EFFECTS OF GENERAL CRITICAL THINKING TEST AND TEACHING METHOD BASED CRITICAL THINKING TEST IN ENHANCING PRE-SERVICE TEACHERS CRITICAL THINKING SKILLS IN NIGERIA

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Abstract
This study aims at investigating the effects of station rotation model in blended social collaborative learning environment in enhancing pre-service teachers' critical thinking skills in university of Maiduguri. A sample of 108 pre-service teachers registered for methods of teaching science course were selected through quasi-experimental study (Experimental group n=54, control group n=54), studying a teacher training program. Two different questionnaires on critical thinking skills (general critical thinking and teaching method related critical thinking questionnaires) were administered to obtain pre-test and post-test scores from the research participants. The results of the study were analyzed using an inferential statistics of multivariate analysis (MANCOVA). The results indicated that there is significant difference in all the five sub-dimensions (inference, assumption, deduction, interpretation, and evaluation of argument) of general critical thinking tests between the experimental group and control groups, whereas the result of the teaching method related critical thinking test indicates significant differences in four out of the five sub-dimensions with the exception of deduction. Therefore, the findings of the study revealed that station rotation model in blended social collaborative learning environment group scored higher than those of the conventional approach group.

Keywords: Critical thinking, station rotation model, collaborative learning, blended learning

Introduction
In order to inculcate critical thinking skills among 21st century preservice teachers, it deems necessary to device a means that might create the enabling learning environment to enhance their critical thinking skills. Critical thinking is defined as a purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based (Demirhan & Kökülkaya, 2014; Facione, 1998; Watson 1980). Teacher education in Nigerian universities, is overwhelmed by teaching approach that does not encourage critical thinking (Adeyemi, 2012; Agbedia & Ogbe, 2014; Mefoh Philip & Ugwu Lawrence, 2014; Peter, 2012; Visande, 2014). The application of conventional approach to learning was prompted by many factors such as lack of adequate resource needed for teaching and learning, behavioral and environmental factors, lack of computer literacy among teachers to adopt to modern technological shifts, inadequate infrastructural facilities (Anene, Imam, & Odumuh, 2014; Dotong, De Castro, & Dolot, 2016).

Training pre-service teacher teachers through conventional approach that gives little or no attention to the development of critical thinking has led to the lack of basic teaching skills to transfer learning to their prospective students, as a result, this may have instilled cumulative adverse effect that may affected the entire system, including the labor force, national economic development and productivity, and general wellbeing of the people (Sada, Mohd, Adnan, & Yusri, 2016; Shardlow, Aldgate, Gibson, Brearley, Daniel, Statham, & Walker, 2015). The need of investigating the levels of critical thinking among pre-service teachers and also to device a framework that encompasses pedagogical processes that will equip pre-service teachers who are bedrock of strengthening the entire education system is paramount.
Despite the striking effort to bring collaboration and social presence in a technology integrated classroom, there is the lack of pedagogical framework that explicitly incorporates station rotation model in blended social collaborative learning environment to enhance pre-service teachers' critical thinking skills. Similarly, there is the paucity of research that integrates these pedagogical approaches that was purely designed through a rigorous academic exercise that involved data triangulation for pre-service teachers. Thus, what necessitate the need for the framework is as a result of lack of ability of pre-service teachers to have critical thinking skills in this part of the world. Similarly, there is projection by the researcher that the framework may help in easing both teachers and student alike in teaching and learning process. Apart from the classroom practice for teacher education program, the framework may serve as a useful guide in other field of endeavor to incorporates into their teaching and learning. Besides that, the study’s framework is belief to improve pre-service teachers’ critical thinking skills. Consequently, the study seeks to encourage active and collaborative learning among students.

