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Blended Learning in Teaching Technical Teacher Candidates With Various Types of Learning Styles

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ABSTRACT

To compare the different impacts of the balance of face-to-face and online learning in blended learning, along with learning styles, an experiment was done using a 3x4 design consisting of three blended learning composition groups of 25% face-to-face and 75% online, an equal balance of face-to-face and online, and 75% face-to-face and 25% online. There were four learning style type groups of Diverger, Assimilator, Converger, and Accommodator. The population was student teachers in electrical engineering. Students of each style were randomly allocated to the three blended learning groups. It was found that both the blend of online and face-to-face learning and the types of learning styles affect competence outcomes significantly in some combinations.

KEYWORDS

Accommodator, Assimilator, Competence, Converger, Diverger, Electrical Engineering, Face to Face, Learning Style, Online, Technical Teachers

INTRODUCTION

The combination of online and face-to-face combination - blended learning – has been claimed to have many advantages (Nazar, Omer, Nazar, & Husband, 2019; Basogain, Olabe, Ifinedo, Pyke, & Anwar, 2018) because the two modes can be mutually reinforcing, with each complementing the other (Dendir, 2018; Yang, Yu, & Chen, 2019). Moreover, the model is able to develop quality teaching (Kennedy, 2016; Pekkarinen & Hirsto, 2017; Cutri & Whiting, 2018) through the pedagogical properties of student-centered and collaborative learning (Wong et al., 2018; McIlveen, 2018; Parsons, Ankrum, & Morewood, 2016). Blended learning can help to apply inquiry-based learning, problem-based learning, and project-based learning related to authentic professional practices, phenomena, problems, and situations.

Digital and mobile communication can make content interactive and lessons adapted to the cultural preferences of students. Students can adapt (Ruhalahti, Korhonen, & Rasi, 2017) by transferring knowledge and work while learning takes place (Hortovanyi & Ferincz, 2015) through Information and Communication Technology (ICT) (Ruhalahti, Aarnio, & Ruokamo, 2018; Khusainova & Lukoyanova, 2018). The learning becomes more dynamic, interactive, and motivating (Cuesta Medina, 2017; Boelens, Voet, & De Wever, 2018; Hughes, 2007; Chmiel, Shaha, & Schneider, 2017;

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Broadbent, 2017), and can foster independent of learning and rich understanding (Nickels & Gartner, 2018). The blended model can also give students to cognitive presence and social experience through synchronous or asynchronous discussions with colleagues and facilitators (Donnelly, 2006; Ndlovu & Mostert; 2017).

Nevertheless, there is a finding that learning outcomes through blended learning do not differ significantly from traditional learning (Botts, Carter, & Crockett, 2018). Moreover, some statements contradict each other that claim learning styles do not affect learning achievement (Brunton, 2014; Kirschner, 2017), but others do not fully agree (Martinez & Tuesday, 2019; Toyama & Yamazaki, 2019; Huang, 2018). However, we think it is necessary to explore that information to consider implementing blended learning while considering the impact of different learning styles on blended learning implementation. Other factors might play a role in influencing the learning process through blended learning and should also be investigated. Moreover, more information about the form of integration most suitable for each type of learning style is needed - in this study teacher candidates in electrical education are the study cohort. Generally, these students come from various situations and conditions, families, home areas, and types of education and economic levels. Hence, we are interested in investigating the use of blended learning to teach them to obtain maximum learning outcomes. The form of online and face-to-face integration is a focus attention of this study because the diversity of integration modes may have different impacts on each group of study participants. The study takes account of claims that the success of blended learning is not the simple integration of teaching in the classroom with digital media but changing patterns and practices of learning (George-Walker & Keeffe, 2010; López-Pérez, Pérez-López, & Rodríguez-Ariza, 2011). Likewise, the diversity of student characteristics may also contribute to differences in the results obtained and differences in the learning material's characteristics (Kim McShane, 2004; Alebaikan & Troudi, 2010). We focus on learning styles because they play an essential role in the learning process (Chang-Tik, 2017; Green & Sammons, 2014). The impact of different learning styles and forms of integration on outcomes are essential to investigate because different individuals in different conditions gave different results (Premlatha, Dharani, & Geetha, 2014; Yang & Quadir, 2018; Shen & Palmeri; 2016; He, 2005).

