DESIGN AND DEVELOPMENT OF A BLENDED SOCIAL COLLABORATIVE LEARNING ENVIRONMENT TO ENHANCE THE CRITICAL THINKING SKILLS OF SCIENCE PRE-SERVICE TEACHERS

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Abstract

Designing a blended learning environment to enhance the critical thinking skills of pre-service teachers requires the application of multiple pedagogical approaches, learning theory, and systematic approaches in instructional system design and implementations. The combination of these strategies may greatly assist educators in specifying the needed instruments and pedagogical practice to set up a befitting learning environment; it also helps in providing a solid base from which to build the technology and theoretical approach to enhance the critical thinking skills of learners. The blended learning environment was designed based on Vygotsky's perception of social learning theory, Instructional Design Model, Horns and Stalker's Blended Learning Model, and Dillenbourg's Collaborative Learning Approach. This paper helps inform educators about how to design and develop an appropriate learning environment and preferences according to enhancing science pre-service teachers' critical thinking skills.

Keywords: design, development, blended social collaboration and critical thinking

Introduction

This paper aims to design and develop a station rotation model of blended learning. This is to give educators, practitioners, researchers, and any other interested party to see the event and process in which this learning environment was developed and implemented. This study used several fundamental pedagogical practices to enhance pre-service teachers' critical thinking. The section seeks to answer the objective, *"To design and develop a blended social, collaborative learning environment to enhance critical thinking among pre-service teachers in a Nigerian public university."*

The Design of Blended Learning Environment for Pre-service Teachers

In this study, the researchers relate the blueprint for designing a blended learning environment. A blended learning environment course for pre-service teachers was designed and developed to enhance pre-service teachers' critical thinking skills. The composition of the blended learning course involves using the station rotation model, a pedagogical principle guided by Lev Vygotsky's Social Constructivist theory of learning. The learning environment constitutes teacher-led activities, collaborative activities, online instruction, and multimedia elements such as PowerPoint, videos, Internet, projector, and smartboard, incorporated into the teaching and learning process.

Decision Factor Involved in Developing the Blended Learning Environment

The decision factor involved in the development of a blended learning environment in this research study focused on the synergy of technology, pedagogy, and content used in teaching blended learning (Pankin, Roberts, & Savio, 2012), which is widely used as a guiding principle for designing and developing a blended learning approach (Abhijith, Nayak, Pavan, & Prasad, 2015; Almohaimeed, Alhaidari, Alhamdan, Alfaries, & Kranov, 2016; Ghadiri, Qayoumi, Junn, Hsu, & Sujitparapitaya, 2013). The following is a detailed description of how blended learning was incorporated into this study. This study included technology, content, pedagogy, logistics, evaluation, resources, research assistant, subject matter expert, software technology, space, material, course duration, the objective of the lesson, and screencast video.

Technology

The following technological devices were incorporated into this study: Microsoft PowerPoint, Camtasia, Smartboard, projector, laptop, headphones, and computers, which are part of the instructional process. These devices were integrated to enhance teaching and learning among pre-service teachers in the Faculty of the Education University of Maiduguri; the researcher was guided by a blended learning environment framework of technology integration to deliver the instruction.

Content

The study employed existing content used in teaching science teaching methods to pre-service teachers in the Education University of Maiduguri faculty. The pre-service teachers delivered the content to skillful, knowledgeable, and experienced teaching staff selected to serve as research assistants to teach the control and experimental groups. Thus, special attention was subjected to the teacher training who led the treatment group. He was guided on group formation and handling of a blended learning environment. The said teacher was trained on the lying technology using science teaching methods. All the students in this study are new to the subject matter; they are undergoing a teacher-training program for the first time.

Pedagogical Approach

The pedagogical principle applied in this study was blended learning through one of its models called the station rotation model. Also, emphasis was accorded to the collaborative learning approach to teaching and learning. According to Dillenbourg (1999), collaborative learning is believed to describe a situation that leads to forming a particular scenario of interaction among learners. It is, therefore, a fact that, according to him, collaborative learning should constitute four principles: situation, interaction, processes, and effects. These four elements are crucial to understanding that are concerned with a collaborative pedagogical approach. For example, the problem in collaborative learning comprises symmetry and the degree of division of labor among the cooperative groups. In contrast, the interaction in a collaborative group deal with negotiability and balance aspects. More so, grounding, and mutual modeling in the collaborative learning environment are an essential element that is signified processes. Lastly, effects in the collaborative learning environment emanate from a situation that triggers interaction patterns that may generate some cognitive results. This relation is not a standalone, but it is reciprocal. Similarly, there is a bi-directional relationship between processes and effects in collaboration in terms of internalization. Therefore, this study's collaborative pedagogical aspect is guided by these four principles of cooperative learning (Dillenbourg, 1999). This includes situations, interactions, processes, and effects.

Role of Teacher

The following roles are expected to be played by the teacher: The teacher should state the learning goals, State the overall objectives, supply material to be used and those that the group will share, explain individual and group tasks, and accountability will be checked and explain criteria to be used, explain if any, rewards and means of acquiring the reward, provide and teach the social skill to receive and give an example, describe teachers' role, assigned each group to a specific area and task, and organize or assign a group to a particular size and compatibility.

