cronbach alpha), bootstrapped paired sample t-test (between first and final measurement point), and profiles based on mean. The results demonstrate that in this teaching context, preservice teachers' time management skills can be improved, and task avoidance, anxiety, and boredom towards quantitative methods decreased. The meaning of these results from the teaching context perspective are also examined, as are the limitations and implications of this study.

**Keywords:** Research methods, Quantitative methods, Preservice teacher, Learning analytics, Flipped Learning, Online teaching

# Introduction

Preservice teacher training (e.g., as a special education teacher or classroom teacher) takes approximately five years in Finland. Generally, teaching as a profession is highly valued among young Finnish people; in the year 2021, 26.1% of applicants received a placement to study teacher education at University of Eastern Finland, with a focus on special and classroom teacher education (VAKAVA, 2021). In Finnish teacher training, research methods (e.g., quantitative, qualitative, and mixed methods) are an important part of the

curriculum, and the training provided can be characterized as scientifically based and research intensive. However, research studies are not the most-favored courses among preservice teachers, and quantitative research methods courses are perhaps the most-hated ones in general. These courses are experienced as being boring, difficult, and even frightening, causing anxiety among preservice teachers (e.g., DeVaney, 2010; Väisänen & Pitkäniemi, 2008; Väisänen & Ylönen, 2004). Thus, based on the challenges in teaching quantitative research, it is critical to develop novel ways of thinking about and approaching the instruction of this important subject matter. The aim of this article is to study evolvement of preservice teachers' self-regulation, self-efficacy, orientation for learning, and emotions during a quantitative research method online course. Use of these constructs were founded on the previous research. The course was designed alingin with the flipped learning approach supported with learning analytics.

## Online teaching, flipped learning, and learning analytics

Over the past decade, the pace of development of various online video conferencing systems (e.g., Teams, Zoom) and cloud services (e.g., Google workplace, Office 365) has been swift. During this time, new environments and tools have been provided for supporting different pedagogical aims and needs. Within the specific context of teacher training, these technologies are not only used for teachers' pedagogical purposes, but also to provide those at the preservice level with examples in how to use technology in pedagogically meaningful ways (e.g., as future teachers)—in other words, these experiences are important for developing facility in using technological skills as teachers (Tondeur et al., 2012). Particularly, teacher trainers can be seen as gatekeepers of technology integration for preparing preservice teachers for their future teaching practices (Tondeur et al., 2019). Further, digital learning environments provide various tools that can be used to support collaborative learning activities (e.g., Koschmann, 2012); serve as platforms to create possibilities for students and teachers to discuss, share their knowledge, and understanding; build shared understanding; and ask questions. One possible approach for considering technology (e.g., conferencing systems, cloud services, electronic environments, and tools) in collaborative learning is the flipped learning (FL) approach (e.g., Weller, 2020).

According to O'Flaherty et al. (2015), no clear model exists of how to implement the FL approach or its pre-stage flipped classroom. While flipped classroom and FL can both be considered pedagogical approaches, one major difference is that flipped classroom is more teacher-driven than FL (e.g., Toivola & Silfverberg, 2014). In other words, using FL without the necessary learning skills or experiences of online teaching and technology may be challenging for students. Thus, it is suggested that starting from the more teacher-directed flipped classroom may be more effective than directly using FL (Väisänen & Hirsto, 2020). Both negative and positive results have been identified in previous studies

(e.g., Akçayır & Akçayır, 2018; O'Flaherty et al., 2015). From the negative perspective, since these approaches require self-regulation and time management skills (e.g., Boevé et al., 2017; Hyppönen et al., 2019), they may influence students who are unfamiliar with them to fall behind in their studies (e.g., Chen et al., 2014). From the positive perspective, it has been suggested that the flipped classroom and FL approaches enhance positive learning experiences (Sointu et al., 2022; Awidi & Paynter, 2019); improve students' learning outcomes (Tusa et al., 2018), self-regulation (Lai & Hwang, 2016), and orientation (Strayer, 2012); and, with instructor availability, enhance the possibility of deeper learning (Gilboy et al., 2015). Additionally, recent study of Sointu and colleagues (2019) found that students perceive their teachers as better content experts, instructors, and technology users with the flipped classroom approach. The general idea of flipped classroom (and FL) is that digital materials (e.g., digital handouts or videos) replace the traditional teacher-led lecturing. These materials are provided to the students before or, as is particularly the case with FL, during face-to-face meetings. The time in face-to-face meetings is devoted to more student-centered and collaborative activities; in addition, the teacher's role becomes more the pedagogical expert who guides the student-centered learning activities and collaborations. In the FL teaching approach, where sequencing and materials are provided to the students during the class meetings, the teacher can provide more group or individualized support for their students based on their particular needs. Such specialization can be implemented using various learning management systems and conference tools in online teaching, and learniong analytics may also offer tools for this type of approach.

