Flipped online approach with learning analytics for supporting higher education students' learning. Course feedback results

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Abstract

Using learning analytics and dispositional learning analytics in teaching is difficult. Examples of their use are required for higher educational institutions and teachers. In this paper, we present a flipped learning approach in online settings (due to COVID-19) with particular emphasis on learning analytics and dispositional learning analytics. For this, an understanding of flipped approaches (i.e., flipped classroom and flipped learning) as well as the role of technology in the teaching context is required and presented. The role of technology includes (1) a digital learning system, (2) a conferencing system, (3) the collection and use of learning analytics and dispositional learning analytics, and (4) content-specific technology. Additionally, our aim is to present students' course feedback results from quantitative research methods course practices (2020, 2021) for preservice teachers (i.e., students; N = 70). The content is highly challenging for these students, causing fear, frustration, anxiety, and boredom. Generally, the results for pedagogy were positive, but the results of students' learning perceptions were lower. Based on the approach and results, discussion with new insights is provided.

Keywords

Flipped learning, online teaching, pedagogy, learning, learning analytics, dispositional learning analytics, higher education

1. Introduction

Learning analytics has received attention in recent decades as a way to support students' learning, improve teaching, and offer personalized support [1]. According to LAK [2], "Learning analytics is 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." Thus, learning analytics relies mainly on data from digital systems (e.g., digital learning environments) that students produce during their learning. Optimally, learning analytics can provide teachers with tools to adapt lessons for those with different abilities [3]. However, despite the potential of learning analytics, there are challenges in its use, such as a lack of training for teachers, including pedagogical practices to support the use of learning analytics with students [3, 4], and pedagogical approaches to implement learning analytics in teaching practices. The aim of this paper is to examine one case where learning analytics were used together with well-planned pedagogical approach and dispositional learning analytics in a challenging quantitative research methods course for preservice teachers. Additionally, results from the course feedback are presented to assess the functionality of teaching in this context.

Proceedings of the Finnish Learning Analytics and Artificial Intelligence in Education Conference (FLAIEC22), Sep 29-30, 2022, Joensuu, Finland
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2. Background

The pedagogical approach in this case was built on a flipped learning approach in the course Quantitative Research Methods 2. With the flipped learning approach, more specific pedagogical practices, and the technology used, such as a digital learning environment and conferencing systems (i.e., Zoom and Teams), the possibility to collect both learning analytics and dispositional learning analytics data of students and content-specific technology (i.e., Statistical Package for Social Sciences [SPSS] and Excel) should be considered as a whole.

2.1. Flipped learning

Flipped learning [5] and flipped (inverted) classrooms [6,7] are often considered similar approaches. However, the main difference between these two approaches is who leads the learning. In the flipped classroom, the teacher has a stronger role, but students are expected to be self-regulating in their learning. In flipped learning, students are expected to make better use of their self-regulation abilities, and thus, the role of the teacher is different than in traditional teaching or flipped classrooms [6].

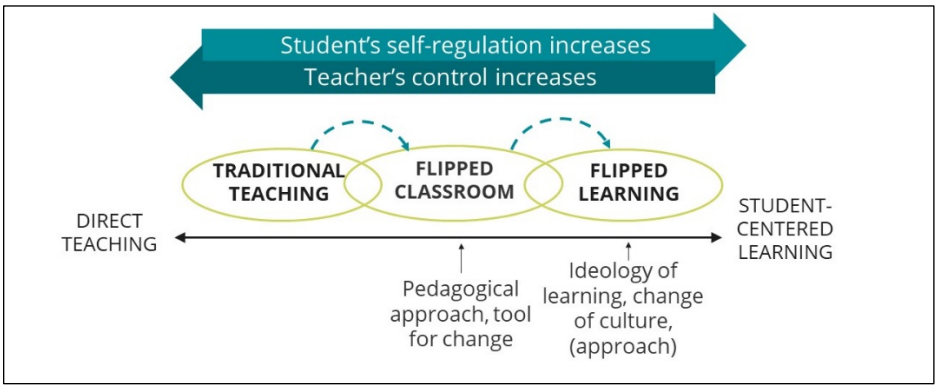

Figure 1: Differences between the flipped classroom and flipped learning when compared to traditional teaching (Adapted from Toivola & Silferberg [6]).