(a) During the Lesson

(i) The teacher is expected to observe pre-service teachers' social skills
(ii) The teacher monitors pre-service teachers' behavior, takes notes, and gives feedback to the pre-service teachers.
(iii) The teacher helps where necessary and responds to group question

(b) After Lesson

i. The teacher check student and follow up
ii. The teacher assists by responding to group questions and reporting any new findings to the class
iii. The teacher comments on positive and negative behavior
iv. The teacher privately critiques the lesson in writing for future correction

Logistics

The quasi-experimental study used a non-random sampling technique to select the sample involving control and experimental groups. The two groups in this study constitute 54 pre-service teachers in the control group and 54 pre-service teachers in the experimental group, making 108 respectively. The study covered eight weeks of the semester

with six weeks of active instruction, and the remaining two weeks were used in administering pre-test and post-test in one week each, and it was conducted in the first semester of the 2017/2018 sessions. The development of the blended learning environment took about three months to be completed. Besides that, the researcher sought content validation by a subject matter expert (SME).

Evaluation of Pre-Service Teachers

What was measured?

i. Pre-service teachers' level of critical thinking was measured using the adapted questionnaire on Watson Glaser Critical Thinking Appraisal W-GCTA) (Watson, 1980) and Teaching Methods Critical Thinking Appraisal TMCTA.

ii. a pretest and post-test form of evaluation was used to measure students' critical thinking.

iii. a pre and post-test were administered to both control and experimental groups.

iv. The participants might have an idea about teaching science. Still, the expectations are that there might be the possibility of them lacking the basic knowledge of the content to solve many problems ranging from inference, assumptions, deduction analysis, summary, and interpretation of results.

v. At the end of the intervention, pre-service teachers in the experimental group were subjected to interviews to determine whether the intervention enhanced their critical thinking skills, and the score of the critical thinking test was graded according to the faculty grading system after which pre-service teachers must pass the course to move to the next level.

Resources

The researcher trained research assistants to serve as the instructor to deliver the content to the study's control and experimental groups. The classroom instruction is given once a week. Each group received a two- to three-hour lesson throughout the six (6) weeks instruction periods covered by the study. The researcher traveled from Malaysia back to Nigeria, where the data collection took place.

Research Assistant and Instructor

The researcher employed the service of research assistants to serve specific functions assigned to them. The research assistant (RA) was professionally trained to deliver some of their responsibilities. The instructors who are the research assistants have prior experience in teaching the content, and therefore, it took them less time and effort to prepare to teach the participants. However, special attention and consideration were given to the instructor who served to introduce the experimental group. This is due to the complex nature of delivering a blended learning environment. More precisely, the instructor was specifically trained on how to employ techniques for small learning because the station rotation model of blended learning is principally dominated by learning modalities that small groups of learners rotate in a fixed-leaning station. For example, the instructor for experimental groups was also trained on the ideas for effective small group learning and teaching; the instructor was trained in line with the principles listed below:

i. First meeting with a small group of station rotation
ii. Use of language
iii. Teachers' session at the end of each group
iv. How to make the learning environment conducive to encouraging effective learning.
v. Grouping techniques
vi. Assisting the learners to communicate with their peer's in-group and individually
vii. Encouraging learners to think critically.
viii. How to identify and handle an overly dominant learner
How to encourage learners to clarify their point of view and ideas by simple expression.
ix. How to respond to learners' questions in a friendly manner
x. How to identify and handle learners who are not actively participating in the group discussion
xi. The instructor was also taught about Jigsaw techniques.

Subject Matter Specialist (SME)

A subject matter specialist service was employed to restructure and redesign the content to have a total content output. The benefits of specialists in curriculum and instruction and educational technology were involved in designing and structuring the content. The role of the SME is to check whether the content conforms with the stated objectives, and the instructional designer's role is to make sure the blended learning environment has informed the goals. It is fit for

delivery for teaching and learning. The two specialists were drawn from the Education University of Maiduguri faculty to volunteer in providing their expertise. Following were the composition of the Subject Matter Expert Assessment: Professor of instructional design, Professor of measurement and evaluation, Professor of educational technology, and Ph.D. Holder in educational technology.

Software Technology

There are involving two major software technologies used in this study. Microsoft PowerPoint and Camtasia were used to develop PowerPoint presentations and the screencast video for instructional purposes. This software incorporates content on science teaching methods into six different topical areas covered by this study. While in the classroom, the instructor deployed a computer, projector, and LED board to deliver the lesson.

Technical Support

One of the faculty technicians in the education department at the University of Maiduguri provided technical support to fixed computers and a projector; Smart Board was required to facilitate the blended learning environment for effective teaching and learning.

Space

The instruction was carried out in a classroom located at the faculty of the education university of Maiduguri. The classroom can accommodate 70-80 learners at a time, which is enough to contain the participants for the experimental group. The room has enough tables, chairs, and all the needed instructional materials for the smooth delivery of the lesson. Thus, the classroom setup has devices such as a smart board, two laptops, and five desktop computers used in one of the stations. Also, the arrangement in the classroom is based on the group in their stations, where tables and seats are arranged to allow collaboration with light access and a projector for general class demonstration. Furthermore, the classroom was perfectly organized to accommodate a proper learning environment that involved the numbering of tables, coloring and coding of groups, cardboard paper inscription, a clock placed to ensure timekeeping, and a computer station.

Material

The researcher has a copy of the existing pre-service teacher pedagogical content delivery materials designed to teach sets of pre-service teachers. The material was printed according to the number of participants in the experimental group. Other instructional aids used to facilitate learning were Cardboard papers, Makers, writing materials, Props, and CDs.