To address these issues, this research study considered a blended social collaborative learning environment to enhance students learning. This study used face-to-face instruction and blended learning to teach the pre-service teachers. Blended learning and face-to-face instruction is believed to increase collaborative learning among students (Bonk & Graham, 2012; Garrison & Kanuka, 2004). Moreover, in this study a theoretical elements of Vygotsky’s social learning theory with a particular emphasis to Zone of Proximal Development (ZPD) that involved learners to relate with their peers and other capable adult to construct their own knowledge (Vygotsky, 1978), station rotation model (Horn & Staker, 2012), collaborative learning environment (Dillenbourg 1994), Critical thinking (Watson & Glaser, 1980) was selected as a guiding conceptual framework for the designing of a station rotation model in blended collaborative learning environment as the basis for pre-service teachers to enhance their critical thinking skills. Hence, there is a substantial need to investigate these issues and the need to develop a framework that addresses some of the literature gaps is of essential. This study is aimed at integrating station rotation blended learning model in blended social collaborative learning environment to enhance pre-service teachers to enhance their critical thinking.

2 Theoretical Framework

There are several theories of learning that attempt to solve different learning problems with the sole aim of enhancing teaching and learning, some of these theories are specifically developed to promote classroom collaboration and social interactions among learners. They exist three measure theories of learning, namely: the constructivism, behaviorism, and cognitivist. The degree of significance exhibit by these theories in promoting the quality of teaching and learning cannot be underestimated. This study employed one branch of constructivist theory to examine the effect of station rotation blended learning model in blended social collaborative learning environment to enhance critical thinking among pre-service teachers. Constructivism is a branch of learning theories that deals with how learners construct their knowledge through experience and learning in active process (Jonassen, 1991). In this theory, learners actively construct knowledge, also knowledge is created base on learner’s experience and interaction, prior knowledge and experience is considered to be the source of knowledge (Zaibon & Shiratuddin, 2010).

The theoretical framework that underpinned this study is based on Vygotsky theory of social constructivist. His belief was that learners that work in a collaboration can perform higher intellectual capabilities as against those who work independently, his claim was supported by the hypothesis on social interaction. Vygotsky (1978), belief that social interaction extends students’ Zone of Proximal Development (ZPD). The underlying assumption of this theory lies on the understanding of human cognition and learning social and cultural as against individual phenomenon (Kozulin, 2003).

Apart from using Vygotsky’s approach to examine pre-service critical thinking skills through collaboration and socialization, the research work employed some models and approaches to aid in building the theoretical foundation of this study. This research work incorporates one of the station rotation blended learning model by (Staker & Horn, 2012) and critical thinking by (Watson & Glaser, 1980). These theories and models are carefully selected to help in the smooth conduct of the research. Below depicts the theoretical foundation adopted for this study.
3 Research Questions

This paper addressed the following research questions:

1. What is the effect on the critical thinking skills of pre-service teachers who are taught using SRM-BSCLE in all the five sub-dimensions in general critical thinking?

2. What is the effect on the critical thinking skills of pre-service teachers who are taught using SRM-BSCLE in all the five sub-dimensions in teaching method based critical thinking?

4 Research Hypothesis

1. There is no significant effect on the critical thinking skills of pre-service teachers who are taught using SRM-BSCLE in all the five sub-dimensions in general critical thinking.

2. There is no significant effect on the critical thinking skills of pre-service teachers who are taught using SRM-BSCLE in all the five sub-dimensions in teaching method based critical thinking.

5 Literature Review

Cognitive base learning is what is required to be inculcated in our teacher trainees (Kingsley, 2015), our today’s society demand that students should acquire skills to face challenges ahead of them, this is to enable them, to face the challenges confronting their physical environment. Shardlow et al. (2015), opined that in order for our society to be relevant, students should be taught critical thinking at all levels of education. In Nigeria, student teachers after attending some pedagogical courses like microteaching and curriculum instruction, they are deployed to teach at various primary and secondary schools to teach. These sets of novice teachers should themselves have skills like critical thinking before passing it on to their future students. The current trend in Nigerian education system is surrounded by producing teachers that are lacking in the area of pedagogy and critical thinking (Adeosun, 2014), with the frequent update of curriculum to meet up with the rapid technology development, pre-service teachers need skill like critical thinking to enhance their teaching capabilities.

