The Improvement of Attitudes toward Convergence of Preservice Teachers: Blended Learning versus Online Learning in Science Teaching Method Courses

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Abstract

There has been a growing need as preservice teachers develop competencies regarding convergence. Focused on a discussion of blended learning before the COVID-19 pandemic versus online learning in the epidemic, we aimed to explore whether preservice teachers' attitudes toward convergence can be influenced by the learning environment. Participants were a total of three hundred preservice teachers who attended the science teaching method courses training their TPACK at a teachers college in South Korea during the 2018 to 2020 academic years (194 in the blended learning group and 106 in the online learning group). Survey data on five subcomponents of attitudes toward convergence were collected at the start and end of the courses and analyzed using ANOVA and ANCOVA. As result, preservice teachers' responses to the attitudes toward convergence in the pretests have a significant difference, whereas the overall scores in the posttests revealed no significant difference in the modalities of learning environments. Consequently, the preservice teachers engaged in the courses enhanced positive attitudes toward convergence regardless of delivery methods either blended learning or online learning. This paper provides evidence that the two teaching modalities of curriculum studies have the potential to foster preservice teachers' attitudes toward convergence. This study supports that the blended and online learning formats of the course were feasible to induce short-term improvements in bias affective domains under the learning environments of science teaching method courses.

Keywords: blended learning, online learning, attitude toward convergence, preservice teachers, science method course

1. Introduction

Due to the COVID-19 pandemic spread over the world, there have been extraordinary disruptions in terms of education and social activities; and cumbersome actions such as the closure of schools, mandatory mask-wearing, social distancing, or smaller sized in-person student groups have been implemented (Sim, 2021; Vaillancourt et al. 2022). With the restriction from the traditional learning environments in classrooms, students' insufficient learning was supported with a couple of options, attending school in-person while others attend remotely, or virtual learning online full-time from home (Vaillancourt et al. 2022). Instructors who are generally experienced in face-to-face learning environments have been supposed to encounter challenges to modify pedagogical strategies and content on the online platforms using course recording or real-time video conferences (Shin & Lee, 2021). In the COVID-19 pandemic, the concern of instructors and learners in higher education head for how an online learning environment can yield learning outcomes and learner experiences that are at least equal to those under the conventional situation

or analogous learning methods (Shin & Lee, 2021).

Given this exceptional delivery approach to teaching and learning, the effects of online versus in-person blended learning need to be examined to comprehend and overcome the limitations in relation to a non-face-to-face learning environment. The present study seeks to explore whether preservice teachers' attitudes toward convergence can be influenced by the learning environment within science teaching method courses in a teachers college. Since online learning has faced phenomenal growth even before the COVID-19 pandemic (Black et al., 2008), a comparison of this affective variable over the past three years would be useful for preservice teacher educators and researchers alike. There also has been a growing need as preservice teachers to develop competencies regarding convergence to facilitate learner creativity and problem-solving skills (Kim & Jeon, 2016). This paper will focus on a discussion of blended learning versus online learning environments that are known for effectively impacting preservice teachers' attitudes toward convergence (Choi & Hong, 2019).

2. Related Research

2.1 The Blended Learning and Online Learning in Higher Education

Most frequently cited in the literature, blended learning has been defined as an integration of face-to-face instruction and learning with computer-mediated online learning experiences (Hrastinski, 2019). In a blended learning environment, learners typically attend conventional face-to-face classes with synchronous interaction and use online learning technologies including a learning management system (LMS) (Baragash & Al-Samarraie, 2018). Blended learning in higher education allows instructors to integrate conventional face-to-face lessons with tailored online learning modalities; it also responds to individual learning needs, flexible schedules, reviewing, and immediate feedback (Berga et al., 2021). For instructors, blended learning can offer an active and flexible learning environment and provide faculty members to communicate with learners in groups or as individuals (Tayebinik, 2013). In blended learning courses, students mostly use their time to conduct online activities or interactions with other learning community members on the LMS (Nguyen, 2017). Therefore, technological factors including LMS might promote their academic performance by participating in online discussions, exams, group projects, and assignments in post-secondary education (Wei et al., 2015). In this respect, blended learning has the potential to develop learning outcomes for students (Tayebinik, 2013).

Online learning refers to web-based and self-directing learning that involved the use of various virtual teaching and learning resources and online tools, whereas face-to-face learning refers to the traditional classroom instruction within a physically designated space (Huang, 2016). Contrary to students in a face-to-face learning environment, online learners have the option of accessing their courses using personal computers or other devices; and they also have the responsibility to ensure that the equipment is effective to study as a physical learning element (Lynch & Dembo, 2004). Although online learning diminishes or eliminates gathering in a physical classroom, it makes learners interact with learning materials, peers, and the instructor (Huang, 2016).