Course Duration

The nature of course duration in the university system in the Nigerian context is determined by the unit (s) of the course. Course unit in the department of education was two (2), and therefore science method course is a two (2) units course, and each team is allocated one (1). This implies that each lesson was taught for two hours, combined with the content-led weekly, and it is exhausted in twelve (12) hours within six (6) consecutive weeks. The breakdown of the lesson is as follows:

TABLE 1: LESSON BREAKDOWN

Lesson	Topic	Duration
Week 1	Role of teachers in teaching science	2 hours
Week 2	Scientific method	2 hours
Week 3	Methods of teaching science	2 hours
Week 4	Choice of Method	2 hours
Week 5	Teaching Aids	2 hours
Week 6	Role of Laboratory in teaching Science	2 hours

Objectives Of the Lessons

By the end of each lesson, the participants (experimental group) will be able to analyze, summarize and interpret accurately lesson learned. The participants are expected to think critically in solving problems related to their methods of teaching science.

Consistent Structure

Consistency was maintained in the delivery of the instruction. This was carried out to ensure effective instruction to the pre-service teachers. The structure of the lesson's content was made to look like it to avoid ambiguity.

Evaluation of Framework

Experts ascertained the framework developed by this study in educational technology (See Appendix 1).

Screencast Video

Learners watch screencasts video that the researcher developed to teach scientific methods to the pre-service teachers. The screencast video was conducted once a week, coupled with face-to-face instruction and collaborative group learning. A total of 6 screencasts were created based on the six topics covered by this study. The screencast was published in a CD drive and distributed to the participants to watch before coming to the lesson. This was achieved in the first meeting when the pre-test was conducted in week one. Pre-service teachers who raised the concern of lack of computers in their homes are directed to use the faculty computer lab to access the videos deposited by the researcher with the help of technicians. The technician guided the pre-service teacher to access and watch the video during their leisure hours. Figures 1, 2, 3, 4, and 5 are samples of screens captured from the screencast randomly selected for display.
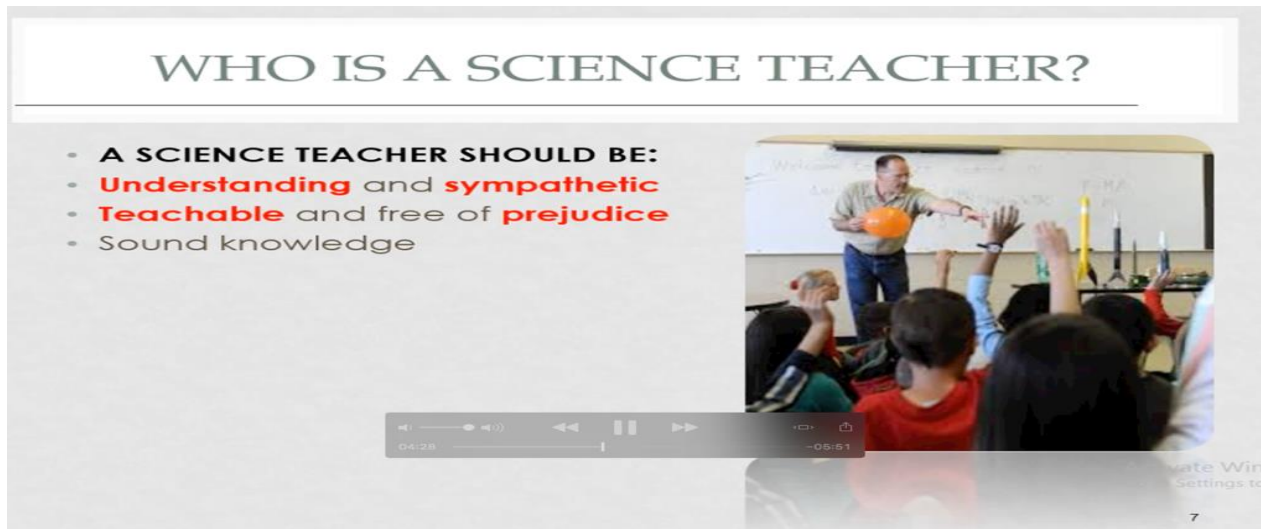