A number of research studies have pointed out that considerable number of pre-service teachers do not have the required critical thinking skill (Adeosun, 2014; Ijaiya, Alabi, & Fasasi, 2010; Mefoh Philip & Ugwu Lawrence, 2014; Peter, 2012; Sada et al., 2016; Shardlow et al., 2015; Visande, 2014). For example, Adeosun (2014) asserts that there is elevated level of concern for the quality of teachers produced by institutions in Nigeria. Thus, a considerable number of teacher training certificates do have less attributes of critical thinking. According to the author, the Nigerian education system is moving in an opposite direction with 21st century education, the state of the art of education is with full of creative thinking, conceptual knowledge and critical thinking skills. Similarly, due to lack of critical thinking skills, most graduates failed to secure jobs. There is massive failure of students in exams as a result of misuse of pedagogical strategies that neglect critical thinking skills (Ijaiya et al., 2010).

A survey of past question papers in one of the faculties of education in Nigeria, an analysis of 20 years questionnaires of undergraduate and postgraduate shows that pre-service teachers were trained on the basis of lower order thinking. The scale of the analysis was scale base on Bloom’s 1956 six level taxonomy: recall, understanding, application, analysis,
synthesis, and evaluation. The results of the analysis indicated that postgraduate and undergraduate question papers do give emphasis to recall and understanding (80% and 82%) which is a lower order thinking and the higher order thinking skill goes with only 12.2% for postgraduate and 17.8% for undergraduate (Ijaiya et al., 2010). These results show that lecturers in higher institutions in Nigeria do not incorporate critical thinking their lecture and examination. Therefore, this attitude may surely result in producing teachers who are lacking in critical thinking and by extension; these novice teachers may not transfer an effective teaching. Adversely, it might affect the entire system of education. For example, institution of higher learning in Nigeria do not usually give emphasis to activities that have to do with critical thinking among students (Ijaiya et al., 2010). It is of importance to outline these problems and make it known to the policy makers on the importance attached teacher education and the need to strategize the application of critical thinking in to our curriculum to match with current trend in the field of teaching and learning. Especially, with advent of modern technologies, the curriculum should incorporate technological tools that may aid is promoting student centered learning (Galindo, 2014), technology tools like screen-cast video, interactive boards, computers, projectors and other relevant gadgets that helps in teaching and learning should be taken in to cognizance while updating the curriculum to settle issues critical thinking.

Despite the fact that critical thinking is enshrine in the Nigeria’s policy on education, there is worrisome fact by researchers that students were not taught the act of critical thinking skills (Sada et al., 2016). A considerable number of higher education in Nigeria is still dwelling on traditional teaching, graduate lacks critical thinking and that prove to rejecting of most of our graduates in the labor market in the country. Schools in Nigeria, especially at the grassroots level are lacking in critical thinking skill, students and pupils are mainly force to memorize material and memorized answers to particular sets of assessment and provide answer, while neglecting to promote their thinking skills. This has become bore-dom to the authorities because most of graduate do not have the required skills to fill up the vacuum in the civil service and the output of prospective teachers is mostly lack in skills of critical thinking to pass on to their future students. Report have shown that in order for student to solve problem in life, there is the need to teach them to be critical thinkers (Mefoh Philip & Ugwu Lawrence, 2014).

The need for a paradigm shift from teacher centered to student centered is obvious, considering the pressing need of learners lifelong learning and development of critical thinking skills, it is very prominent that teacher trainees should be taught with teaching method that encourage the development of critical thinking skills. A constructivist approach may help in instilling critical thinking to learners, teaching approach like problem-based learning, collaborative learning, or active learning is found to have a significant effect in enhancing critical thinking among pre-service teachers.

Engaging student in a collaborative learning, problem based learning and active learning activities can promote critical thinking in a classroom (Peter, 2012). However, this could be achieved, if the means of instruction is in conformity with thinking process: guiding student to think critically and by asking questions that makes them think critically. Also, student teachers that do not think critically may have it strange to use their thinking faculty to teach others. For instance, asking questions such as identify, define, enumerate, analyze, and list (IDEAL) could trigger their critical thinking skills (Chikiwa, & Schäfer, 2018; Peter, 2012; Sciacca, 2016). This technique of arousing students critical thinking usually encourages collaboration among learners. For instance, mathematics educators should use such techniques to attract their students critical thinking, creating environment that engage learners in an active way to investigate information and application of information knowledge might help in improving learners critical thinking (Peter, 2012).