2.2 The Significance of Attitudes toward Convergence

As the importance of convergence increases, the academic boundaries of disciplines become indistinct and collaborative works beyond a specific area are conducted across the various fields (Choi & Park, 2021; Sya'bandari et al., 2019). Convergence in the educational context also has been spotlighted and embodied in STEM (Science, Technology, Engineering, and Mathematics) education (Sya'bandari et al., 2019). Attitudes toward convergence involve one's preferences on approaches, values, purposes, knowledge, and methods to integration because the concept includes the epistemic perception of convergence (Shin et al., 2014). To make integrated lessons prevalent in classrooms, it is critical that preservice teachers possess pedagogical knowledge through a profound understanding of STEM (Kim & Jeon, 2016). According to the previous review, attitudes and perceptions of preservice teachers can be enhanced when they received effective teacher preparation programs offering experiences of transformative thinking and learning with technology; and the TPACK (Technological Pedagogical Content Knowledge) framework might be one of the strategies to awake their inherent potentiality to integration (Chai et al., 2010; Choi & Hong, 2021). It was reported that in-depth views of technology integration for designing STEM lessons can be ameliorated when preservice teachers reflect their TPACK with metacognitive perspectives (Choi & Hong, 2021).

3. Methods

3.1 Participants and the Instructional Design

Participants in this study were a total of three hundred preservice teachers at a teachers college in South Korea. They

attended the science teaching method course focused on enhancing their TPACK. For the three years, 194 Teacher candidates in the 2018 and 2019 academic years were engaged in the blended learning, while the third cohort of 106 preservice teachers in the 2020 academic year took the course in online learning owing to the COVID-19 pandemic.

The blended science method course lasts for eight weeks during the fall terms according to the TPACK enhanced program developed for preservice teachers which topics involved the theory and the procedure of TPACK framework based on learning activity types, organization of the science content-based STEM lessons, lesson plan design based on the TPACK framework, preparation for STEM lessons using the TPACK framework, and practice and reflection on teaching with TPACK (Choi & Hong, 2019). The participants had to complete two hours of face-to-face lessons and self-directed online learning with digital resources on the Google classroom. The online learning program includes the same objectives and contents, but whole teaching and learning methods such as real-time lessons, recording, learner-learner interaction, learner-instructor communication, assignments, feedback, and assessments are virtually provided to learners via LMS.

3.2 Instruments

The instruments to measure attitudes toward convergence were adapted from Shin et al.'s (2014) questionnaire comprises 23 items and five components of knowledge, personal relevance, social relevance, interest, and self-efficacy. The adaptation of the questionnaire consisted of an adjustment of specific subjects that did not match with the situation of the case in a teachers college, through it was applicable without the change of certain terms and translation. The first component, knowledge contains 5-point Likert scale typed 4 questions that ask whether they can elucidate what convergence means and how different it is from other disciplines. The components of personal and social relevance have respectively 5 and 4 items referring to the contextual value regarding why they need to comprehend convergence with perspectives as both an individual and a member of the society. The third component includes affective response on convergence, for instance, perceived preference for the process and example of integrated problem-solving. The last component contains 5 items targeting the confidence to learn, solve, and approach in more fused ways.

3.3 Data Collection and Analysis

Questionnaires were distributed to the participating preservice teachers through online survey tools of Google Forms; then the responses were collected at the periods right before beginning the science teaching method courses and after finishing them. The participants in the three academic years were assured that they solely conducted the investigation for the research purpose only, not affecting their assessment. After responses on attitudes toward convergence in the pre-and posttests were collected, data were statistically analyzed with IBM SPSS 24.0 using analysis of variance (ANOVA) to compare the average scores of those groups. Being concerned the pretest results might be a variable affecting the improvement of their attitudes toward convergence, we additionally executed an analysis of covariance (ANCOVA). Before analyzing the data, we eliminated detected careless responses in surveys for the statistical processing. The size of the research subject was suitable to quantitatively compare the mean values of the two groups on the outcome variable.

4. Results

4.1 Data Collection and Analysis

Results on the total scores of the attitudes toward convergence in the pretests were compared (Table 1). Table 1 presents data on preservice teachers' responses to all sections of the attitudes toward convergence based on the overall scores of each academic year for learners in blended learning and online learning.