Building competencies in electrical teacher candidates is essential because they have become necessary provisions to involve them in further teaching assignments (Zhu, Wang, Cai, Engels, 2013; Kömür, 2010; Baran, Correia, & Thompson, 2011) and master the theory and practice of electricity (Keltikangas & Martinsuo, 2009) for planning, implementation, and evaluation of learning (Goodwin & Kosnik, 2013; Kantonidou & Chatzarakis, 2005). This paper describes how teacher candidates' competency is built through appropriate forms of blended learning.

LITERATURE REVIEW

The incorporation of online and face-to-face learning can provide students with excellent opportunities to interact with fellow students and lecturers online (Shorey et al., 2018; Ra, Chin, & Lim, 2016). The convergence between technology-based environments and traditional arrangements is recognized as an effective model and has been implemented in a virtual laboratory in flipped classrooms (Chapman & Hassein, 2018; Gilboy, Heinerichs, & Pazzaglia, 2015). In this context, students can get learning assistance in the form of guidance or demonstrations/simulations, both directly and indirectly (Vitale & Linn, 2018; De Jong, Linn, & Zacharia, 2013). Therefore, it is possible to support independent learning and collaboration (Stoltzfus, 2016; Lim, Yan & Xiong, 2015) because more communication channels are supported (Kimmelmann & Lang, 2018).

Students' speed in processing information varies (Alexakis & Andert, 2015; Kurtz et al., 2013), so choosing cooperative learning for each group is essential. A variety of online and face-to-face blends is possible to fulfill the learning needs. The provision of learning assistance is appropriate to each group based on shared individual learning characteristics (Haruehansawasin & Kiattikomol, 2017; Shu & Gu, 2018). Online learning can provide opportunities for prospective teacher students

who are fast learners and have high learning creativity. In contrast, face-to-face learning can assist the slower learners and provide encouraging results (Lockhart, McKee, & Donnelly, 2017; Kent, Laslo, & Rafaeli, 2016; Ansari Ricci, Persiani, Williams, & Ribas, 2019; Wetzel, De Arment, & Reed, 2015). The study time for students independently and with lecturer involvement in the classroom can be arranged as needed. In shaping the professional prospective teachers' competence, teaching material is delivered through blended learning, which combines online and face-to-face instruction (Jean in Inoue, 2010). The prospective electrical engineering teacher needs to understand the concepts of electricity and have skills in selecting and using the appropriate tools on the task, efficient use of time in carrying out tasks, work safety, and precision of the work results.

In this study, we make variations in three types of combinations of online and face-to-face instruction, adjusted for the learning material. The three types are 25% online and 75% face-to-face instruction, 50% online and 50% face-to-face instruction, and 75% online and 25% face-to-face instruction. IThese relate to the individual's speed difference in digesting information. Diversity of integration is intended to be able to accommodate the diversity of differences that students have. Online learning provides broad opportunities for students to learn independently, especially those who have high learning creativity, and face-to-face can be effective in facilitating and motivating slower students (Wilke, King, Ashmore, & Stanley, 2016; Zwart, Van Luit, Noroozi, & Goei, 2017). Thus, their different competencies can be developed maximally because it is possible for these differences to be accommodated (Manwaring, Larsen, Graham, Henrie, & Halverson, 2017; Kuo, Belland, Schroder, & Walker, 2014), as monitored through measurement and assessment (Moss & Brookhart, 2009).