Along with the creation of environments and platforms that can facilitate collaboration, there has been active development of technologies that could provide students with more personal and timely support and learning activities. One of these approaches is learning analytics (LA), defined as the "measurement, collection, analysis, and reporting of data about learners and their contexts, for the purposes of understanding and optimizing learning and the environments in which it occurs" (LAK, 2011). In order to succeed, the learning environments and technologies should be able to capture the various learning activities by the students. Different online environments have the capability to capture such data (e.g., clicks, views of online materials, submission and time). With this data and LA, it is possible to better understand different learning processes and to better optimize learning activities.

Even though there are considerable promises and expectations related to LA, several challenges exist. A major challenge is, how pedagogical practices can fully take advantage of LA and how it can be integrated into teachers' work (Kuhl et al., 2019). The rich data itself as its sources does not easily transform into meaningful information that can be used for supporting teaching and learning processes (e.g., Greller & Drachsler, 2012); thus, more research in this field is needed.

## Aspects influencing the learning of quantitative research methods

Various aspects influence learning, particularly the learning of quantitative research methods. In this research, these aspects are theorized as self-regulation, self-efficacy, orientations for learning, and emotions (e.g., Broadbent & Poon, 2015; Pekrun, 2019; Pintrich, 2004; Vermunt & Vermetten, 2004). In addition to general understanding of learning, the selction of these aspect were guided by previous research of quantitative methods learning (DeVaney, 2010; Rautopuro, & Väisänen, 2004; Väisänen, & Ylönen, 2004; Väisänen, & Pitkäniemi, 2008). Self-regulation can be viewed from several different perspectives such as learning process and result, lack of regulation (Nurmi et al., 2003; Vermunt & Vermetten, 2004), and time management (Schunk, 2005). Self-efficacy is seen as the capability to judge and execute certain types of performance in various circumstances (e.g., Bandura, 1997), and students with higher self-efficacy may better succeed in studies when faced with challenges (e.g., Schunk & Ertmer, 2005). Orientations for learning refer to students' intentions in diverse learning activities. These can be divided into intrinsic (i.e., one's own will to master the task) and extrinsic (i.e., external need to achieve better) goal orientations, mastery orientation (i.e., interest in the content for learning in general), professional orientation (i.e., relatedness of the content to a future profession), and avoidance orientation (i.e., finding something else to do when facing obstacles) (e.g., Broadbent & Poon, 2015; Nurmi et al. 2003; Pintrich, 2004; Vermunt & Vermetten, 2004). Emotions are important considerations in learning processes (e.g., Pekrun, 2019), particularly with challenging content. One approach to viewing emotions is the control-value theory (e.g., Pekrun et al., 2007, 2017), which can be used to investigate the effects and preconditions of emotions (Pekrun, 2006). According to Pekrun et al. (2007), anxiety, frustration, and anger are unpleasant or activating negative emotions. Anxiety is related to the focus of the learning outcome, and frustration and anger to the learning activity. Boredom is related more to the outcomes (e.g., sadness or disappointment), and enjoyment is an activating positive emotion (Pekrun et al., 2007). Generally, if students' experiences of control over their learning situations is low, this leads more to negative emotions such as anxiety, frustration, and boredom, whereas high feelings of control can lead to enjoyment (Pekrun et al., 2007). Based on control-value theory, some emotions can lead students to work more and harder in learning situations and their studies (Pekrun, 2006; Pekrun et al., 2007, 2017).