Fig. 1. Sample Screenshot of a Screencast Video for Lesson One

Fig. 2: Sample Screenshot of a Screencast Video for Lesson on Choice of Method

Fig. 3: Sample Screenshot of a Screencast Video for Lesson Six

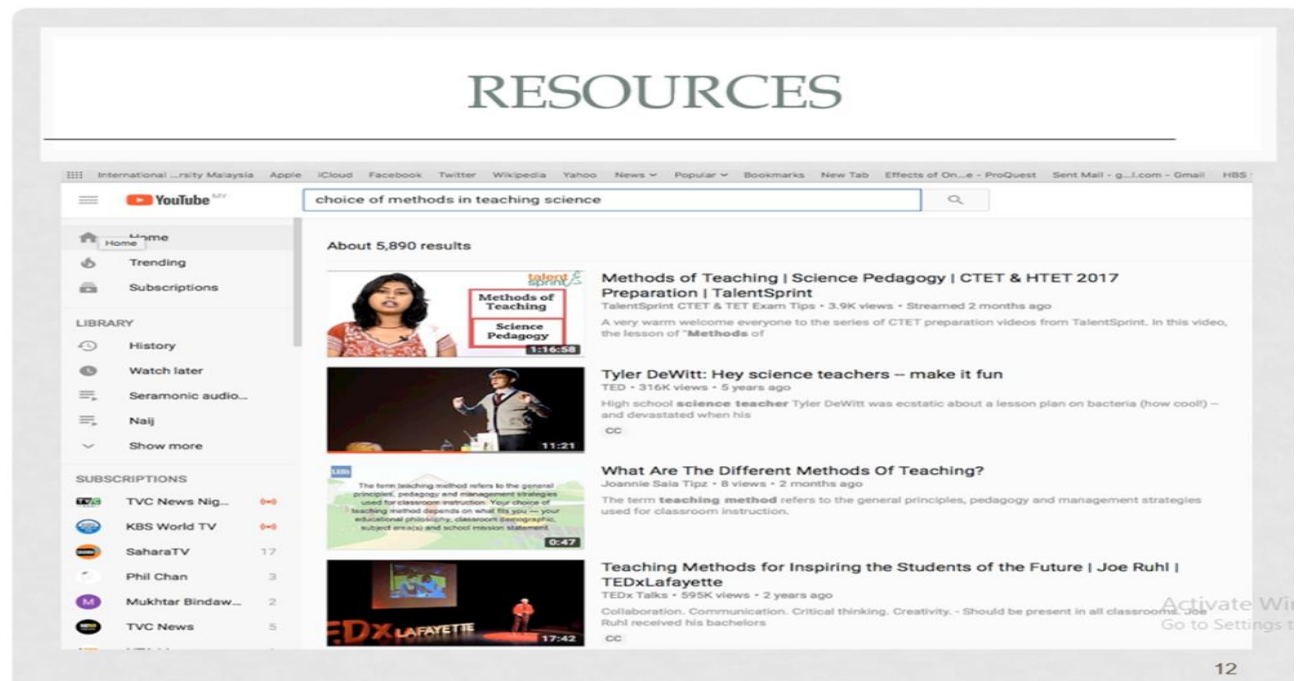Figure 4: Sample Screenshot of a Screencast Video of Lesson on Laboratory

Fig. 5: Sample Screenshot of a Screencast Video for Resources

Delivery of Blended Learning

The following is a detailed description of how the blended learning station rotation model was designed and implemented in this study. This study incorporated face-to-face learning, topic discussion, assignment, video instruction, group collaboration, online learning, and individual tutoring. Also, the study was aided by teaching aids like CD/DVD, calendar activity, handouts, smart board, and screencasts video. These are the pedagogical principles and technological tools needed to integrate into this study's classroom practices. Following is the discussion on the factors involved in developing the screencasts video: (Oliver & Trigwell, 2005; Pankin et al., 2012). The instructional content affected a blended learning environment that comprised of the following: collaboration, small group learning, presentations, assignment, video instruction, which was professionally developed by the researcher base on the existing content of the faculty of education.

Thus, nine stations are involved in the learning environment, and each of these stations performs a different task at an additional time. For example, the researcher designed the program based on the station rotation blended learning model that allows learners to rotate in other learning modalities. To achieve successful learning, the researcher developed an innovative learning environment that extends the existing model to incorporate pedagogical techniques like collaborative learning and zone of proximal development (ZPD) to make learning admirable to pre-service teachers. This was purposely designed to accommodate several learners at a time inside a classroom setup. In this learning approach, it is believed that learners are presented with several activities that include solving problems in a group, active teacher guidance, coaching the learners to accept responsibilities and work in a group, collaborating with peers to find solutions to problems, online learning that allows learners to interact with electronic media, watching instructional screencast video to digest learning content from within and outside the classroom. Social interaction results from the zone of proximal development, in which peer-to-peer collaboration and teacher support are imminent. Therefore, this learning environment combines several active learning scenarios that give learners a high advantage to learn specific content and enhance their critical thinking skills.

TABLE 2: DELIVERY METHOD ADAPTED FROM PANKIN ET AL. (2012)

Group (GR)	Instructor (IS)	Collaborative and Social Learning
• Participate in the discussion forum • Review other's work remotely • Group presentation • Watch instructional videos online and discuss remotely • Download relevant materials	• Coaching (in-class) • Advising the groups on how to carry out their online task • Maintaining strict academic application while the group is online • Coaching and guiding pre-service teachers on online learning.	• Research online • or online document • Take an eLearning course • Handling groups task • Allowing peer interaction in between and among groups
• Group project work • Group presentation • Group learning • Watch instructional screencast videos online and discuss remotely. • Group assignment • Topic discussion	• In-class lesson • Hands-on with feedback • Coaching (F2F) • Advising on project • Case study with feedback	• Read articles, books • Keep journal • Write paper • Comment on the work of peers • Interaction

Station Rotation Model
The station rotation learning modalities for the pre-service teachers' delivery were organized based on the six groups. Each group performed a specific learning task that differed from the others. The station rotation model makes it possible for pre-service teachers to shift from one learning modality to another. This is carried out to ensure that pre-service teachers work in all the stations in each lesson. There are about nine stations in the station rotation model, designed to accommodate the participants assigned to groups. Each of the groups was designated to move from one station to another. Initially, according to Staker & Horn (2012), three stations are there in the station rotation model. This research expanded these stations to cover nine grounds to see the possibilities of containing a large group at a point. These learning modalities are group assignment, small group face-to-face instruction, topic discussion, video instruction, online learning, collaborative activities, and individual tutoring.

Collaborative activities were designed to engage pre-service teachers in several activities fostering learning and guiding group activities. For example, the experimental group participants were assigned different responsibilities, such as timekeeper of the group, moderator, questioner, and envoy were exchanged between groups to learn from other groups and inform the other group of the process of handling activities in their group.
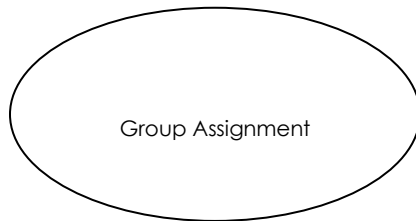
Collaborative

Activities
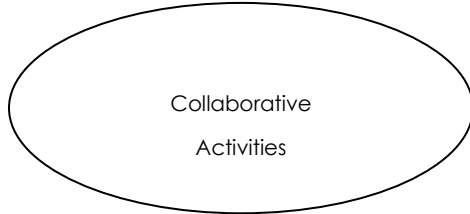
Time Allowed: 15 minutes

Objectives: relate with group members to solve problems

Material Needed: paper and pencil, cardboard paper, papers, and Writing materials.