For teachers who have more experience with traditional teaching approaches (e.g., lectures, online lectures, demonstrations), Väisänen and Hirsto [7] as well as Sointu et al. [8] suggest that the use of the flipped classroom approach may be better than aiming directly for flipped learning because the flipped classroom approach includes more traditional components of teaching. It can also be considered more teacher-driven than flipped classrooms [6]. However, the flipped classroom also includes some new elements that may improve teaching toward more student-centered learning. Thus, the flipped classroom may be considered the first step to flipped learning in pedagogical development [8]. One challenge with the flipped approaches is that there is no clear model of how to implement it in teaching [9].

According to Akçayır and Akçayır [10] and O'Flaherty et al. [9], both positive and negative results from the previous research have been identified. Positive results include that flipped approaches may improve students' learning outcomes [11], self-regulation [12], and orientation [13]; enhance positive learning experiences [14]; and enhance the possibility of deeper learning when teacher availability in needed points of learning is visible [15]. Moreover, a recent study by Sointu et al. [16] indicate that students consider their teachers as experts in pedagogy and the use of technology in teaching with the flipped classroom approach. Research indicates positive weak to moderate effects on student satisfaction with the flipped classroom in their meta-analysis [17]. Sointu et al. [18] identified five key factors of student satisfaction with the flipped classroom: guidance for teaching approach, aiming for understanding (i.e., combining theoretical information into practice), a safe learning environment, teachers' content teaching skills, and students' technological skills. The negative results of flipped approaches often include the need for students' self-regulating and time management skills [19], as a lack of these skills can increase the unfamiliarity of the approach and cause students to fall behind in their learning [20]. In particular, students with higher task avoidance orientation and lower self-

regulation skills should be considered with a flipped approach [21]. Thus, considering the elements of student satisfaction with a novel pedagogical approach and additional data from learning analytics and dispositional learning analytics, the meaningful use of technology may increase the possibility for more positive learning experiences and learning results.

2.2. Technology tied to the context

Technology should be considered and planned well in flipped teaching. The technology should not be overly complicated for either teachers or students. According to Koehler and Mishra [22], the use of technology should align well with the pedagogical approaches used and the content areas taught during the course. There are several different technologies that can be used for supporting different pedagogical needs [23]. Especially during the recent decade, the development of tools for supporting collaborative and student-centered pedagogies has been emphasized. The COVID-19 pandemic prompted the development of different conferencing systems. Along with different pedagogical approaches, the nature of the content knowledge taught poses its own demands for the technologies used [22]. In addition to teaching the content, the technologies should provide students with experiences of the technologies used within the content discipline, i.e., technologies that are used by experts in the field.

In this course's online flipped learning approach, several technologies were needed to meet the needs outlined by the Koehler and Mishra [22]. Technologies had to provide the space for students' collaborative and self-regulated learning activities. To provide students with information about their learning process, the elements of learning analytics had to be integrated. Finally, data analysis software was needed to provide students with experiences using authentic software for conducting quantitative research. To meet these goals, the following technologies were used for teaching and learning:

1. Digital learning environment (called Valamis)
2. Conferencing systems (Zoom and Teams)
3. Collection and use of learning analytics and dispositional learning analytics data from Valamis
4. Content-specific technology for quantitative research methods (Statistical Package for Social Sciences [SPSS] and Excel)

(1.) The digital learning environment (i.e., Valamis) was used to deliver the learning materials to studentts. These materials included short online videos (theoretical and practical) about the content, handouts based on the videos, tasks based on the videos, and handouts as well as self-correcting quizzes to monitor learning. The aim of the materials was to support students' learning and to help them understand and learn the content better. Moreover, students were able to complete the assignments during class and group work after the class. Students were often encouraged to do collaborative work with their fellow students. Even though collaborative work was supported, every student had to finalize each assignment, task, and quiz in the digital learning environment. In addition, when using a learning management system for teaching, it should be capable of collecting data from learning analytics and dispositional learning analytics for student support and research.