These factors affecting learning are highly interwoven. From the self-regulation perspective, it is important to recognize the resource management capabilities (i.e., motivational and emotional regulation strategies as well as social resource usage) of students (Dresel et al., 2015). Moreover, Hyppönen et al. (2019) found that low self-regulation, in combination with high task-avoidance, creates a risk to learning during studies in the flipped classroom approach. As self-regulation is considered to be a cyclical

process (Zimmerman, 2002), it is important to consider the role of emotions, as emotions are found to be important in preservice teacher education quantitatime methods studies (e.g., Ylönen & Väisänen, 2005). These emotions and experiences are typically based on preservice teachers' previous challenges and experiences of quantitative methods learning or in mathematics (e.g., Väisänen & Ylönen, 2004), perhaps as a result of an incorrect understanding of the content area or gossip from the older preservice teachers (Rautapuro & Väisänen, 2004). The novel instructional methods of FL have also been found to promote students' learning regulation and collaborative skills (Blau & Shamir-Inbal, 2017), as well as self-efficacy for learning (Lai & Hwang, 2016). Generally, LA are suggested to support learners' self-regulated learning and to increase motivation (Ifenthaler & Schumacher, 2016), and can be one way to support the learning of challenging contents in preservice teacher education. With these important goals in mind, the purpose of this study was thus to investigate how LA with an FL approach supports preservice teachers' self-regulation, self-efficacy, orientation for learning, and emotions in a quantitative research methods online course over time.

# Methods

## Participants and procedures

An eight-week Quantitative Research Methods 2 course was arranged in October–December 2020, and 40 preservice teachers. Multiple online questionnaires in the learning management system – i.e. dispositional learning analytics – was collected with five measurement points (M = 11,8-day interval) from all participants. Additionally, LA data (not reported here) were collected. The majority of the preservice teachers (N = 38; response rate = 95%; Mage = 26.03 SDage = 4.55; Nfemale = 33, 86.6 %) were in their fourth year of studies and responded to the whole dispositional learning analytics data collection. University of Eastern Finland Institutional Review Board (decision, 11/2020) approved the research design, and the research strictly followed national ethical principles of research with human participants (Kohonen et al., 2019), EU GDPR (2016/679), and the National Data Protection Act (1050/2018).

## Research context

The FL approach was used in a fully online teaching setting. In the learning management system, the learning materials were sequenced in 1½-week intervals for preservice teachers to study. Following the FL approach, learning management system was built for delivering materials, including videos, handouts, and tasks (i.e., FL materials) in online class meetings. These materials helped participants to familiarize themselves with the content of the topic, learn the subject matter, and complete the designated assignments on the class meeting. During the sessions, FL materials cave students freedom to use these materials as they wish, but also other materials found from library or from the web.

Following the FL approach, both short theoretical and tutorial videos of the content, tasks, and quizzes (self-correcting with answers) based on tasks were constructed to scaffold preservice teachers' learning in the learning management system. Additionally, participants were encouraged to collaborate with their peers. Generally, the use of FL materials, conducting tasks and quizzes were monitored from the learning management system LA tools for supporting their learning. The course was constructed in such a way that it could have been carried out as a self-study. Still, as the content of quantitative methods is challenging, the majority of the preservice teachers participated in the online class meetings (rate of participation = 84%). The tandem use of Zoom and Teams was conducted in discussions with participants online. As Zoom was used for general discussions with the students, Teams was implemented for more personalized or small-group support. Follwing the FL approach, in situations of needed guidance or help, students could ask in Zoom chat or contact the teacher in Teams for a call. This type of tandem use was done particularly to support the self-regulation, self-efficacy, orientations, and emotions of the participants. In this way, the role of the teacher was to support and motivate students whenever they needed it. Moreover, this made more-individualized support for participants possible. In cases of several participants struggling with the same challenge, the teacher was also able to form groups in teams for peer support. For individual and group support, the teacher was able to use the learning management system LA data in order to understand what content was easier or more challenging for participants. Additionally, course teacher used dispositional learning analytics data to consider students' regulation and emotions for the their studies. Finally, preservice teachers were well-guided in the beginning about the learning approach, expectations, objectives, and how to use the analytics in the learning management system for monitoring own learning.

