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Evaluating students' behavioral engagement in a flipped and a typical new technology in physical education course

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Abstract
The aim of this study was to evaluate students' behavioral engagement in the course N119 - New Technology in Physical Education using a flipped learning approach, comparing it to a traditional learning method at the Democritus University of Thrace. Ninety-three (n=93) first-year undergraduate Physical Education students, aged 18 to 20, were assigned to two teaching method groups by a random draw: a flipped instructional (FI) group with 47 students and a typical instructional (TI) group with 46 students. The instructional period, practical exercises (activities), and testing occurred over six consecutive weeks, involving five 90-minute training sessions for the participants. Students completed behavioral engagement surveys as pre- and post-test measurements at the beginning and end of the study. A two-way analysis of variance (ANOVA) with repeated measures was performed to evaluate the influence of teaching methods and measurements over time on students' behavioral engagement. The data analysis revealed no significant differences in behavioral engagement scores between students in the FI and TI groups for this course content. Importantly, the findings indicated that both instructional methods had a significant impact on students' behavioral engagement, with FI students achieving scores similar to those in the TI teaching approach. In summary, this study has provided valuable insights and perspectives on fostering behavioral engagement in flipped learning environments.

Keywords: Behavioral engagement, flipped classroom, typical learning, technology, physical education

Introduction

Flipped learning holds significant promise for integrating technology into classrooms and fostering students' digital competencies (Kostaris, Sergis, Sampson, Giannakos & Pelliccione, 2017) [1]. It aims to boost higher-order thinking skills, active learning time (Gough, DeJong, Grundmayer & Baron, 2017) [2], and cultivate problem-solving, teamwork, and collaboration abilities (Lo & Hew, 2017) [3]. Additionally, it has the potential to increase engagement for both parents and students (Aycicek & Yelken, 2018 [4]; Bond, 2019) [5]. Despite a growing body of research on educational technology's potential to enhance engagement, particularly in higher education (Henrie, Halverson, Graham, 2015) [6], studies specifically focusing on flipped learning and student engagement have yielded mixed results (Chen, Lui, & Martinelli, 2017 [7]; Njie-Carr *et al*., 2017) [8].

Specifically, Tomas, Doyle, & Skamp (2019) [9] conducted a multi-method case study on student experiences with flipped learning in a science and sustainability education course. Using surveys, teacher observations, and student journals, the study collected quantitative and qualitative data from 163 students over two years. Survey results showed that 80% of students watched pre-class video lectures, finding them useful. Half of the students perceived flipped learning as more engaging than traditional classrooms, while 15% disagreed. The study highlighted high levels of student engagement with the videos, but instructor surveys revealed reluctance among students to engage in student-centered activities, presenting mixed results.

Fisher, Ross, LaFerriere, & Maritz (2017) [10] focused on 53 students in an undergraduate entrepreneurship and innovation class at an Australian university. Using a Learning Management System, the semester-long course incorporated activities aligned with online lectures. The study gathered data through student surveys and interviews. Survey results indicated a general agreement that flipped learning increased student engagement. Qualitative data from interviews supported increased engagement, with students describing initial frustration followed by a sense of control, heightened self-motivation, and self-confidence. The findings aligned with engagement theory, including high engagement levels, collaboration, student-centered activities, and positive learning outcomes.

Unruh, Peters, & Willis (2016) [11] conducted a three-year study on student engagement from the instructors' viewpoint in a Texas school district. Using a matched sample of teachers, the study focused on teacher beliefs and attitudes impacting student engagement. Data, collected from students in flipped and traditional groups, included surveys and interviews. Analyses revealed statistically significant differences in favor of flipped learning. Teachers using flipped learning reported increased factors of perseverance and engagement, aligning with engagement theory.

Karabulut-Ilgu, Cherrez, and Hassall (2018) [12] studied instructors' perceptions of student engagement in flipped learning within large class settings. The participants, grant recipients of the Flipped Learning Initiative, taught diverse courses. The study collected data through course documents, surveys, and interviews, revealing positive outcomes and challenges, including diminished issues over the semester.

Pérez, Collado, Herrero, & San Martín (2019) [13] conducted an empirical study on engagement in flipped learning within a business communication course for third-year college students in Spain. Data, collected from exams, projects, activities, and a student questionnaire, involved 150 participants. Results indicated positive student responses, concluding that flipped learning enhances classroom effectiveness and student engagement.