Learning styles are a process where knowledge is formed through the transformation of experience. Based on Kolbs' learning experience theory, it starts from the Concrete Experience stage (CE), Reflective Observation (RO), Active Experiments (AE), and Abstract Conceptualization (AC). Teaching materials refer to delivering blended learning practices so that students with various learning styles are served. The bipolar continuum (CE and AC) is orthogonal to the bipolar continuum of both RO and AE, which are contiguous modes of preference from the experiential learning cycle. They lead to four basic learning style combinations, which are known as Diverger (between CE and RO), Assimilator (between RO and AC), Converger (between AC and AE), and Accommodator (between AE and CE). Someone may have one of these preferred styles but can learn in and use the other modes. Divergers have strong imaginative abilities and are good at using various views to see things creatively and work with others. Those who prefer inductive thinking and abstract ideas and make theoretical models are Assimilators. Convergers have a strong practical orientation; they are generally deductive and tend not to be emotional, while Accommodators love to do things and solve problems intuitively and take risks (Manolis, Burns, Assudani, & Chinta, 2013).

The learning design uses various approaches to accommodate diverse student learning modes (Pizzi, 2014). Some people say that non-traditional students generally prefer to start from the AC-AE quadrant, whereas traditional students prefer the RO-AC quadrant (Svinicki & Dixon, 1987; Vince, 1998; Wynd & Bozman, 1996). These variations illustrate that using a variety of face-to-face instruction and online instruction also needs to be adapted to different learning styles. For example, more online learning may be more suitable for convergent types. For this reason, it is necessary to choose the right form of learning to give maximum results - that is, high student performance in the course (Chimmalgi, 2018; Vizeshfar & Torabizadeh, 2018; Vanslambrouck, Zhu, Lombaerts, Philipsen, & Tondeur, 2018).

METHOD

Tools and Materials

We built learning webs (URL: http://jpte-ft-unimed.edu20.org) as a platform for this study. Validating completeness of navigation, information loading space, the display aspects, and ease of use of the site was done by involving IT and learning technology support. The learning material prepared is

referred to as the curriculum, and involved three experienced lecturers in assessing the conformity aspects of the material content. Mastery theory tests and skills assessment sheets as competency test instruments were developed, referring to learning objectives. Theory mastery was measured using 25 questions in the form of essays. Dexterity using tools on the task, choosing the right tool, the precision level of the work results, time-efficient use in carrying out tasks, and work safety were all included in the practical skills assessment sheet. The theory mastery scores were determined by giving a score of two if correct and zero if incorrect for all items, so the maximum total score was 50. The range score of Skill Assessment is 0 – 10 for each aspect. Therefore, the maximum total score also 50. Then, the competency score is a combination of the two scores. We tested the instrument's validity first by conducting a test that involved 35 participants and three raters (the lecturers in electrical engineering). No significant differences were found between them (F=.145, Sig,=.865) and we concluded it was feasible to use. We then uses Kolb's Learning Style Inventory 4.0 for tracking participants' learning style types,

Participants and Design

Eighty-four people were selected to become participants in the experiment using the Kolb Learning Style Inventory 4.0. They consisted of 21 people for each different learning style, namely Diverger (Di), Assimilator (As), Converger (Co), and Accommodator (Ac). A total of seven participants were randomly drawn from each learning style group to be placed in a study group with the three different blends of face to face and online learning (25%-75%, 50%-50% and 75%-25%) so that the experimental group became a 3 x 4 design.

Procedure

Pretests were given in advance to all experimental groups to find out their prior knowledge base. Based on the analysis, their initial competencies did not differ significantly (F=2.149, Sig.= 0.76 > .05). The learning activities were then carried out. One lecturer in each group taught activities up to 12 times in one semester. When learning online, the participants had different access codes for each learning group. The groups were BL1 (25 – 75 blended, four times online and eight times face to face); BL2 (50 – 50 blended, six times online and six times face to face); and BL3 (75 – 25 blended, eight times online and four times face to face), Each blend covered the same time and material. As soon as the learning ended, competency tests were carried out and each group member's competency data were recorded.