## Measures and data analysis

We collected dispositional learning analytics data using several questionnaires and their subscales: (1) Self-regulation was measured with subscales of (1.1) self-regulation of learning processes and results, (1.2) lack of regulation from the Inventory of Learning Styles (Vermunt, 1994), and (1.3) time management from Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, 1991). (2.1) Self-efficacy was measured with a subscale from MSLQ (Pintrich, 1991). (3) Orientation was measured with subscales of (3.1) avoidance orientation from the Strategy Attribution Questionnaire (Nurmi et al., 1995), (3.2) extrinsic and (3.3) intrinsic goal orientation from MSLQ (Pintrich, 1991), and (3.4) professional and (3.5) mastery orientation designed and pilot-tested for the research project. (4) Measures for emotions were measured with subscales of (4.1) anxiety (Väisänen & Ylönen, 2004), and (4.2) boredom and (4.3) enjoyment towards quantitative research methods (Pekrun et al., 2011). Participants responded to the measures 1.1 (e.g., When I have difficulty grasping a particular piece of subject matter, I try to analyze why it

is difficult for me) and 1.2 (e.g., I notice that I have trouble processing a large amount of subject matter) with a five-point Likert-type scale (1 = I do this seldom or never, 5 = I do this almost always). Participants responded to the remaining measures with a six-point Likert-type scale: 1.3 (e.g., I make good use of my study time), 2.1 (e.g., I expect to do well in my studies), 3.1 (e.g., I often find other things to do when I have a difficult task ahead of me), 3.2 (e.g., My main concern is to get good grades in my studies), 3.3 (e.g., I prefer to study matters which are challenging and I can learn new things from), 3.4 (e.g., This course is very important for my future professional skills), 3.4 (e.g., I am really interested in the study contents of this course), 4.1 (e.g., I feel anxious in studying quantitative methods), 4.2 (e.g., Studying quantitative methods is so boring that it is difficult to stay awake), and 4.3 (e.g., I really look forward to studying quantitative methods). Previous studies indicate adequate internal consistency of the selected measures.

Data were analyzed, first, by investigating the internal consistency (Cronbach alpha [α]) for reliability of the used measures. We used criteria ($\alpha > 0.7$) for the indicator of adequate reliability (Nunnally & Berstein, 1994). Second, based on the adequate α score, we calculated mean composite (i.e., sum) scores for interpreting the mean (M) and standard deviation (SD) based on the original metric of measures. Third, we ran paired sample t-tests (with bootstrap) for the first measurement point (T1) and last measurement point (T5) to investigate possible statistically significant differences between T1 and T5. Bootstrap was used, as the sample size was small and some subscales violated the data normality assumptions. Fourth, Cohen's D (D) effect size (ES) was calculated to investigate the magnitude of possible differences. We used Cohen (1988) criteria for D ES < 0.1 no, 0.1–0.5 small, 0.5–0.8 intermediate, and > 0.8 large effect. Finally, based on the M, profiles of each measurement point were constructed to represent the change over time of statistically significant subscales.

# Results

The reliability of subscales, descriptive statistics (M, SD), and the results of paired sample t-tests (p, D) are presented in Table 1. Based on the results, internal consistency of all subscales was adequate ($\alpha > 0.7$). Base on the statistically significant differences between the first (T1) and final (T5) measurement points, preservice teachers had better (1.3) time management, with small effect size (ES); less (3.1) task avoidance, with ES approaching large; and less (4.1.) anxiety as well as (4.3) boredom towards quantitative research methods learning, with intermediate ES at the end of the course. On the other hand, preservice teachers' (3.3) intrinsic goal orientations and (3.4) professional orientations for quantitative research methods decreased during the course, with small ES.

**Table 1**

*Reliability, descriptive statistics, and paired sample t-tests results of measured areas*

| | | T1 | T5 | Paired sample *t*-test T1, T5 | |
|---|---|---|---|---|---|
| | *α* | *M* (*SD*) | *M* (*SD*) | *p* | *D* |
| (1.1) Self-regulation of learning processes and results | .80 | 2.32 (0.85) | 2.38 (0.89) | *n.s.* | – |
| (1.2) Lack of regulation | .82 | 2.38 (0.76) | 2.51 (0.98) | *n.s.* | – |
| (1.3) Time management | .71 | 3.79 (1.03) | 4.03 (1.07) | <0.05 | 0.38 |
| (2.1) Self-efficacy for learning | .80 | 3.35 (0.92) | 3.49 (0.98) | *n.s.* | – |
| (3.1) Task avoidance | .84 | 3.15 (1.14) | 2.62 (1.22) | <0.01 | 0.71 |
| (3.2) Extrinsic goal orientation | .72 | 2.96 (0.94) | 2.84 (1.21) | *n.s.* | – |
| (3.3) Intrinsic goal orientation | .74 | 3.52 (0.78) | 3.27 (0.94) | <0.01 | 0.32 |
| (3.4) Professional orientation | .95 | 2.60 (1.10) | 2.25 (1.09) | <0.05 | 0.34 |
| (3.5) Mastery orientation | .82 | 3.08 (1.02) | 3.01 (1.06) | *n.s.* | – |
| (4.1) Anxiety towards QRM | .92 | 3.99 (1.35) | 3.26 (1.48) | <0.01 | 0.64 |
| (4.2) Boredom towards QRM | .83 | 3.00 (1.05) | 2.63 (1.21) | <0.01 | 0.51 |
| (4.3) Enjoyment towards QRM | .88 | 2.59 (0.97) | 2.80 (0.93) | *n.s.* | – |