(2.) The rationale for using two conferencing systems came from the practice: Zoom was used for general teaching in the classroom setting and joint discussions, while Teams was used for individual or small group support for students. Moreover, Teams was the main venue for students to contact the teacher. Each meeting started with a general discussion in Zoom and responses to the questions that participating preservice teachers had. Afterward, students started to work in the digital learning environment and the teacher was available to support their learning either in Zoom or Teams. However, based on the rules made between the students and the teacher, Zoom was kept mainly silent during class because students wanted to concentrate on the materials in the digital learning environments. Thus, we decided that Teams was the venue where students could contact the teacher and help them out whenever needed. More precisely, the aim was to develop a safe environment for learning for students, and Teams provided a venue for this as they were able to discuss individually

with the teacher. We also agreed with the students that the teacher check every thirty minutes that everything is okay in Zoom.

The tandem use of Zoom and Teams allowed the teacher to provide stronger support for students, but it also required the teacher to use two devices (e.g., two computers, a computer and a tablet). The use of Teams helped the teacher to provide more personalized or small-group support for the students. Additionally, if several students had challenges with the content and contacted the teacher, in this case, the teacher was able to form small groups in Teams, explain and overcome the obstacles, and suggest to the students that they could continue working collaboratively. The use of Teams became the natural way of working, and students were skilled in using both systems. With challenging content in an online setting, the tandem use of conferencing systems enables not only students to contact the teacher but also the teacher to contact individual students and support their regulation, orientation, self-efficacy, and emotions for learning [8]. Additionally, this allows the teacher to motivate the student. Nevertheless, this would be less useful for supporting students in online settings if no data about their progress and learning circumstances had been available. This is where the learning analytics and dispositional learning analytics become important tools for self-monitoring and teacher support.

(3.) According to Sointu et al. [18], guidance is highly important in flipped courses. Along with guidance provided by the teacher, the elements of learning analytics were integrated into the digital learning environment to provide students with information about their learning processes. We assume this information provided by the digital learning environment as one form of guidance [24]. Students were also well guided in the use of analytics data themselves. Learning analytics data were collected and visualized for the students from their progress, quizzes, and tasks in the environment. With this, we aimed to guide and provide feedback to the students about their self-regulation and learning processes. With the learning progress data, the teacher could also gain more in-depth knowledge about students' learning, such as understanding which content students struggled with and which content they found easier.

In addition, we used dispositional learning analytics (i.e., short questionnaires) to gain further insights about students' orientation to learning (e.g., did they consider the course important for their future career), self-regulation and time-management skills, and emotions (enjoyment, boredom, and anxiety) toward the content. This provided an additional tool for the teacher to understand students' mindsets better from outside the cognitive perspective. When students had challenges with time management, task avoidance, or emotions, the teacher was able to use more pedagogical practices to help them based on the knowledge gained from dispositional learning analytics data. For instance, the teacher could provide further guidance for the learning and technology, connect the content to the student's future profession, attempt to create the feeling of a safe learning environment online, and show emotional sensitivity and understanding for students' anxiety toward the content. Overall, the use of both learning analytics and dispositional learning analytics provided the teacher with tools to understand more students' learning in the online environment and support them when confronting challenges.

(4.) One of the main aims of this quantitative research methods course is to learn how to conduct quantitative analysis using the Statistical Package for Social Sciences (SPSS) program. Thus, SPSS and Excel were content-specific programs. The content of the course was divided into six topics for the six meetings as follows:

1. General information, guidance for the teaching approach and programs used in the course, and content related to variables and correlation
2. Reliability, composite scores, recoding, normality testing, and correlation
3. Validity, exploratory factor analysis
4. T-tests and non-parametric matches for them
5. Variance analysis and nonparametric matches
6. Regression analysis

SPSS was used mainly in the course content. Excel was also used at meaningful points (e.g., data management, name and label transformations, calculations). The content of the course is highly difficult for preservice teachers (see e.g., [8]), and the course curriculum guides the teaching of the content and the use of SPSS.