Data Analysis

The descriptive statistics used to describe competency data were the Kolmogorov Smirnov Test and the Levene Test use to test normality and homogeneity of data. The variety of learning styles, the different forms of learning, and the interaction of learning with learning styles and their effect on competencies was tested through two-way ANOVA at the significance level of .05. Moreover, differences in the average of competencies between learning groups and the type of learning style group was measured through post hoc testing. Plotting the competencies of each group's type of learning style in each form of learning suggests the most suitable combination. All data analyses were carried out through IBM's SPSS 25 program.

RESULTS

Competence Description

The participants' competency description of each learning group (n = 28) shows that the 25-75 Blended Group had the highest score on average (Mean = 73.68; Sd = 7.977), followed by 50-50 Blended (Mean = 75.61; 6.437), and the 75-25 Blended Group (Mean = 71.04; Sd = 5.818). Based

on the learning style group scores, the Assimilator type group members had higher scores (Mean = 76.33; Sd = 7.492) than the members of the other groups: Diverger (Mean = 74.76; Sd = 9.006), Accommodator (Mean = 72.19; Sd = 2.294), and Converger (Mean = 70.48; Sd = 7.336).

Regarding competence in learning by learning style type (n = 7), the Divergers' competency scores showed the highest average score in the 25-75 blended learning group (Mean = 83.29; Sd = 2.690), followed by the 50-50 blended group (Mean = 77.86; Sd = 2.911) and the 75-25 blended group (Mean = 63.14). The average score of the Assimilator group was highest in the 50-50 blended group (Mean = 84.00; Sd = 2.309), followed by the 25-75 blended group (Mean = 76.86; Sd = 4.670) and the 75-25 blended group (Mean = 68.14; Sd = 3. 579). The Converger learning style types had the highest competency score in the 75-25 blended group (Mean = 79.29; Sd = 3.773), followed by the 50-50 blended group (Mean = 68.43; Sd = 2.820) and the 25-75 blended group (Mean = 63.21; Sd = 3.147). Meanwhile, the Accommodator type had the highest competency score in the 75-25 blended group (Mean = 72.57; Sd = 2.070), followed by the 50-50 blended group (Mean = 72.14; Sd = 1.574) and the 25-75 blended group (Mean = 70.86; Sd = 1.676).

Regarding the participants' competency score obtained in the learning group by learning style type (n =7), the Diverger type had the highest scores in the 25-75 blended learning group (Mean = 83.29; Sd = 2.690) followed by the Assimilator (Mean = 76.86; Sd = 4.670), Accommodator (Mean = 70.86; Sd = 1.676), and Converger types (Mean = 63.71; Sd = 3.147). Participants' competency scores in the 50-50 blended learning group, sorted from the highest to lowest scores, are Assimilator (Mean = 84.00; Sd = 2.309), Diverger (Mean = 77.86; Sd = 2.911), Accommodator (Mean = 72.14; Sd = 1.574), and Converger types (68.43; Sd = 2.820). In the 75-25 blended group, the converger type scored the highest (Mean = 79.29; Sd = 3.773), followed by the Accommodator (Mean = 73.57; Sd = 2.820) , Assimilator (Mean = 68.14; Sd = 3.579), and Diverger types (Mean = 63.14; Sd = 2.193).

Data normality is fulfilled (N = 84, Mean = 71.79, Std. Dev. = 6.174, Test statistic = .089), and (Asymp.Sig (2-tailed) = .113 > .05). Also, data homogeneity based on the Mean, Median, Median, and adjusted df, and the Trimmed Mean is Sig.> .05 so analysis continued.

Blended Learning's and Learning Styles' Influence

The various forms of blended learning, learning styles, and their interactions influence the competence of the prospective teacher significantly (Intercept, F = 51381.495, DF = 11, Sig. = .000 < .05). Then Blended learning-BL varieties have a significant influence on competence (F = 16,725, df = 2, Sig.=.00 <.05) as well as the LS-style Learning variety (F = 16,246, df = 3, Sig. = . 00 < .05). Also, their interaction (BL * LS) is significant (F = 57,219, Sig.= 00 < .05). There are significant competence differences among blended learning groups (Table 1).