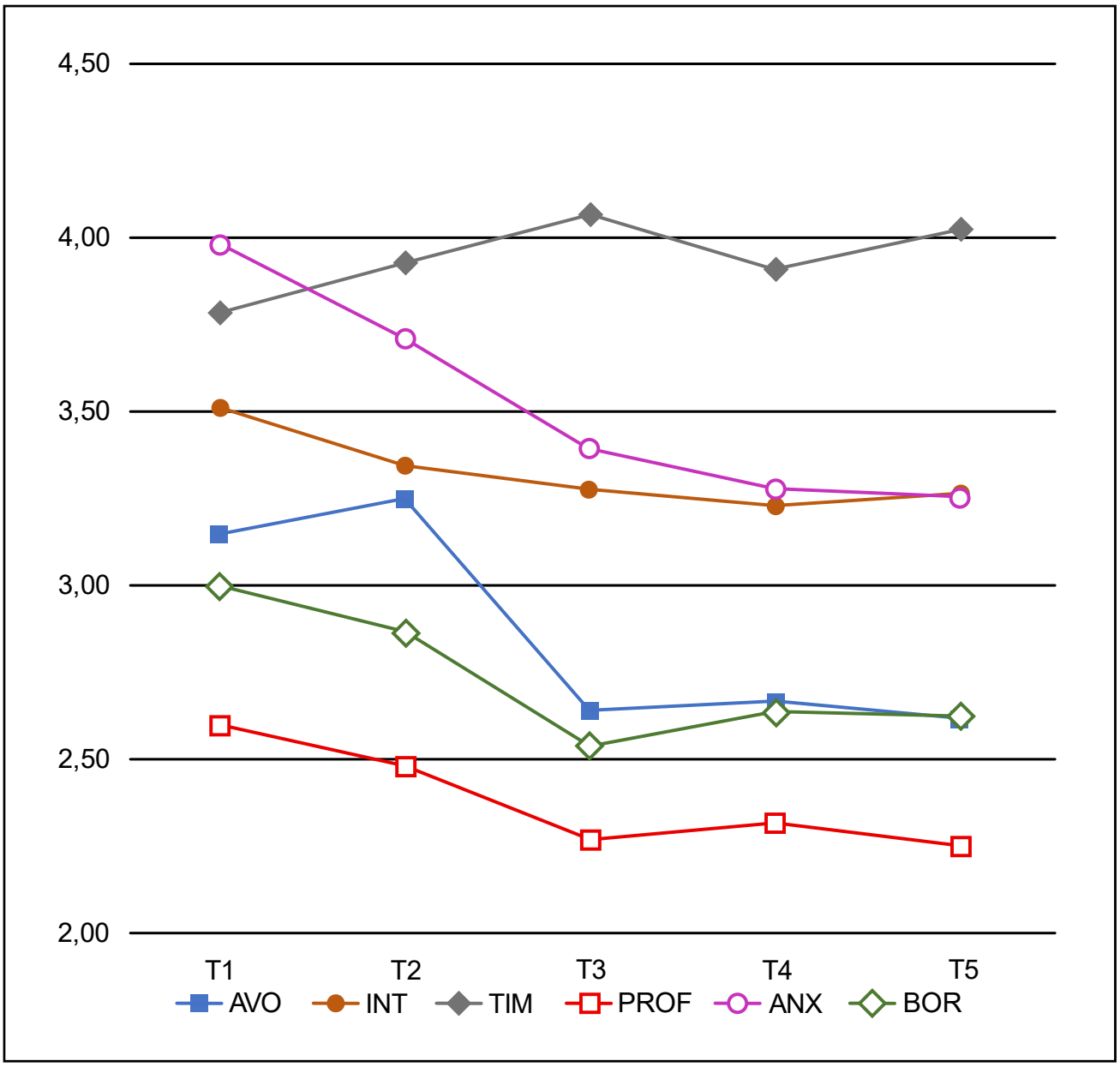
*Note*: *T1* first and *T5* final measurement points, *QRM* quantitative research methods, *α* Cronbach alpha, *M* mean, *SD* standard deviation, *p* significance of paired sample *t*-tests between T1 and T5 measurement points, *D* Cohen D effect size, *n.s.* non-significant.