Group assignment was issued out to all the groups. At the end of each lesson, groups were given an assignment on the presented task. Instruction was given to the group to work on the assignment at their disposal to submit and discuss their findings in the next meeting. The participants were allowed to walk away to allow socialization and intimacy to exist among the group participants and engage in activities that promote discussion, writing, problem-solving activities, interdependence, division of labor, and sharing ideas to solve the assignment. The outcome of the assignment was slated to discuss within the time frame of the station of group assignment.

Group Assignment

Time Allowed: 10 minutes

Objectives: collaborate with group members to conduct the assignment

Material Needed: paper and pencil, computer, internet, papers, writing materials.

Video instruction: in this station, pre-service teachers were allowed to watch a screencast video specifically designed for the current lesson for the day. Pre-service teachers in the experimental group were expected to watch the video and digest it thoroughly before proceeding to the next station. Before the lesson, each screencast video was given to participants to watch before coming to the class. Subsequently, the participants during the station re-watch the footage in their sub-station.
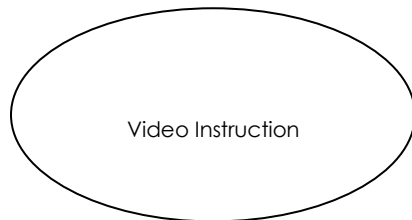
Video Instruction

Time Allowed: 15 minutes

Objectives: Watch screencast video

Material Needed: Computer, Flash Drive, Papers, Writing materials, CD plate, and Headphones.

The *online instruction* station was provided with computers, an internet, and materials on what to search on the internet. This station was designed to help pre-service teachers browse the internet for resources and download needed material with the teacher's guidance. The station's handling was assisted by the experience of the responsibility held by any group member.

Online Instruction
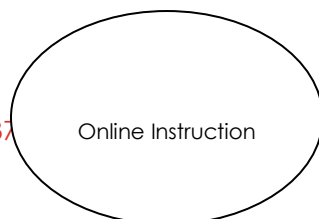
Time Allowed: 15 minutes

Objectives: Surf through the internet to search for materials and visit learning websites.

Material Needed: Computer, internet, jotters, writing materials, and Headphones.

In the ***Topic discussion*** in this station, pre-service teachers were presented with content and task to be performed at the point of the current lesson. This was achieved through a brief presentation to the group at their station.

Topic Discussion
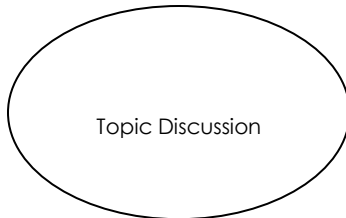
Time Allowed: 10 minutes

Objectives: presentation of content and task to be perform

Material Needed: Writing materials, and handout.

In ***small group face-to-face learning,*** pre-service teachers were presented with the daily task that allowed the group to interact with the teacher in finding solutions to group problems together. In this station, group members were allowed to positively inquire from the teacher and critique.
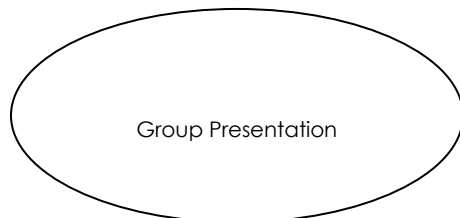
Small Group F2F learning
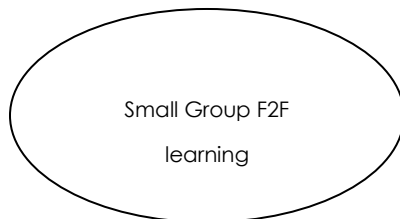
Time Allowed: 10 minutes

Objectives: meeting with group member to solve problem

Material Needed: Computer, Flash Drive, Papers, Writing materials, and Headphones.

Group presentation is tame to allow group members to select one or two members to make presentation findings of their activities based on the day's lesson. This was achieved through random assignment of any member or a may that was agreed by the group to make the presentation. In this station, collaborative activities play a significant role in controlling, guiding, and keeping time during the presentation. Due to time constraints, not all group members have time to present; members are allowed to queue for their tone in subsequent presentations.

Group Presentation

Time Allowed: 15 minutes

Objectives: pre-service presents group project

Material Needed: round table presentation

Small group learning is manned by first informing learners of their role, spelling the group role, and spelling the group rules. The roles and the responsibilities are constantly reminded to participants for update purposes. There will go to be a group exercise involved in this station. Members are presented with a learning task.

Small Group Learning
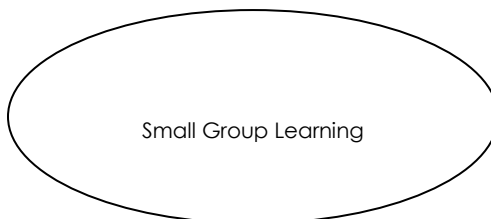
Time Allowed: 15 minutes

Objectives: doing group exercise

Material Needed: Computer, Flash Drive, Papers, Writing materials, and Headphones.