Several pairs of groups are not significantly different among groups of learning style types (Diverger-Assimilator, Mean Difference = .157; Sd = .916; Sig.=.324 > .05; Converger-Accommodator, Mean Difference = 1.71, Sd = .916, Sig. =. 250 > .05) while other pairs are significant (Table 2).

Figure 1 depicts the competency of each group based on blended forms and learning styles combination. It appears as though people with the diverger learning-style type are better in 25-75 blended learning than assimilators, converters, and accommodators, who performed better, respectively, in 50-50 blended, 75-25 blended, and 75-25 blended.

DISCUSSION

The diversity of online and face-to-face learning combinations gave different impacts on teacher candidates' competencies, in line with the findings of Kim McShane (2004). The composition of blends is fundamental for considering blended learning implementation, as seen in the findings of López-Pérez, Pérez-López, & Rodríguez-Ariza (2011). Using blended learning is not only based on the integration of classroom teaching with digital media but also needs to consider other factors to

Table 1. Competence comparison among blended learning groups

(I) Blended	(J) Blended	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
25-75 Blended	50-50 Blended	-1.93*	.794	.046	-3.83	-.03
	75-25 Blended	2.64*	.794	.004	.74	4.54
50-50 Blended	25-75 Blended	1.93*	.794	.046	.03	3.83
	75-25 Blended	4.57*	.794	.000	2.67	6.47
75-25 Blended	25-75 Blended	-2.64*	.794	.004	-4.54	-.74
	50-50 Blended	-4.57*	.794	.000	-6.47	-2.67
*. The mean difference is significant at the .05 level.						

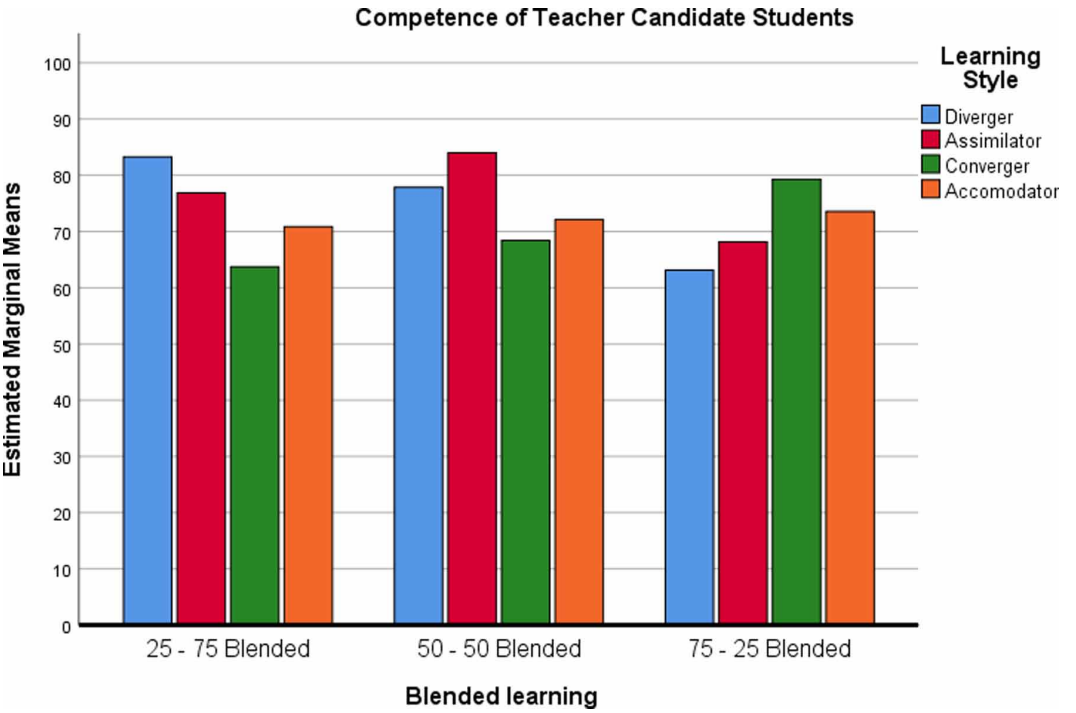
make blended learning superior in practice to create diverse learning patterns and learning materials (George-Walker & Keeffe, 2010).