The results of significant paired t-tests between T1–T5 are presented as mean-based profiles in Figure 1. These profiles indicate that the (1.3) time management (TIM; grey line) improved between T1–T3, decreased for T4, but improved almost to the highest level for T5. (3.1) Task avoidance (AVO; dark blue line), on the other hand, increased from T1 to T2, but dropped dramatically for T3 and remained at that level until T5. (4.1) Anxiety towards quantitative research methods (ANX; dark magenta line) was the highest in T1 of all

measured constructs, but steadily decreased towards the end of the course (i.e., T5). (4.3) Boredom towards quantitative research methods (BOR; green line) decreased from T1 to T3, but slightly increased for T4 and remained there in T5. (3.3) Intrinsic goal orientation (INT; brown line) steadily decreased from T1 to T4, but made a slight positive change for T5, still remaining lower that in T1. (3.4) Professional orientation (PROF) was the lowest of all measured constructs in T1, as it decreased to T3 and remained at that level until the end of the course (T5).

**Figure 1**

*T1–T5 student profiles during quantitative research methods course Note: AVO task avoidance, INT intrinsic goal orientation, TIM time management, PROF professional orientation, ANX anxiety, and BOR boredom towards quantitative research methods. Only statistically significant results between the first (T1) and fifth (T5) are presented in the figure.*



# Discussion

The purpose of this study was to investigate preservice teachers' self-regulation, self-efficacy, orientation for learning, and emotions in a quantitative research method online course over time. The course used learning analytics (LA) and the flipped learning (FL) approach. Based on the results of the study, time management (self-regulation) improved, while task avoidance (orientation), anxiety, and boredom (negative emotions) for quantitative research methods decreased during the course, as did intrinsic goal orientation and professional orientation.

Time management was the only subscale of self-regulation that changed in a statistically significant manner. Still, this is an important aspect, as time management is part of the self-regulation process, namely as recourse management (Schunk, 2005). It may be that the FL approach with LA supports the structuring of scheduling preservice teachers' learning, thus supporting their understanding of scheduling and how to plan, control, and manage their own learning actions (cf. Zimmerman, 2008). Moreover, the clear structure of FL, with the support of LA, may bolster the metacognitive monitoring (see Zimmerman, 2002) of preservice teachers, which in turn supports their time management. Regardless, the general assumption that LA supports learners' self-regulated learning (Ifenthaler & Schumacher, 2016) was not confirmed in any of the aspects used in this study. It may be that the content itself (i.e., quantitative research methods) requires even stronger support for self-regulation, as the beliefs from history and previous emotions strongly influence the learning of this content.

Task avoidance was the measured area that changed most strongly during the course. Based on the previous finding by Hyppönen and colleagues (2019), task avoidance with low self-regulation is a major risk for challenges during the studies in the flipped classroom context. Moreover, task avoidance can lead to a lack of effort and, ultimately, study failure (Nurmi et al., 2003). In light of this, the result that task avoidance can be decreased with an effect size approaching large is quite promising. Nurmi et al. (2003) also consider that low levels of regulation lead to higher task avoidance. Task avoidance is also a challenge observed by higher education teachers because the responsibility of keeping up with studies and course competition is the responsibility of the student (i.e., preservice teachers, in this case) (Hyppönen et al., 2019). In such a situation, LA offers an option for tackling this challenge, and the decreasing level of task avoidance may be one clear indicator of how LA can support student learning. Time management can have an influence on this, likewise the decreasing change of negative emotions.