The flipped learning approach was implemented online due to COVID-19. In practice, all course materials were available in the digital learning environment as self-study materials for the students. Since the content is difficult for these students, the majority of the students participated in meetings that had 1-2-week intervals. One meeting lasted three hours. Zoom and Teams were used in tandem for online teaching and particularly to support the students. Learning analytics were guided for students to monitor, and the teacher used learning analytics and dispositional learning analytics data to support the students and better understand their needs for support. Previous research by Sointu et al. [8] demonstrated that this type of approach may improve students' time management skills and decrease avoidance orientation, anxiety, and boredom toward the content. Additionally, this approach also seems to support those students with high anxiety, boredom, and low enjoyment with learning quantitative research methods [25]. However, the knowledge from the course feedback forms is still missing. Thus, the aim of this study was to present the quantitative course feedback results collected from the participating preservice teachers after the course.

3. Methods

In total, 99 preservice teachers participated in the eight-week quantitative research methods practices courses during late fall 2020 and late fall 2021: 40 participants in 2020 and 59 participants in 2021. Each yearly cohort had two classes. The convenience sample of this paper includes the responses of seventy (N = 70; N_{2020} = 28, N_{2020} = 42) preservice teachers. The course was a part of a project called *Utilization of Learning Analytics in the Various Educational Levels for Supporting Self-regulated Learning* (OAHOT) funded by Business Finland through the European Regional Development Fund (2020-2022). Students were invited to respond to the anonymous feedback questionnaire voluntarily based on their informed consent. Moreover, the OAHOT project was approved by the University of Eastern Finland (UEF) institutional review board decision (11/2020). The data were collected via an electronic system with UEF [26] study course form. Professor Jyri Manninen from UEF led the development of the feedback form. The feedback form adapted for this study includes eight questions, in which students were asked to assess the quality of the quantitative methods course on a scale of 0–5 (0 = Rejected, 1 = Sufficient, 2 = Satisfactory, 3 = Good, 4 = Very good, 5 = Excellent). The questions were: (1) Connection between learning objectives and content of the course, (2) Own commitment in studying in the course, (3) Interaction between students and teacher, (4) Learning atmosphere in the course, (5) Course instruction (i.e., teaching), (6) Functioning of the study methods, (7) My own learning in the course, and (8) General grade to the course. Moreover, the feedback form included open-ended questions not reported here. The data were analyzed with SPSS. We report descriptive statistics: mean (M), standard deviation (SD), and percentage distributions.

4. Results

The results indicate rather positive feedback from the participants (see Table 1). The highest assessments from all measured areas were from the *Learning atmosphere* (M = 4.34, SD = .72), *Course instruction* (i.e., *teaching*) (M = 4.26, SD = .90), *Functioning of the study methods* (M = 4.23, SD = .87), *Interaction between students and teacher* (M = 4.22, SD = .84), and *Connection between learning objectives and content of the course* (M = 4.20, SD = .68). Generally, the course was considered quite successful as indicated by the general grade for the course (M = 4.32, SD = .74). The lower assessments in the course feedback survey were related to the own commitment or learning assessed by students. More precisely, students considered *Own commitment in studying in the course* (M = 3.57, SD = .99) and *own learning in the course* (M = 3.44, SD = .96).

Table 1
Course assessment by students

Assessed area	*M*	(*SD*)	Min	Max
Connection between learning objectives and content of the course	4.20	(.68)	3	5
Own commitment in studying in the course	3.57	(.99)	1	5
Interaction between students and teacher	4.22	(.84)	1	5
Learning atmosphere in the course	4.34	(.72)	2	5
Course instruction (i.e., teaching)	4.26	(.90)	2	5
Functioning of the study methods	4.23	(.87)	2	5
My own learning in the course	3.44	(.96)	1	5
General grade to the course	4.32	(.74)	2	5

Note. M Mean, *SD* Standard deviation, *Min*/*Max* minimum/maximum values used with the response categories by students. Students were asked to assess the quality of the quantitative methods course with a scale 0–5: 0 = Rejected, 1 = Sufficient, 2 = Satisfactory, 3 = Good, 4 = Very good, 5 = Excellent

These items were also investigated in frequency level as indicated with percentages in Figure 1. The majority of students considered the course very good to excellent in *Learning atmosphere* (89.2%), *Course instruction* (i.e., *teaching*) (81.4%), *Functioning of the study methods* (77.2%), *Interaction between students and teacher* (84.0%), and *Connection between learning objectives and content of the course* (89.2%). However, own commitment in studying in the course (sufficient = 4.3%, satisfactory = 7.2%, good = 31.0%, very good = 40.6%, excellent = 15.9%) and own learning in the course (sufficient = 4.3%, satisfactory = 8.6%, good = 37.1%, very good = 38.6%, excellent = 11.4%) were distributed more evenly.