In Nigeria curriculum of teacher education is lacking in critical and it is recommended that there is the need to review critical thinking in higher education (Ijaiya et al., 2010). This assertion could be ascertained by the fact that, the story in other parts of the world is almost similar to that of Nigeria. For example, Allamakhrah (2013) in a study learning critical thinking in Saudi Arabia revealed that there is an urgent need to review Saudi Arabian curricular to include critical thinking skills as against the existing usage of conventional teaching techniques which render pre-service teachers’ inexperience and unproductive. When school curriculum is aligned with critical thinking, it will foster development to all aspects of education and indeed to the benefit of generality of the society.

Gashan (2015) opined that educating citizen and qualifies workforce a critical thinking skills is of essence, considering the current transformation in technology based economy and the flow of tones of accurate and inaccurate information and communication technology and the competitive nature of our today’s society, critical thinking skills is the basic tool to confront those challenges and perhaps teachers are expected to use their cognitive thinking in delivering instruction to their students at all levels of education, in this regard, the importance of training pre service teachers the concept of critical thinking has become the basis to promote the society to encounter the pressing challenges facing the education system and the society as a whole.

The quality teachers determine how effective the education system and therefore there is overall belief that teacher education is the bedrock of not only education system but by extension it is beneficial to the society or the nation as a whole. The nation itself should weight their emphasis to the teaching and learning of critical thinking skills because teachers and the work force that will handle the economy is all product of education system. Failure may render the economy
unproductive and left the economy in a paralyzed manner. In order to meet up with the existing gap in the labor force and the current demand in our today’s society, it is of essence to train our pre-service teachers the act of critical thinking, so that they would translate those skills in their classrooms, and by extension the output of what they taught will benefit to the society.

The world of information age is with full of qualities that shapes human life and most probably in educational research these qualities are used to shape the society. Among these qualities are the critical thinking, problem solving, and creative thinking (Güven & Kürüm, 2007). The current trends in the field of education have considered how critical thinking would utilize to bring about effectiveness in teaching and learning. Critical thinking skills among pre-service teachers is very essential because with the skills they can teach their students in accordance with the laid down teaching principles.

Apart from Nigeria, there are issues related to lack of critical thinking among pre-service teachers in some countries around the world (Akdere, 2012; Akinoglu & Karsantik, 2016; Bakir, 2015; Gashan, 2015; Sendag, Erol, Sezgin, & Dulkadir, 2015; Shardlow et al., 2015; Güven & Kürüm, 2007; Temel, 2014). For instance, Results shows that pre-service teachers’ level of critical thinking is below average, though a moderate positive attitude and self-efficacy in teaching CT was observed (Akdere, 2012). Güven & Kürüm (2007), Pre-service teachers’ critical thinking skills is found to be low. Also, Gashan (2015) found out that pre-service teachers were found to have inadequate knowledge of critical thinking skills. The level of critical thinking among pre-service teachers is found to be low (Temel, 2014). In a result on a study on Saudi pre-service teacher on their knowledge about critical thinking skills, finding of the study revealed that there is low level of utilization of web 2.0 among pre-service teachers though the result has indicated high level of competence in social networking tool like YouTube among pre-service teachers. A meaningful relationship between pre-service teacher use of web 2.0 and their critical thinking skill was observed. Furthermore, the use of combination of several web 2.0 tool might improve pre-service teachers critical thinking skills (Sendag et al., 2015).

Moreover, studies on experimental with control and experimental groups research were carried on pre-service teachers critical thinking skills (Arsal, 2015; Kong, 2001; Mcbride, Xiang, Wittenburg 2002) shows that there is statistically significant differences found between experimental group and control group. The result revealed that pre-service teacher has a positive inclination toward critical thinking skills (Mcbride et al., 2002). There is concern about critical thinking skills of pre-service around the world, this has necessitated the inclusion of critical thinking and higher order thinking skills in young adolescent. It is more compelling for teacher to have knowledge of critical thinking skills, a teacher should understand the nature of content and material and the critical thinking skills before transferring to their students. The California Critical Thinking Disposition Inventory (CCTDI) is useful for assisting teachers as they train novice teacher the act of CT (Mcbride et al., 2002). Similarly, there is statistically significant difference between experimental and control groups, where experimental group showed a greater progress of critical thinking disposition. It is advice that implementation of micro teaching should be plan to improve pre service teacher critical thinking skills (Arsal, 2015). The critical thinking skills of pre-service teachers in experimental group who are exposed to thinking module have significantly improved as against those in control group that did not received similar treatment (Kong, 2001). This sets of pre-service teachers whose level of critical thinking skills have been improved as result of the treatment might have the opportunity to tackle academic problems as well as mange their classroom effectively.