Finally, AlJarrah, Thomas, & Shehab (2018) [14] investigated engagement patterns among students in a mobile applications computer programming class using flipped learning. The study involved 63 students in a 16-week course. Data from the Learning Management System tracked student activity. Analysis revealed that, despite ample time for material review, most students accessed content on the day of or the day before class. High and low-performing students showed similar engagement levels, while medium-performing students demonstrated the highest engagement.

As previously mentioned, research exclusively focusing on flipped learning and student engagement has shown mixed results (Chen *et al*., 2017; Njie-Carr *et al*., 2017) [8]. For instance, the scoping review conducted by O'Flaherty & Phillips (2015) [15] found limited evidence supporting increased engagement, with only modest improvements in exam scores or student satisfaction, and they therefore called for future research to explore additional indicators of engagement. Other studies have also emphasized the necessity for more rigorous research designs (Lo & Hew, 2017 [3]; Ward, Knowlton, & Laney, 2018) [16], including adequate sample sizes and comprehensive information on study context and participants. Therefore, the aim of this study was to evaluate students' behavioral engagement in the course N119 - New Technology in Physical Education using a flipped learning approach, comparing it to a typical learning approach at the Democritus University of Thrace. The research questions guiding this study were as follows:

1. Are there differences in mean behavioral engagement scores between the flipped Instructional (FI) group and the Typical Instructional (TI) group?
2. Do students, on average, report differently on the behavioral engagement for the pre-test and post-test measurements?
3. Do the differences in means for the behavioral engagement between the FI and the TI groups vary between the pre-test and post-test measurements?

Methods

Participants

During the winter semester of 2021, a total of 93 first-year undergraduate students, aged 18 to 20 (M=19, S.D. =1.03), from the Department of Physical Education and Sport Science at Democritus University of Thrace participated in the study. Among them, 49 were male (52.7%), and 44 were female (47.3%). These students were enrolled in the N119 - New Technologies in Physical Education course. Through a random draw, students were allocated to either the flipped instructional group (47 students, 24 males, 23 females) or the typical instructional group (46 students, 25 males, 21 females). Prior to the experiment, students were informed about the research purpose, their assigned group, the teaching methodology, and their responsibilities, ensuring voluntary participation without impacting their grades.

Instruments

Behavioral engagement was assessed using Miserandino's (1996) [17] task involvement survey. This measure corresponds to the primary factor identified in Miserandino's psychometric examination of a broader perceived behavioral engagement survey. This specific subscale consists of seven statements crafted to assess students' behavioral engagement. Participants rated their agreement with each statement on a 7-point Likert scale, ranging from strongly disagree (1) to strongly agree (7). Sample statements include: "I listen carefully in class "and" I work hard when we start something new in class."

To calculate scores, responses for the entire subscale are averaged. Researchers opted for this specific scale because it captures behavioral engagement through students' on-task attention, lesson involvement, and effort, focusing on task involvement rather than broader constructs like school engagement or prosocial conduct, as seen in some other studies assessing behavioral engagement. Additionally, this scale is closely comparable to other extensively used and validated behavioral engagement scales (Skinner, Kindermann, & Furrer, 2009) [18]. Previous research has demonstrated the scale's reliability and validity, showcasing its effectiveness in predicting student achievement (Jang, Reeve, Ryan & Kim, 2009 [19]; Miserandino, 1996).

Procedure

This study compared two instructional approaches, examining activities before, during, and after class. In the flipped model, pre-class activities involved readings and EDpuzzle videos to introduce new concepts. In-class sessions included cognitive check reviews, short lectures, and interactive quizzes with web-based responses. Group discussions followed if responses were below 90%, facilitated by the instructor. Approximately 6-10 questions were covered in each class, and students submitted a 10-question handout for self-explanation via eClass after class.

In the traditional model, pre-class activities and cognitive check reviews were shared, with direct instruction using a slide show. The video, watched by flipped students during EDpuzzle, was shown at the end of the lecture. Instructors occasionally asked questions during lectures for student participation. Notes were taken using handouts, and the second weekly session included a lecture, video, and cognitive check. Students submitted a 10-question handout for self-explanation via eClass after class.

The instructional period lasted six weeks, comprising five 90-minute sessions. Students completed behavioral engagement surveys as pre- and post-test measurements at the beginning and end of the study.