In this experimental condition, several groups showed that competence based on learning styles did not significantly differ, especially with similar types, namely, the diverger type group against the assimilator type group and the converger type group against the accommodator type group. This further reinforces finding of Huang (2018) that not all learning styles make a significant difference in academic achievement. This is possibly because of the similarity of learning occurring between the process of concrete experience and reflective observation (diverger type) and the process of reflective observation and active experimentation (assimilator type). The same thing happens between the active experimentation process and abstract conceptualization (converger type). This borders on the process of abstract conceptualization and reflective observation (accommodator type). The diverger group

Table 2. Competence comparisons among learning style groups

(I) LS	(J) LS	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Diverger	Assimilator	-1.57	.916	.324	-3.98	.84
	Converger	4.29*	.916	.000	1.88	6.70
	Accomodator	2.57*	.916	.032	.16	4.98
Assimilator	Diverger	1.57	.916	.324	-.84	3.98
	Converger	5.86*	.916	.000	3.45	8.27
	Accomodator	4.14*	.916	.000	1.73	6.55
Converger	Diverger	-4.29*	.916	.000	-6.70	-1.88
	Assimilator	-5.86*	.916	.000	-8.27	-3.45
	Accomodator	-1.71	.916	.250	-4.12	.70
Accomodator	Diverger	-2.57*	.916	.032	-4.98	-.16
	Assimilator	-4.14*	.916	.000	-6.55	-1.73
	Converger	1.71	.916	.250	-.70	4.12
The error term is Mean Square(Error)=8,512. An asterisk (*) signifies that the mean difference is significant at the .05 level.						

Figure 1. Teacher candidates' competence based on learning style in blended learning



competences were very different from the converger group, as were the assimilator and accommodator group's competences. This is in line with previous research - Toyama & Yamazaki (2019) and Martinez & Tuesca (2019) state that different learning styles provide significantly different learning outcomes.

Based on the results from the learning groups, the diverger learning style group showed higher competence in the 25 percent online and 75 percent of face-to-face learning combination, while the converger group befitted from the 75 percent online and 25 percent face to face combination. This suggest that students with the diverger learning style benefit from learning that is more directed towards traditional learners, while the converger type group is non-traditional as stated by Svinicki & Dixon (1987), Vince (1998), and Wynd & Bozman (1996). The assimilators were better at learning with a composition of 50 percent online and 50 percent face-to-face learning, and the accommodator type did better with the 75 percent online and 25 percent face-to-face learning. This shows that different individuals in different conditions tend to produce different results in line with Yang, & Quadir (2018), Shen & Palmeri (2016), She (2005), and Premlatha, Dharani, & Geetha (2014).

CONCLUSION

This research considered the balance on online and face-to-face learning in blended learning to obtain maximum results in student teachers. The results suggest that this balance of online and face to face learning has an impact, but so do different types of learning styles. The interaction between the learning styles of prospective teachers and blended learning was also found to be significant. Teacher candidates' resulting competencies based on their type of learning style were different in each online and face-to-face blended group. So, for teaching them, it is necessary to pay attention to their type of learning style first to choose the right approach and obtain maximum learning outcomes.

IMPLICATIONS

Learning styles are found to play an essential role in the process of forming teacher competency. Therefore, forming learning groups based on students' learning styles should be considered so that the results obtained can eb maximized. The learning styles of students are therefore identified first, for that purpose.

LIMITATIONS

This study only focused on three formats of online learning and face-to-face learning in the context of blended learning. These compositions were applied to prospective teacher students (in the field of electrical engineering) with various types of learning styles. Based on these limited conditions, subsequent researchers have an opportunity to review other factors that play a role in the teaching and learning process through blended learning, perhaps investigating the role of other learning characteristics, including cognitive style and cognitive control.

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Conflicts of Interest

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