Chapter 2

The Use of the ASSIM Model for Technology Integration in Instructional Delivery by Faculty Members and Pre-Service Teachers

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Additional information is available at the end of the chapter

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Abstract

This chapter presents an instructional model that promotes and facilitates the changing role of both the learner and the teacher in a twenty-first century teaching-learning environment that is technology driven. The model provides a pedagogical approach that is student centred with the teacher assuming the role of a facilitator in the student learning process. Qualitative methods of data collection were used in collecting the data that were used in the development of the model. Document analysis and focus group interview were used for data collection at the preliminary stage of the study while developing the model. The model was tested for a period of 3 years. Interview and observation were used for data collection during and after the testing period. Document analysis was used in analysing the data collected from documents while content and thematic analysis were used in analysing the data collected from interviews and observations. Findings from the study indicated that the use of the model facilitates the development of inquiry skills, critical thinking and problem-solving skills among the pre-service teachers who participated in the study.

Keywords: technology integration, twenty-first century pedagogy, twenty-first century teaching-learning environment, social sciences, changing role

1. Introduction

Information technology (IT) has over the years made remarkable impact in the education industry at all level and in the world over as applicable to other sectors of the global economy [1]. Advancement in the IT sector has made the web a source of unlimited content for all subject disciplines that can be accessed anytime anywhere in the world over. This development has necessitated a shift in the role of teachers from that of being knowledge providers to that

of facilitating the process of accessing information to develop and construe knowledge by learners. Thus, teaching and learning is gradually becoming more students centred, activity-oriented and inquiry-based. Teachers are now faced with the challenge of designing instructions that promote the use of student-centred pedagogy, encouraging students' inquiry as a base for knowledge construction. It has help to improve the process and quality of instructional delivery, learning and research, as well as facilitating access to educational products (knowledge, values and skills) and services to global community of learners, educational practitioners and the industry [2, 3]. Generally, educational practices and it products at all levels revolve round the use and dissemination of information relating to knowledge, values and skills development for the overall improvement of the human race as responsible citizens of a global society [4]. Innovative use of IT facilities in the education industry has made this process easier, faster and convenient. Educational practitioners can now collaborate globally with their peers in conducting researches and in instructional delivery as distance across the globe is no longer a barrier to communication of any nature.

From nineteenth century to date, stakeholders of the education industry are continuing to provide educational institutions with information technology (IT) equipment of different nature to improve educational practices [5, 6]. Schools and institutions of higher learning are now equipped with computers and internet while students goes around using different kind of internet enabled devices (laptops and Smart Phones) as their learning tools [7, 8]. This development has revolutionised the process of teaching and learning in educational institutions making ICT an integral part of the teaching-learning process [9], thus ushering the twenty-first century teaching-learning environment that is technology driven [10]. The emerging twenty-first century teaching-learning environment has transformed the role of parties involved in teaching and learning [11, 12]. Learners are now actively involved in the process of building knowledge, whereas teachers mentor and facilitate the process of construing knowledge by learners [13]. Instructional objectives are now directed toward the development of skills for life-long learning and knowledge construction for problem solving and decision-making in a global economy [14]. New pedagogical designs to meet the demand of the twenty-first century learner and the twenty-first century teaching-learning environment are now fast emerging, and the process of instructional delivery is taking a new dimension [15, 16]. This chapter considered some theoretical underpinnings explaining the emergence of twenty-first century pedagogical designs and also present an instructional model for the attainment of twenty-first century instructional objectives in the arts and social sciences.

2. Theoretical considerations in the development of twenty-first century pedagogical designs

The 'teaching-learning environment' (as referred in the context of this study) is a platform where learners acquire knowledge, values and skills (education) through instructional delivery. Instructional delivery on the other hand is the process of providing relevant information that can help the learner acquire knowledge, values and skills needed in problem-solving and decision-making. The two concepts ('teaching-learning environment' and 'instructional delivery')

can be formal (in a school setting with a well-structured curriculum) or informal (outside the school with no structured curriculum). In whatever form they exist, the two concepts are dynamic (changing over time and space in history). In the context of this work, we are particularly concern with the formal situation (that is instructional delivery in a school setting). Traditionally, instructional delivery in a school setting has to do with a face-to-face interaction between the teacher and the learner. In the process of such interaction, the teachers provide learners with information and explain relevant concepts, theories and processes that can help the learner acquire education in a given subject area. There are different ways, techniques and approaches to instructional delivery (pedagogy) that the teacher can use. Instructional delivery is a very complex process that requires careful planning and implementation; this has to do with the choice of pedagogical design and how it can be used to achieve instructional objectives.