Station No.: 2

Individual tutoring involves the teacher to direct learner face to face contact to allow clarification of any doubt and explanation of complex areas. In this station, a particular need for further clarification and explanation is given utmost priority to achieve the lesson's objective. The teacher recorded and used this avenue as a feedback mechanism on whether to retain or repeat the class. Due to the rigorous nature of the classroom activities, minor complaints or clarifications were recorded during the exercise.

Individual Tutoring
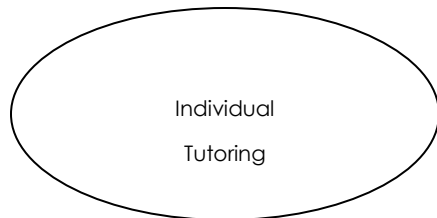
Time Allowed: 15 minutes

Objectives: establish contact with teacher to seek for clarification

Material Needed: Writing materials,

Figure 6 below shows the station's cyclic presentation in a blended social, collaborative learning environment involved in the station rotation model.
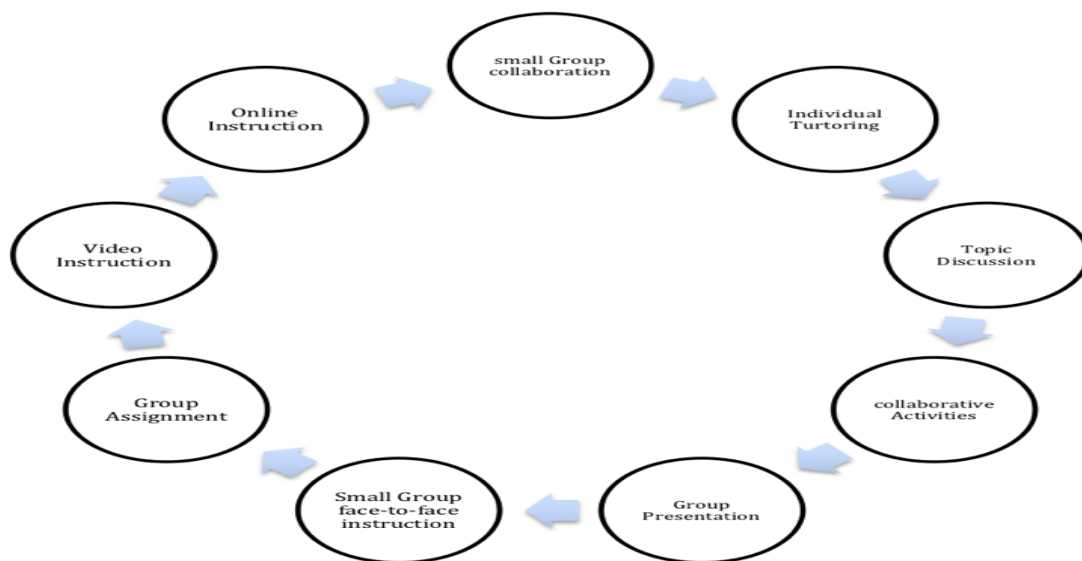

Fig. 6: Station Rotation Model through BSCLE

Based on the above cyclic formation, there are nine learning stations designed for pre-service teachers in SRM-BSCLE to learn through engaging in different activities. To supplement the objectives of the present study, the implementation of these learning activities was conducted both within and outside the classroom to ensure effective learning has taken place.

Topic Discussion Through Instructor-Led Instruction

This phase dealt with teaching points on the content and instructions on the task performed by pre-service teachers led by the teacher at the end of entry into each lesson. The instructor identifies those tasks and procedures designed to teach pre-service teachers in six installments. In a short presentation that allows learners to interact with content, the teacher briefly reminds learners of their daily routine in each instruction. For example, each lesson was introduced to the learners begins with a brief explanation of video, artifacts, and infographics on the six topics of interest. The topical areas covered by the teachers' brief introduction are the Role of a teacher in teaching science, scientific method, methods of teaching science, choice of method, teaching aids, and role of the laboratory in science teaching. These were achieved online and offline the following (SEE Table 2): coaching (in-class), advising the groups on how to

carry out their online task, maintaining strict academic application while the group is online, coaching and guiding pre-service teachers on online learning., The in-class lesson, hands-on feedback, coaching (F2F), advising on project, and case study with feedback.

Face-to-Face Instruction
The face-to-face instruction is delivered using material adapted from existing learning material from the faculty of the education university of Maiduguri. This content was designed exclusively for pre-service teachers from the faculty of the education university of Maiduguri. The instructor delivered most of the instructional content by assigning pre-service teachers' different tasks such as face-to-face, small group work, hands-on desk, exercises, topic discussion, etc. (Ghadiri et al., 2013). In this form of learning, learners must be organized in their groups to present their work to the teacher. Learners are allowed to critique their colleagues while teachers, on the other hand, serve as facilitators to encourage interaction. The instruction guides the pre-service teachers to allow space for interaction through brainstorming and group mentoring.

Small-Group Assignment
At the end of each lesson, the pre-service teacher was given a take-home assignment throughout the six weeks of the study. These assignments were carefully selected from the delivered speech. They served as the interface between the face-to-face content and the blended learning provided to the experimental group in the classroom. Below are the assignments are given to the participants during the intervention:

Role of a teacher in teaching science: beyond classroom instruction, guidance, and support, teachers do play a fundamental role outside the classroom? Discuss.

    i.   Clues for doing the assignment: you are expected to answer the above question in the following format: introduction. This main body may comprise the teacher's role in the classroom and outside the school.
    ii.   Submission date is slated for the next session, or an interested person may submit before our next meeting.