Statistical analysis

The study utilized a pre-test/post-test design, and before conducting the analysis, the data underwent screening for potential violations of statistical assumptions, with none detected (Green & Salkind, 2017) [20]. A two-way analysis of variance (ANOVA) with repeated measures was performed to evaluate the influence of teaching methods and measurements over time on students' behavioral engagement. The dependent variable was behavioral engagement scores, with within-individual factors including teaching method groups (FI, TI) and time (pre-test, post-test), both at two levels. Significance of mean differences across time was assessed at the 0.05 alpha level. Effect size was computed using the eta-squared statistic ($\eta 2$) for practical significance, with Cohen's guidelines: 0.01=small, 0.06=medium, and 0.14=large (Cohen, 1988) [21].

The hypotheses for this study were as follow:

H01: There will be no statistically significant difference in the mean scores of behavioral engagements between the experimental groups (FI and TI).

H02: There will be no statistically significant difference in the mean scores of behavioral engagements between the pre- and post-test measurements.
H03: There will be no statistically significant difference in the mean scores of behavioral engagements between the experimental groups (FI and TI) in the pre- and post-test measurements.

Results

Reliability analysis

The behavioral engagement survey demonstrated strong internal consistency with a Cronbach's alpha reliability coefficient of 0.83, evaluating its seven items. According to Green & Salkind (2017) [20], a Cronbach's alpha value equal to or greater than 0.70 is considered satisfactory. Hence, the behavioral engagement survey proved to be a reliable measurement tool for assessing behavioral engagement in the course N119 - New Technology in Physical Education.

Two-way analysis of variance with repeated measures

An independent samples t-test was executed to examine the hypothesis that there would be no significant difference in behavioral engagement measures at the pre-test stage between the two experimental groups (FI and TI). The results indicated no significant initial distinctions in mean behavioral engagement scores between the two method groups, $t(91) = -0.415$, $p = 0.679$.

A two-way analysis of variance (ANOVA) with repeated measures was performed to assess hypotheses H1, H2, and H3. Contrary to expectations, the H2 hypothesis was not supported. A significant main effect was observed for Time, $F(1, 91) = 1154.84$, $p < 0.001$, partial $\eta 2 = 0.927$, while the Teaching methods x Time interaction effect was not significant, $F(1, 91) = 1.34$, $p = 0.25$, partial $\eta 2 = 0.014$. The univariate test associated with the Teaching method group's main effect was also not significant, $F(1, 91) = 1.28$, $p = 0.261$, partial $\eta 2 = 0.014$.

Pairwise comparisons using t-tests with a Bonferroni adjustment were employed to analyze the main effect of Time. The findings revealed significant mean differences in behavioral engagement scores between pre-test and post-test ($MD = -2.88$, $p < 0.001$) in both experimental groups (FI, TI). As illustrated in Figure 1, the post-test behavioral engagement scores were notably higher than pre-test behavioral engagement scores for both experimental groups.