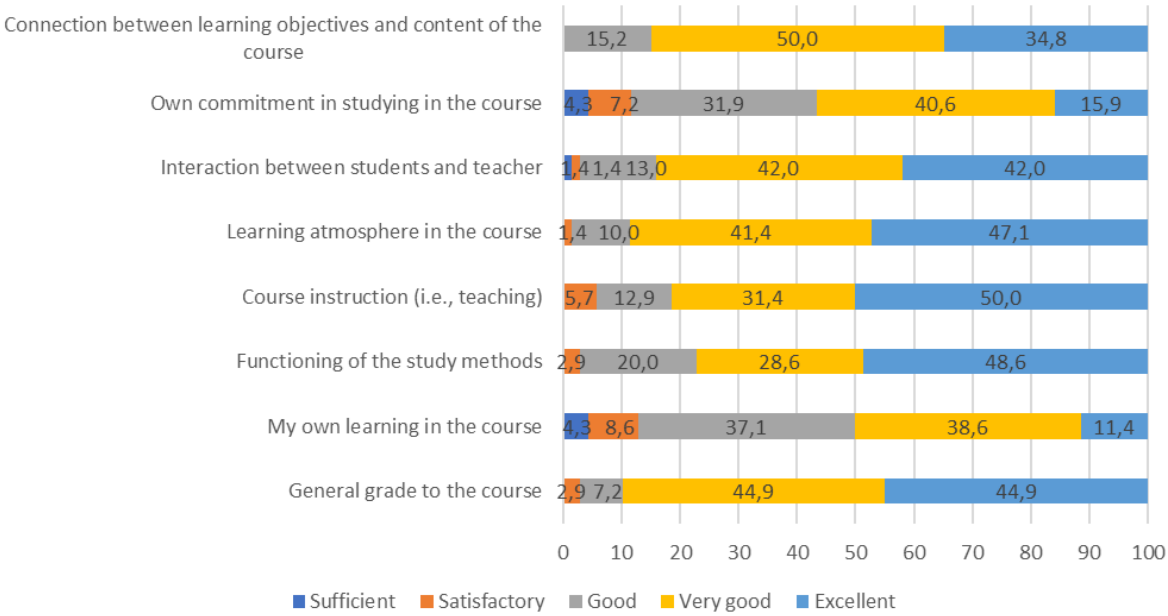

Figure 2: Frequencies of the course assessment by students. *Note.* The numbers in the figure represent percentages. No zero (rejected) responses were used in the feedback survey.

5. Discussion

The aim of this paper was to describe how flipped learning in online teaching was used with learning analytics and dispositional learning analytics. Additionally, we wanted to find some indicators of how students considered this type of approach. Based on the feedback form results, the highest ratings were given for *Learning atmosphere*, *Course instruction* (i.e., *teaching*), *Functioning of the study methods*, and *Interaction between students and teacher*. We see these as successful from the perspective of the course design. It can be assumed that the course elements created the feeling of a safe atmosphere, teacher accessibility, functional pedagogical design, and technologies for students. These results align with previous studies within the field of flipped learning [18]. Moreover, the *Connection between learning objectives and content of the course* was the fifth highest, indicating that the course followed the course curriculum. One important aspect of teaching is to open the curriculum during the courses, and the sequencing of flipped learning makes this possible. This relates to both the content and program (i.e., SPSS) used in the course. Generally, the course was considered quite successful as indicated by the *general grade for the course*. Altogether, this example provides a concrete approach to how to build a learning analytics-supported course including pedagogical approach considerations, interaction, and a safe atmosphere.