Scientific method: With the aid of a diagram, illustrate the process of the scientific method?
    i.   Clues for doing the assignment: you are expected to draw accurately the process involved in the scientific method and color each process with distinct colors. Use cardboard paper to draw it.
    ii.   Submission date is slated for the next session, or an interested person may submit before our next meeting. Additionally, you are to fix the drawing next to you.

Methods of teaching science: Choose any of the discussed methods of teaching science and write a comprehensive lesson plan that has elements of the adopted teaching method.

    i.   Clues for doing the assignment: you are expected to write a lesson plan base on a selected topic of choice that has roots in one of the methods of teaching science you were taught in this class. Note that you will be provided with a sample sheet of the lesson plan to ease your task.
    ii.   Submission date is slated for the next session, or an interested person may submit before our next meeting. Additionally, you are to share your lesson plan with your group members.

Choice of methods: Explain factors that influence the choice of methods in science teaching. Your answer should be restricted to mentioning and explaining those factors, and you are also required to justify your answer by giving practical examples.

    i.   Clues for doing the assignment: you are expected to write a short concept paper indicating factors that influence the choice of method in teaching science. You should likely have an introductory part of the paper followed by the tentative body of your writing with a conclusion and reference. The assignment should not exceed four pages. It should be typed and printed in three copies for sharing among group members. Note: you are too used to computers and printers in the library to conduct the assignment.
    ii.   Submission date is slated for the next session, or an interested person may submit before our next meeting. Additionally, you are to share your findings with your group members.

Teaching aids: As a prospective teacher, you are posted for a teaching practicum at a school in a remote area, where teaching aids are difficult to obtain. Would you use your creativity to develop the required teaching apparatus to impart to your students, or would you not?

    i.   Clues for doing the assignment: provide your answers in an argumentative form. This time, you must write and make a presentation to your colleagues in your group. Note: you are to make a presentation off the head of a written paper.

    ii.   Presentation date is slated for the next session, and the time allowed for the presentation is five minutes.

Role of the laboratory: It is common knowledge that a good teacher needs to be proactive and innovative. Not all schools have science laboratories, or some might lack one. As a trained teacher who has undergone training on methods of teaching science, how would you deal with the above scenario?

    i.   Clues for doing the assignment: You must act as a professional teacher with vast experience producing an alternative of needed laboratory equipment to teach their students. Therefore, you must formulate a scenario with a convincing case study and present it to your colleagues in your group. Note: you are to make a presentation using illustrations and explanations.

    ii.   Presentation date is slated for the next session, and the time allowed for the presentation is five minutes.

Video Instruction

The short screencasts video instruction consists of 10 to 12 minutes narrated by the researcher, and it is comprised of a detailed description of the content and illustration. The research employed a blended social, collaborative learning environment (BSCLE) to integrate the station rotation model of blended learning into pre-service teacher instruction. The screencast video lesson was presented to the experimental group; they were provided with a copy of the video content to digest within 10 to 15 minutes. Lastly, the pre-service teachers are expected to pause, rewind, and play to their convenience and speed.

Online Instruction

The online component in the station rotation model may take many dimensions; it may be direct surfing of the internet to gain access to education websites (like Coursera, Khan Academy), download or watch topics of interest, or use already downloaded videos, artifacts, pictures, infographics, which was already downloaded by the researcher and deposited it in computers for pre-service teacher access. A limitation in Internet access necessitated this. In this study, the researcher, through the RA, applied the station rotation model with the combination of both internets and stored data obtained online in assisting pre-service teachers in the experimental group to gain access to online learning. The entire online element and the Internet were provided in the class to aid the instructor in handling the online component. Pre-service teachers are assigned to: watch videos on topics of interest, digest the footage, make presentations on them, and they were given a take-home video through VCD.

Collaborative Activities

The pre-service teachers were engaged in collaborative work through in-class collaborative groupings among them: Group, Group task, Presentation, Group assignment through group determine the role (Introduction, Typing, Discussion, Final product), and Chart describing the nature of the assignment. Below are the collaborative activities that were employed in the blended model environment:

    i.   Group discussion through English as a means of communication

    ii.   Role of participants in the discussion. The creation of competition among groups and the provision of roles to each member were maintained throughout the group instructions.

    iii.   Collaborative activities were created based on the following: Timekeeper, Moderator, Notetaker, Speaker, Questioner, and Envoy

a) Timekeeper:
The timekeeper makes sure that the group is working by the time frame set for the plan. Their role is to help the group adhere to the already set schedule and estimate the amount of time spent on a particular topic and by contributors. This may reduce the workload among other group members who are also burdened with other responsibilities.

b) Moderator:
The moderator, gatekeeper, and or facilitator in collaborative activities served as the person who helped the group to focus and ensure control dominance by a group member. In the discharge of their duty, they are cautioned to remain impartial; they coordinate the group discussion, give equal opportunity to participate, encourage asking the question, and command respect from the group. The choice of moderator requires that they can help build trust among group members who can facilitate dialogue and manage time according to the group's set schedule. With the help of the research assistant (RA), the moderator and all the other responsibilities were distributed among group members.

c) Speaker:
The speakers' role is to contribute their suggestions, ideas, and solutions to the problem. They served as the group ambassador who often represented the group's viewpoint to other groups outside of their group. This role could be heightened when the instructor explained the topic by expressing an opinion on an issue.

d) Questioner:
The questioner listens to the speaker and asks a relevant question to ensure further clarification.