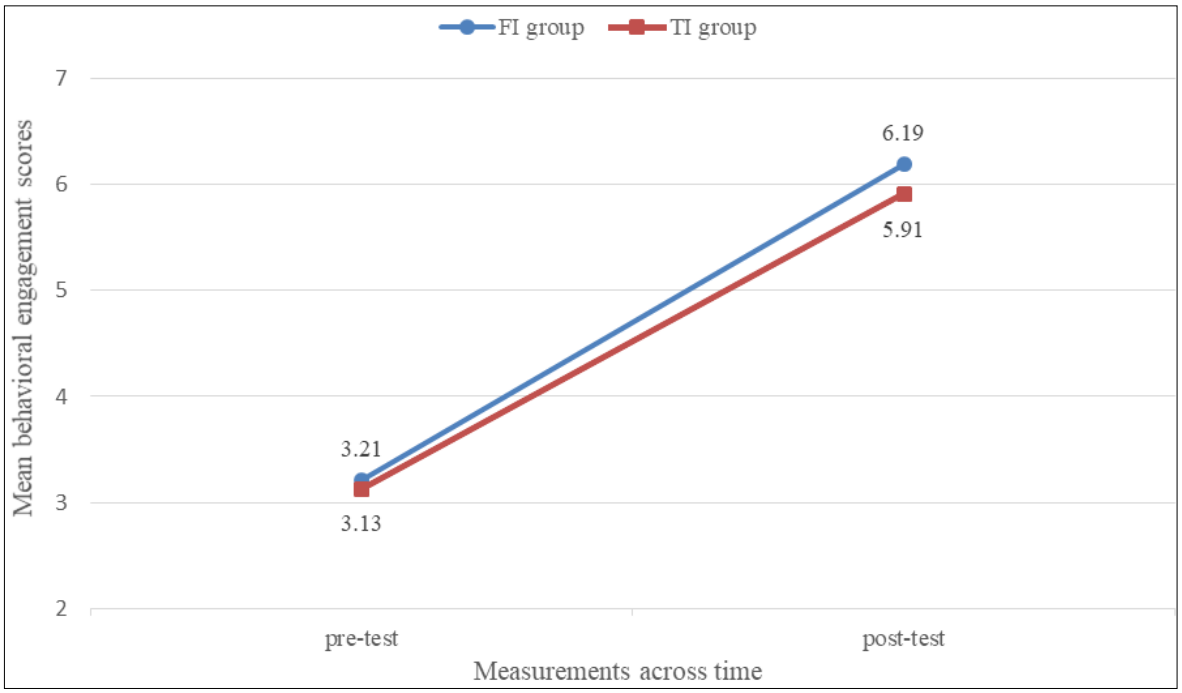

Fig 1: Mean scores of the experimental groups (FI and TI) on behavioral engagement scores.

Discussion

Research findings highlight a robust association between student engagement and learning, persistence, and success in higher education. Increased levels of active engagement, whether with university faculty and staff, fellow students, or the subject matter being studied, significantly enhance the likelihood of students persisting in their university studies and achieving higher levels of academic success. This critical connection has been underscored in numerous major studies and reports focusing on the undergraduate experience (Chen *et al*., 2017 [7]; Njie-Carr *et al*., 2017 [8]; O'Flaherty & Phillips, 2015) [15]. Therefore, the purpose of this study was to evaluate students' behavioral engagement in the course N119 - New Technology in Physical Education using a flipped learning approach, comparing it to a typical learning approach at the Democritus University of Thrace. In pursuit of this objective, specific questions were formulated, meticulously examined, and the study's outcomes related to these questions are elaborated below. The research question aimed to investigate potential differences in mean behavioral engagement scores between the FI and TI groups and between pre-test and post-test measurements. The study's data are aligned with the hypothesis positing that there will be no statistically significant difference in mean behavioral engagement scores between the experimental groups (FI and TI) in both pre-test and post-test measurements.

The data analysis revealed no significant differences in behavioral engagement scores between students in the FI and TI groups in the N119 - New Technology in Physical Education course objectives. Moreover, both groups demonstrated an improvement in their behavioral

engagement levels with this course content. In essence, the findings suggested that both instructional methods significantly influenced students' behavioral engagement, with FI students achieving scores comparable to those in the TI teaching approach. The consistent pattern observed implies that Flipped Instruction (FI) has the potential to create learning environments that elevate students' feelings of achievement and ignite internal motivation for active participation in the learning process. This interpretation suggests that FI could enhance students' overall performance and experiences by instigating a holistic transformation in their attitudes toward learning, fostering satisfaction, and encouraging active engagement.

The similarity in behavioral engagement scores between classes may be explained by the lack of discernible instructional advantages between the models. Both classes were exposed to identical content presented in the same sequence, intending to isolate differences related to effortful retrieval and peer interaction in the flipped classroom. Regarding the improvement observed in the levels of behavioral engagement in FI group, this could be attributed to several factors. Firstly, the flipped learning approach may have facilitated active learning within the classroom, encouraging student participation and involvement. This could be due to students coming to class prepared with improved study habits, leading to increased questioning and engagement. Secondly, the flipped approach might have instilled a sense of enjoyment in physical education students, making them feel more focused on the class and actively participating, rather than passively listening to the teacher. Lastly, the voluntary nature of activities such as re-watching videos, note-taking, and content exploration empowered students accustomed to passive learning, fostering curiosity and encouraging them to take responsibility for their own learning. This shift towards active learning likely prompted students to become more independent in their educational journey.

Conclusions

In summary, this study has provided valuable insights and perspectives on fostering behavioral engagement in flipped learning environments. However, it faced certain challenges, and it is crucial for future researchers to be mindful of these. Caution is advised in generalizing the results due to the study's small-scale nature. To enhance the robustness and applicability of the findings, there is a need for more extensive longitudinal studies with larger sample sizes and extended investigation periods. Furthermore, while questionnaires are commonly used in the literature, their reliance may introduce common method biases. Hence, there is a call for further research that complements these findings by incorporating a broader array of data sources, such as in-depth student interviews, interaction analyses, and behavioral patterns.

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