The negative emotions (i.e., anxiety and boredom) also decreased significantly with intermediate effect size during the course. This is an interesting result, as previous research has found quantitative research methods studies to be frightening, boring, and

difficult (e.g., DeVaney, 2010; Väisänen & Pitkäniemi, 2008; Ylönen & Väisänen, 2004). The decreasing negative emotions may be seen as more activating emotions for learning (i.e., preservice teachers observe that this is not that difficult or frightening). In particular, the decrease of anxiety that is related to the learning outcome, decreasing boredom, and less deactivating negative emotions (cf. Pekrun et al., 2007) support this. As the control of learning improves, this should lead to enjoyment or at least to less anxiety and boredom (cf. Pekrun et al., 2017). The FL approach might also help students to understand the content better, which may in turn lead to less negative emotions as concerns the challenging content.

Interestingly, however, intrinsic goal orientation and professional orientation during this quantitative research methods course decreased. It may be that the content has so large a stigma among the preservice teachers that positive change or even no change at all for intrinsic orientation is difficult to achieve. The result of no change in student enjoyment may support this notion, as no positive emotion change occurred, even though the negative emotions decreased. Thus, changing this stigma cannot be achieved during one course, and this should be considered for the entire preservice teacher training level. Moreover, students participating in the course are most likely future teachers, not researchers. It may be that preservice teachers do not, at this stage, find the research methods training important for their future work. Still, research methods studies have been found to be important for the quality of Finnish teacher training.

The profiles from the first (T1) to last (T5) measurement points indicated some fluctuations in time management, task avoidance, orientations, and emotions during the course. Several factors may influence this, such as teacher effect, challenges in the LMS, and students' individual characteristics and situations. For example, with regard to the final set, students may have started to feel exhausted as the academic year proceeded and the end of the semester approached. Additionally, the contents became more challenging during the course. Nevertheless, it should be kept in mind that these differences were not tested with statistical methods in all measurement points (only between T1 and T5), and more research on this matter is warranted.

From the overall view of this study, the on-time support of course teachers for preservice teachers via LA, along with the possibility of making one's own observations of progress via LA (cf. Barthakur et al., 2021), can have a positive influence on increased time management and decreased task avoidance, anxiety, and boredom. In addition, LA can support students' understanding of themselves as learners as well as their learning skills and metacognitive thinking (Durall et al., 2014; Marzouk et al., 2016), which is partially seen in our study results. In this sense, perhaps the FL approach offers a clearer structure for teachers using LMS and technology. For the teacher of this type of course, the FL approach can offer a meaningful pedagogical way to take advantage of LA as a valuable

support mechanism. In this way, the rich data itself and its sources, can be more easily transformed into meaningful information for supporting teaching and learning processes (cf., Greller & Drachsler, 2012). Clear pedagogical practices are needed to take advantage of LA and to display how teachers can integrate LA into their teaching practices (Kuhl et al., 2019), which is seen in turn as a clearer structure to the students as well. The clear sequencing structure of the FL approach, with its on-time materials as a learning aid for preservice teachers to use, improves students' time management and decreases their task avoidance as well as negative emotions. Moreover, possibility for general support (e.g., in Zoom) and more individualized support (e.g., in Teams) resonates also with the positive results of this research. Not only these conferencing systems, but also cloud services and functional learning systems stitched together with learning analytics and meaningful pedagogy (i.e., flipped learning approach, in this case), can enhance the learning of challenging content associated with research studies, namely, quantitative research methods.

# Limitations and future research

There are limitations to this research, which tie in with our suggestions for future studies. First, even though the sample represented well the whole course, it is rather small. In the future, larger data sets should be obtained, and stronger analyses should be used with larger sample sizes, including measurement and structure equation modeling. Second, the research did not yet use or merge the LA data. In the future, the results should be investigated with LA data to obtain a more comprehensive understanding. Further, the use of qualitative data would improve the understanding of the learning analytics used in this type of setting. Third, as no (quasi-)experimental designs were used in the research, the results should be investigated with these types of designs to obtain stronger results. This would also include the possibility of controlling for various aspects, such as teacher effect.

# Implications

This paper offers one example of using learning analytics in a combination flipped learning approach and online teaching modality to provide instruction in a higher education research methods course. Considering these elements helps us to understand how to support learning with meaningful pedagogy and learning analytics. Also, the tandem use of conference tools with learning analytics can offer additional insight for supporting learning in the online teaching context. Moreover, higher education can involve a variety of challenging content material and important aspects for learning (e.g., time management, task avoidance, and emotions) that should be considered in course instruction and learning. Finally, this paper can be used to understand the role of research method teaching in Finland and internationally.

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