Table 1. ANOVA for the Attitudes Toward Convergence in the Pretests

	Sum of squares	df	Mean square	F	Sig.
Between groups	14.624	2	7.312	9.760	.000***
Within groups	5167.053	6897	.749		
Total	5181.678	6899			

***p<.001

Table 2. Scheffe's Test Data on the Total Scores of the Three Groups in the Pretests

Dependent Variable: Total Scores in the Pretests

(I) Academic years	(J) Academic years	Mean difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
2018	2020	.113*	.026	.000	.05	.18
	2019	.071*	.025	.020	.01	.13
2019	2018	-.113*	.026	.000	-.18	-.05
	2020	-.042*	.025	.250	-.10	.02
2020	2018	-.071*	.025	.020	-.13	-.01
	2019	.042	.025	.250	-.02	.10

*p<.05

As shown in Table 1, the result of ANOVA in the pretests indicates that there is a considerable difference in the initial attitudes of those groups (F(2,6897)=9.760, p<.001). Table 2 above presents data on the differences in detail among the academic years. Specifically, the participants in 2018 had significantly positive attitudes toward convergence than what the other groups responded, while the overall scores between the 2019 and 2020 academic years did not have a significant difference. We believe that the different ratios of men to women or humanities to science high school tracks can influence the significance among those groups since the ratio of members depends on who has enrolled in the course each year.

4.2 Comparison of the Attitudes toward Convergence in the Posttests

As can be seen in Table 3, the overall scores of the attitudes toward convergence of the preservice teachers in the posttest demonstrate that there is no significant difference in the modalities of learning environments. This result may be due to the effects of the course intervention that involved the experience of designing integrated lessons. Namely, the intervention led to respectively improved preservice teachers' attitudes toward convergence.

Table 3. ANOVA for the Attitudes Toward Convergence in the Posttests

	Sum of squares	df	Mean square	F	Sig.
Between groups	2.410	2	1.205	2.537	.079.
Within groups	2598.434	5471	.475		
Total	2600.844	5473			

Table 4. Scheffe'S Test Data on the Total Scores of the Three Groups in the Posttests

Dependent Variable: Total Scores in the Posttests

(I) Academic years	(J) Academic years	Mean difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
2018	2020	.050	.024	.123	-.01	.11
	2019	.042	.022	.171	-.01	.10
2019	2018	-.050	.024	.123	-.11	.01
	2020	-.008	.023	.946	-.06	.05
2020	2018	-.042	.022	.171	-.10	.01
	2019	.008	.023	.946	-.05	.06

Similarly in Table 3, the comparison of data in the three groups shows that there is not a significant difference in the overall scores of the posttests. The finding supports the idea that the course intervention regardless of the delivery methods can contribute to reducing the gap in preservice teachers' attitudes toward convergence.

4.3 No Differences between Blended and Online Learning in terms of the Improvement of Attitudes toward Convergence

The descriptive analysis revealed that the average overall scores of the attitudes toward convergence in the pretests are respectively different (M=3.85 in 2018; M=3.74 in 2019; and M=3.78 in the 2020 academic year). The averages overall scores in the posttests are in a significantly similar range (M=4.06 in 2018; M=4.01 in 2019; and M=4.02 in the 2020 academic year). Namely, the preservice teachers who participated in the science teaching method courses

through blended learning or online learning enhanced positive attitudes toward convergence. The affective improvement of preservice teachers manifested in the five components of knowledge, personal relevance, social relevance, interest, and self-efficacy as can be seen in Figures 1 and 2.