The development of critical thinking skills is an essential part of pre-service teacher education (Anastasiadou & Dimitriadou, 2011). Pre-service teacher who have critical thinking skills can plan and execute their lesson that will improve students’ critical thinking skills (Arsal, 2015). Critical thinking could be seen as a self-discipline and guided thinking that reason at a higher quality level in a fair-minded manner (Arsal, 2015).
6 Methodology

This paper employed a quasi-experimental design involving experimental and control groups. A pre-test and post-test was administered to the participants in order to determine whether the effect of SRM-BSCLE in enhancing pre-service teachers critical thinking skills. Sample of this study were selected based on purposive sampling technique, where participants were selected to participate in experimental and control groups consisting of pretest and posttest with an intervention (SRM-BSCLE). The participants were first semester pre-service teachers who were selected based on nonrandomly sampling technique from department of education university of Maiduguri (n=54). Two questionnaire were used to collect data from the participants: general critical thinking questionnaire contained 80 items and teaching method related critical thinking questionnaires contained 45 items. Both questionnaires measures five sub-dimensions namely, Inference, Assumption, Deduction, Interpretation, and Evaluation of Argument which was adapted from Watson Glaser Critical Thinking Appraisal (WGCTA) by Watson and Glaser (1980) . The questionnaires are multiple choice that was designed to address critical thinking skills across the five different sub-dimensions.

The Cronbach values of general critical thinking is 0.85 and that of teaching method related critical thinking is 0.89 respectively. The information obtained from the participants were analysed using the statistical tool for analyzing quantitative data. Thus the data were analysed through multivariate analysis (MANCOVA).

8 Results

This section deals with SRM-BSCLE based on the outcome on multivariate analyses of covariance. When testing hypothesis (What is the effect on the critical thinking skills of pre-service teachers who are taught using SRM-BSCLE in all the five sub-dimensions in general critical thinking and sub-dimensions in teaching method based critical thinking?). A one-way multivariate analyses for covariance (MANCOVA) was conducted to examine the difference on the post-test and five sub-dimensions of critical thinking in general critical thinking and teaching method based critical thinking.

Therefore, pre-service teachers’ pre-test scores was subjected to covariance and the post-test scores were subjected to dependent variables list. In order to observe a noticeable improvement of critical thinking skills among pre-service teachers, two separate MANCOVA’s were conducted on the two critical thinking questionnaires used in this study, that is, general critical thinking and teaching method based critical thinking. The measurement of the critical thinking was conducted through the five sub-dimensions measured by both questionnaires, these dimensions includes the inference, assumption, deduction, interpretation, and evaluation of argument.

8.1 General Critical Thinking on Pre-service teachers SRM-BSCLE

The first MANCOVA was conducted on general critical thinking and the outcome of the test has yielded a statistically significant effect on the groups Pillai’s for inference (See APPENDIX C8 and C9), V = 0.046, F (5, 93) = .902, p = .000, assumption V = 0.072, F (5, 93) = 1.439, deduction V = 0.117, F (5, 93) = 2.454, p = .000, interpretation V = 0.061, F (5, 93) = 1.202, p = .000, evaluation of argument V = 0.033, F (5, 93) = 0.641, p = .000. Based on the results of the five sub-dimensions measure by general critical thinking, a statistically significant effect was noticed.

The results show a significant effect on the two groups toward the five dependent variables in the study which are inference [F (2, 97) = 202.6, p < .05], assumption [F (2, 97) = 155.6, p < .05], deduction [F (2, 97) = 78.6, p > .05], interpretation [F (2, 97) = 115.7, p < .05], and evaluation of argument [F (2, 97) = 76.9, p < .05]. Table 5. 19 below shows value of $R^2$ for the characteristics of critical thinking of pre-service teachers.