e) Notetaker:
The role of the note taker is like that of the organization's secretary, that is responsible for taking every minute of the meeting by observing the process and providing tentative feedback to the members of the group, especially to the speaker and questioner. They are responsible for recording groups' activities and obtaining relevant information from within and outside the group; after sourcing the data, it is their role to maintain that information for future application. This is to help achieve the smooth running of the group's collective effort. Note gathering encourages concept mapping to compose ideas in a condensed form for further exploration.

f) Jigsaw
Pre-service teachers can work in-group to become experts in several aspects of teaching the scientific method. This was carried out to assist them in sharing information between groups. Several jigsaw activities were used to facilitate learning among pre-service teachers. These activities include the following: rainbowing and envoy.

g) Rainbowing
The collaborative grouping was assigned with distinct colors for demarcation and easy identification. A cardboard paper was used for color separation; each paper indicated specific colors with each group's finding and level of task completion fixed right close to the group. The cardboard was inscribed with the group color, nature of the assignment, results, conclusions, and next task.

h) Envoy
After completing the group task, the pre-service teachers in each group were assigned an envoy to go to the other group and explain their findings, and as well the envoy, in turn, shared what they obtained from the group visit.

    i. Jigsaw
    ii. The class size = 10 – 54
    iii. Time frame   = 10 or more minutes
    iv. Settings   = moveable seating requires a lot of space preferable
    v. Outcome   = learners are expected to become experts
    vi. Movement   = envoy
    vii. Puzzle Pieces/subgroup = rotational grouping
    viii. Coloring = handout/ cardboard papers

The more learners are in groups, the more interaction improves, promoting active engagement, competition, and challenge. The envoy who is shifting their ground to share their group's findings and gather information about the results of the visiting groups was expected to share the same scenario with his group members. Based on this, cooperation and social interaction were enhanced. Finally, the teacher's role is to assign pre-service teachers to different posts according to their specialty.

Collaborative Learning

In the first meeting, learners and the instructor brainstormed to inform them about the expectation and group tasks. The instructor also spelled out the rules and regulations governing the group activities. This was also supplemented through writing and fixing on each group in a laminated paper that caries the rules.

    a)   Small Group Learning

Group leader, administrator of the group
Uses of collaboration in learning through a station rotation
Teacher supervision is eminent
    b)   Group Rules

Table 3 Group Rules set for the groups and the participants.

Rules and Procedures	Remark
Preparation to class	30 minutes before class
Arrival and departure time	2 pm to 4:30 pm
Individual contribution	Each member is expected to contribute.
Active participation	Learners are required to be fully engaged in all the activities.
Member's opinion	Respect opinion of one another
Teachers' role	Guidance, mentoring, and encouraging learners' active participation.

    c)   Group Exercise

List of topics based on teaching methods of teaching science: Role of a teacher, Scientific method, Methods of teaching science, Choice of the technique, Teaching aids, and Role of Laboratory in Teaching Science.

    a)   Groups Discussion

The group exercise was adapted from Stanford Teaching Common by Cohen & Lotan (2014). Below is the list of the group exercise:

(i) Explain why/how teachers' role is herculean?
(ii) What is the meaning of the scientific method?
(iii) Why are pre-service teachers allowed to go for teaching practice?
(iv) What the school lacks a laboratory?
(v) What conclusion could you draw about selecting the scientific teaching method?
(vi) What is the best method of teaching science and why?
(vii)What do you think are the causes of mass failure of secondary school students in WAEC? Why?
(viii)   What are the methods of teaching science?
(ix) What will happen when you teach your student without teaching aids?
(x) Is there any other way of looking at teaching learners without teaching aids?
(xi) Mention the strength and weaknesses of each method of teaching science you learned?
(xii)Answering range from 5 – 10 minutes.
(xiii)   Teachers' role is to go around and discuss answers provided by the groups.

Individual Tutoring

In this section, learners are allowed to meet the instructor one-on-one; this is done to encourage learners to receive exceptional guidance on areas of defect. The session was specifically designed to meet after the class session.

Conclusion

The study outlines the design and development of the learning environment that enhances pre-service teachers' critical thinking skills. Firstly, the study introduced the process involved in design and development. Secondly, the study looked at how a blended learning environment was designed for pre-service teachers; the study further elaborates on the decision factors involved in developing the learning environment. Additionally, the study extensively discussed blended learning delivery in the created environment. Lastly, the study concludes by summarizing the significant component of the current study.
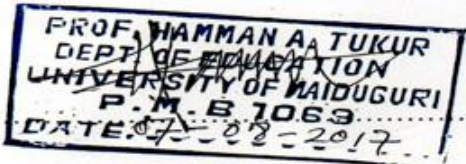
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VALIDATION OF STATION ROTATION MODEL IN BLENDED SOCIAL COLLABORATIVE LEARNING ENVIRONMENT

Expert Validity

I hereby validate the learning environment created for the purpose of teaching pre-service teachers to enhance their critical thinking skills that the learning environment suit and eligible for the study.

Signature ......
Full Name .... Prof. Hamman Abubakar Tukur
Occupation/Position... Lecturer / Professor
Working Experience........ 22 Years
Academic Qualification...... Professor
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Date...... DATE: 07-02-2017

1) Eligible to be implemented without correction ☑
2) Eligible to be implemented with correction ☐
3) Not Eligible to be implemented ☐

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DR. TIJJANI MOHAMMED
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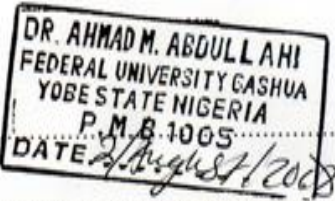**YOBE STATE NIGERIA**

Date......

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