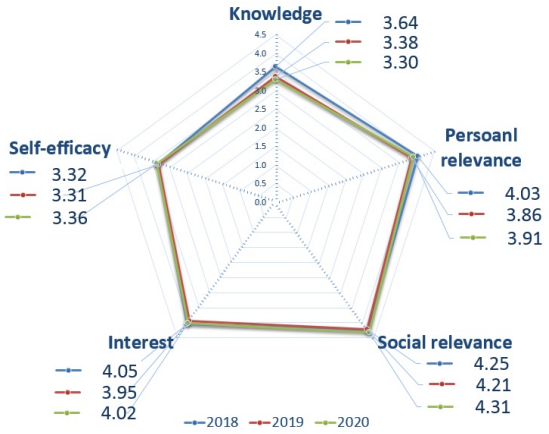

Figure 1. Average Scores of Sub-Components in the Pretests of the Three Groups

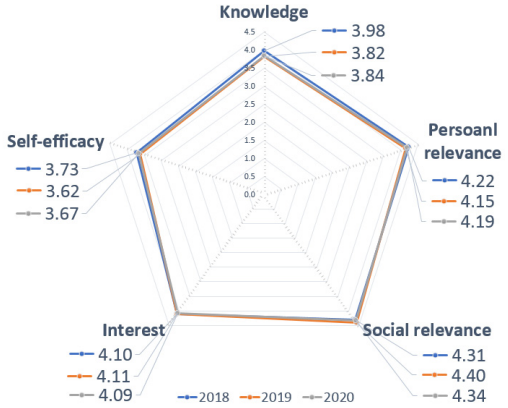

Figure 2. Average Scores of Sub-Components in the Posttests of the Three Groups

Since the pretest results are taken into consideration, we employed ANCOVA to support the reliable comparison of the changes in the attitudes toward convergence of the preservice teachers. Just as ANOVA results present, the initial attitudes toward convergence of the three groups significantly influence the overall scores after the courses the pretests' F value is 8.108 and P=.004 (< .05). However, it turns out that there is not a significant difference among those groups in the posttests with F=1.978, and P=.138 (> .05) when the influence of the pretest gap is controlled (Table 5).

Table 5. ANCOVA for the Attitudes toward Convergence by Course Intervention with Pretest

Dependent Variable: Overall Scores of the attitudes toward convergence after the Courses

Source	Type III Sum of Squares	df	Mean Square	*F*	*p*
Corrected Model	6.256[a]	3	2.085	4.396	.004
Intercept	3680.428	1	3680.428	7759.206	.000
Pretest	3.846	1	3.846	8.108*	.004*
Academic year	1.877	2	.938	1.978	.138
Error	2594.588	5470	.474		

a. R Squared = .002 (Adjusted R Squared =.002) *p<.05

The findings agree with the perspectives of several previous studies that covered the impacts of blended and online learning approaches. Considering proper objectives, contents, individual learner context, and educational technologies, instructors' continuous efforts to improve lesson design, management, and student-centered activities can ultimately help to reach a meaningful lesson regardless of the learning environment (Shin & Lee, 2021). Within the scope of technology integration like Google Classroom activities that provide opportunities to solve problems and do online projects, preservice teachers showed an upward trend in the mean of thoughts (Yılmaz, 2021). As the implication of the subcomponent of knowledge, the participation of those delivery methods using technology equipment might lead to more positive attitudes on their knowledge about convergence because they recognize technology integration in teaching and learning is useful. It is also reported that when students frequently attend an online course and substantially pay attention to it, they will achieve higher grades as they are satisfied (Wei et al., 2015). The improvement of social relevance proves that blended and online learning with LMS allowed them readily to interact with the instructor and colleagues. Social influence, which is known as the predictor of using LMS, makes learners more access to LMS or discover the value of LMS use (Ozkan et al., 2020). Moreover, self-efficacy for learning course content and for technology skills are predictive variables of successful learner performance for online learners; thus, a comfortable and competent mindset with technological tools is useful in terms of developing positive beliefs about learner ability (Choi & Park, 2021; Lynch & Dembo, 2004). An integrated approach to science lets learners boost interest and curiosity about the scientific phenomena and possibly help to decide on STEM careers (Shin et al., 2014).

5. Conclusion

This study revealed that a compulsory online learning environment of a teachers college during the COVID-19 pandemic was not a commensurate factor that drove a significant difference in improving preservice teachers' attitudes toward convergence. Namely, this study provides that modes of delivery cannot be a significant variable to predict the enhancement of the attitudes toward convergence when it comes to serving the same contents regarding teaching method courses. Our study suggests that both blended and online learning offers pedagogical benefits to foster preservice teachers' attitudes toward convergence in science teaching method courses. Moreover, there appears to be a gap in the affective domain that can be alleviated through the pedagogical intervention respective to the learning environment set. We note that though more positive attitudes toward convergence were detected for the blended learning group in the 2018 academic year, overall scores in the posttests were significantly the same level.

Finally, the results obtained from this study clarify evidence concerning the optional teaching modality of curriculum studies on how to instruct with technology integration in preservice teacher programs. The results also added to the existing evidence base for blended and online learning in teacher training. Moreover, the study demonstrated the feasibility of conducting educational experimentation to understand attitudes toward convergence in the field of preservice teacher education alongside quantitative research within undergraduate elementary education. Further studies will encompass expanded pedagogical approaches using the latest technological innovation in blended and online learning to support the instructional competencies of preservice teachers. There is also a need to examine possible differences in other affective domains that contribute to learner performance in different types of educational modalities such as blended versus face-to-face courses, or online and designated learning methods in preservice teacher education.

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