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Percentage change in dependent variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inference</td>
<td>70.6%</td>
</tr>
<tr>
<td>Assumption</td>
<td>67.8%</td>
</tr>
<tr>
<td>Deduction</td>
<td>51.6%</td>
</tr>
<tr>
<td>Interpretation</td>
<td>56.1%</td>
</tr>
<tr>
<td>Evaluation of argument</td>
<td>52.5%</td>
</tr>
</tbody>
</table>
The value of $R^2$ show that in this study contribute 70.6 percent of the change in dependent variable of inference, 67.8 percent of the change in the dependent variable of assumption, while change dependent variable on deduction was found to be 51.6 percent. Subsequent results of the contributes 56.1 percent in dependent variable on interpretation and finally, the dependent variable on evaluation of argument got 52.5 percent.

### 8.2 Teaching Method Based Critical Thinking on Pre-service teachers SRM-BSCLE

The second part of the analysis for MANCOVA was conducted for teaching method based critical thinking and it has yielded a statistically significant effect on the groups Pillai’s $V$ for inference (See APPENDIX C5 and C6), $V = 0.254$, $F(5, 93) = 6.337, p = .000$, assumption $V = 0.351$, $F(5, 93) = 10.06, p = .000$, interpretation $V = 0.147$, $F(5, 93) = 31.96, p = .000$, evaluation of argument $V = 0.181$, $F(5, 93) = 41.21, p = .002$, however, no statistically significant effect was noticed on deduction $V = 0.075$, $F(5, 93) = 1.515, p = .193$. The results show a significant effect on the two groups toward the five dependent variables in the study which are inference $[F (2, 97) = 173.3, p < .05]$, assumption $[F (2, 97) = 141.1, p < .05]$, interpretation $[F (2, 97) = 207.0, p < .05]$, and evaluation of argument $[F (2, 97) = 285.0, p < .05]$, meanwhile deduction is found to be not be significant $[F (2, 97) = 5.222, p > .05]$. Table 5.20 below shows value of $R^2$ for the characteristics of critical thinking of pre-service teachers.

### Table 12: Percentage Change in Characteristics of Teaching Method Based Critical Thinking

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Percentage change in dependent variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inference</td>
<td>67.9%</td>
</tr>
<tr>
<td>Assumption</td>
<td>63.3%</td>
</tr>
<tr>
<td>Deduction</td>
<td>13.0%</td>
</tr>
<tr>
<td>Interpretation</td>
<td>57.3%</td>
</tr>
<tr>
<td>Evaluation of argument</td>
<td>68.0%</td>
</tr>
</tbody>
</table>

The value of $R^2$ show that in this study contribute 67.9 percent of the change in dependent variable of inference, 63.3 percent of the change in the dependent variable of assumption, while change dependent variable on deduction was found to be 13 percent. Subsequent results of the contributes 57.3 percent in dependent variable on interpretation and finally, the dependent variable on evaluation of argument got 68 percent.

In summary, all the two tests conducted for MANCOVA has shown a statistically significant effects on the five sub-dimensions in general critical thinking skills of pre-service teachers in the SRM-BSCLE, namely: inference, assumption, deduction, interpretation, and evaluation of argument. The result of the analysis for the teaching method based critical thinking shows that there statistically significant effect in the two groups, in which the $p < .05$ four of the five sub dimensions except deduction that show a not significant result with $p > .05$ while the results of the analysis on general critical thinking indicated a statistically significant effect on all the five sub dimensions measures by the instrument. Therefore, the null hypothesis for both instruments used to analyzed MANCOVA were rejected and the researcher concludes that there was statistically significant effect on the critical thinking skills of pre-service teachers who are taught using SRM-BSCLE in all the five sub-dimensions in general critical thinking and four (except deduction) sub-dimensions in teaching method based critical thinking.

### 9 Discussion

As revealed in the result of the MANCOVA, on the five dimensions for Critical Thinking, there was a statistically significant effect in the critical thinking skills of SRM-BSCLE group in general critical thinking and teaching method related critical thinking used to determine the changes of critical thinking among pre-service teachers, where the findings suggest that the station rotation model in blended social collaborative learning environment group groups on the five sub dimensions were found to perform significantly higher in critical thinking skills in the five sub dimensions in critical thinking namely, inference, recognition of assumption, deduction, interpretation, and evaluation of argument.