Interestingly from the students' perspective, their *own commitments in studying in the course* and *own learning in the course* were above three (i.e., at the level of good), but still, they deserve more attention in the future. These results provide us with challenges that may be avoided by focusing more on the pedagogy and use of technology. Typically, the area of quantitative research methods has been perceived as a difficult or even scary topic (see e.g., [8]). This preconception may show within these results as students' experiences of their personal capabilities to study the topic and commit to the course (see e.g., [19, 20, 21]). We assume that the analytics from the learning environment supported with the collection of frequent dispositional analytics can provide the teacher with ways to better acknowledge the challenges with student learning and possibly the negative emotions toward the course, especially toward the challenging content. We assume that with these approaches, the challenges with learning and commitment can be alleviated.

However, it is also important to understand that many of the aspects of creating a successful course are very much teacher-dependent and vary between teachers (i.e., teacher effect). Additionally, this may vary between different disciplines and the content of these disciplines. This is particularly important to notice when students need additional support and how teachers can approach these support needs. For example, further guidance for the learning and technology, reasoning the content to the future profession, attempts to create a feeling of a safe learning environment even online, and emotional sensitivity and understanding particularly for students' anxiety towards the content (i.e., quantitative research methods) can be approached differently by different teachers. In other words, the approaches used in this study do not automatically work for every teacher. Teachers must consider their own pedagogical and learning perceptions, skills, and teacher identity. In the case of this course, the teacher had experience with and understanding of the flipped classroom [6, 7], flipped learning [5], and teaching with technology [22]. Thus, the understanding was grounded on student-centered learning, student activity [6], sequencing of the course [16, 18], and balance between possibilities for self-studies and more scaffolded studies. Moreover, the teacher of the course had a long background in special education, thus providing the teacher with additional tools to support learning challenges. The teacher's background made it possible to guide and support the students. The teacher had also read evidence from the practices that create satisfaction among students in flipped approaches [18] (see also [17]) and followed these guides. The teacher had experience with quantitative methods content, teaching them in the university and working as an evidence-based practices teacher in the comprehensive (basic) education. Thus, the teacher could reason the practical aspects of why teachers may need an understanding of quantitative methods in their future careers, in addition to possible thesis use at the university. Furthermore, the teacher also used humor in his approach when appropriate to ease students' anxiety and boredom with learning quantitative research methods. However, the use of humor can also be challenging, so teachers must consider the place and time. Furthermore, with the students' higher anxiety toward the content, teachers must understand and hear these negative emotions and be sensitive and encouraging toward the students to support their learning and help them overcome their fears and frustration [see e.g., 8, 25]. In all of

this, learning analytics and depositional learning analytics help the teachers support students learning difficult content.

Even though evidence of the functionality of the flipped learning approach online with learning analytics and dispositional learning analytics were found, limitations exist, and future research should be considered. First, even though the data were a representative sample of the course, it still was a rather small convenience sample. In the future, research should attempt to use larger samples and quasi-experimental designs. As noted above, teacher effect may exist in this study, thus sample sizes needed for multilevel modeling should be sought. Second, the results were based on a feedback questionnaire form. In the future, more robust rating scales should be used in investigating the phenomenon. With individual items presented in this study, there were no possibilities to investigate the reliability or the validity. Thus, future research should take these into account too. Additionally, no analysis was performed on the learning analytics data used in this study. Future studies should include learning analytics analysis. Finally, qualitative data from the students' feedback forms provide an important venue to understand the phenomenon more thoroughly. Thus, future research should consider combining qualitative data and quantitative data with a mixed-methods approach.

Acknowledgements

This work was supported by a grant from Business Finland through the European Regional Development Fund (ERDF) project *Utilization of Learning Analytics in the Various Educational Levels for Supporting Self-regulated Learning* (OAHOT) (Grant no. 5145/31/2019). We would like to thank our funder. Additionally, this study was supported by the School of Educational Sciences and Psychology, Special Education unit, and the School of Applied Educational Science and Teacher Education. Thank you to these departments at the UEF. Additionally, our deepest gratitude to the OAHOT project researcher for the work well done. Last but not least, our sincere thanks to all students for participating in the course and responding to the course feedback form.

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