Similarly, the results of the teaching method based critical thinking for MANCOVA shows that there are statistically significant difference in critical thinking of pre-service teachers in station rotation model in blended social collaborative learning environment (SRM-BSCLE) group. The result of the present study concurs with previous study conducted by (Fauziah, 2011). Thus, the result of the present study in teaching method based critical thinking shows enhancement in the critical thinking skills in four of the five dimensions, namely; inference, recognition of assumption, interpretation, and evaluation of argument with exception of deduction which shows an insignificant results. Thus, the sub dimensions of deduction
does not show a significant effect in between the two instruments. Despite this outcome, the researcher concludes that the intervention on SRM-BSCLE is able to enhance pre-service teachers critical thinking skills.

These findings confirm the findings of (Howard, Tang, & Jill Austin, 2015; Sadeghi, 2012; Tiruneh, De Cock, & Elen, 2017; Tiruneh, Weldeblasie, Kassa, Tefera, De Cock, & Elen, 2016) who found that there is significant difference in the sub-dimensions of critical thinking skills in intervention group. Therefore this study’s findings supports the previous studies findings since they focus on enhancing pre-service teachers critical thinking skills. The present study is important in demonstrating that pre-service teachers critical thinking was enhanced after the intervention. In the present study critical thinking have been used as designing a constructivist approach to learning that was believe to enhance critical thinking of learners (Hong, Chang, & Chai, 2014; Tiruneh et al., 2016). Similarly, the instrument used to measure pre-service teachers critical thinking in this study was used to test learners critical thinking before and after the instruction on experimental groups.

The impact achieved from both instruments was achieved as a result of the intervention on station rotation model in blended social collaborative learning environment. It is not surprising that pre-service teachers critical thinking was enhanced due to the learning environment that comprised of blended learning, collaborative learning, social learning, and a blended learning model of station rotation. According to Ennis (1986), there are two major approaches to incorporating critical thinking into teaching and learning, they are infusion and immersion approach. The infusion approach is directly embedding critical thinking in to the subject matter and instructs learners. This is taking place while learners are being trained on specific knowledge and activities of acquiring critical thinking skills. The second approach to embed critical thinking skills to a learning content is called immersion approach, this deals with the opposite to the former which state direct application of critical thinking components in the subject matter content. The immersion approach deals with embed critical thinking in the content matter through learning approach that develop critical thinking, this implies that learners could imbibe critical thinking skills on the process of learning in a learning environment that promotes critical thinking.

10 Conclusion

In conclusion, there are limited literature that support the immersion approach, however, there are few studies that employ the technique and the findings of the study was found to be significant in enhancing learners critical thinking skills. Thus, the present study employed the immersion approach by developing learning environment that encourages critical thinking for pre-service teachers. this study adopted and used a theoretical and empirically valid approaches that foster critical thinking, these include collaborative learning (Dillenbourg, 1999; 2009 & Kreijjs, 2003), blended learning (Crawford & Jenkins, 2015; Popovic, Popovic, Rovecanin Dragovic, & Cmiljanic, 2017; Liu & Shi, 2016), social interaction through zone of proximal development (ZPD) (Fani & Ghaemi, 2011; Vygotsky, 1978; Zeuli, 1986), and station rotation model (Byndas, 2017) are all pedagogical approaches that promote critical thinking among learners. For example, since the enhancement of critical thinking was significant in station rotation model in blended social collaborative learning environment group, with a major improvement in the five sub dimensions in both questionnaires of critical thinking teaching method based critical thinking.

Furthermore, in order to see the study on different dimension to see its effect, since the approach to critical thinking used is immersion with only two groups, the researcher suggest that further research on infusion and immersion approach to critical thinking for pre-service teachers, a Solomon four group design may be conducted to how different approach might help in enhancing critical thinking of pre-service teachers. Hence, another strategy to be adopted is the implementation of instructional design technique that promote cognitive learning among learner. This may take a kind of instruction that engage learners from outside classroom scenario and self-regulated learning strategy should be tested in a future research.

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