The choice of a pedagogical design for instructional delivery is largely influenced by the nature of the learning environment where the instructions would hold; nature of the subject content to be delivered and characteristics of the learners [17]. Thus, the teacher is expected to have a good knowledge of pedagogy, subject content and knowledge of educational psychology to be able to design and deliver a face-to-face classroom instruction. As a result of these, curriculum studies and educational psychology (theories of learning) in addition to knowledge of specific subject disciplines becomes the major knowledge domains of pre-service teacher education and training [18]. Knowledge of the interplay between subject content knowledge and knowledge of pedagogy in instructional design and delivery becomes additional knowledge domain known as pedagogical content knowledge (PCK) in teacher education [19, 20]. However, changes in the nature of the teaching-learning environment as influenced by the presence of information and communication technology (ICT) have made the choice of pedagogy for instructional delivery a more complex process.

With computers and internet as new features that have come to stay in the twenty-first century teaching-learning environment [21], knowledge of curriculum, educational psychology and pedagogical content knowledge are no longer enough in designing and delivering instructions using ICT [22, 23]. Knowledge of technology (use of ICT) is critically needed in pre-service teacher training and education in preparing teachers to teach in the computer and internet age [24]. This situation has made the TPACK (Technological, Pedagogical and Content Knowledge) theory relevant for twenty-first century teacher education and training [25]. In addition to the knowledge of curriculum, educational psychology and pedagogical subject content [19] as core knowledge domains of teacher education, 'technology' is now added [22]. Adding technology to the core domains of teacher education has ushered in additional sub-domains of equal importance in teacher education; that is, technological content knowledge (TCK), technological pedagogical knowledge (TPK) and knowledge of the interplay of all the domains combined known as technological, pedagogical and content knowledge (TPACK). The TPACK theory provides a framework that build on the Shulman theory by integrating the knowledge of technology into pedagogical practices and teacher education. The theory emerged as a result of the concern over the persistent criticism on the lack of theoretical framework and underpinnings for technology integration in educational practices. Driven by this concern, the theory attempts to capture the essential qualities of teacher knowledge required for technology integration in teaching. The framework provides a complex and

new approach that is all embracing in pedagogical practices, teacher education and teacher training in line with societal reality of the present information age. The focus of the theory is on the complex role and interplay of 'content', 'pedagogy' and 'technology' in teacher education and general pedagogical practices. The framework for teacher education and training that emerges from the TPACK theory provides seven knowledge domains that are critically needed in training the teachers who can bear relevance to the emerging twenty-first century teaching-learning environment and the need of the twenty-first century learner. The seven knowledge domains are briefly explained below:

1. *Content Knowledge:* as conceived in the theory refers to the knowledge of the actual learning content, skills and values of specific subject discipline that is to be learned or taught. That is knowledge of the teaching subject in the case of pre-service teacher training. It implies the need for teachers (in the case of pedagogical practices) and pre-service teachers (in the case of teacher education and training) to have a proper and in-depth understanding of the subject (they teach or are to teach) as the case may be. This would include concepts, values, skills, theories and procedures within a specific subject discipline (teaching subject) [22]; knowledge of explanatory frameworks that organise and connect ideas and knowledge of the rules of evidence and proof [24]. It also entails the need to know and understand nature of inquiry and knowledge in other subject disciplines to be able to understand why and how a proof in maths, for example, would have to differ from that of historical explanations [24].
2. *Pedagogical Knowledge:* has to do with the need for teachers to have a proper understanding of teaching methods for instructional delivery as relate to the overall goal and values of education in society. This knowledge for the teacher is generic involving all issues relating to classroom learning; classroom management; development and implementation of lesson plan and the evaluation of students learning [22]. As applicable to this study, it entails the need for teacher educators to equip pre-service teachers with the necessary knowledge that would help them in understanding the: techniques and methods of classroom instruction; nature of the students in view (to teach) and the strategies of evaluating students' achievements in the learning process. As noted in literature, a teacher with deep pedagogical knowledge will have a good understanding of how students understand and construct knowledge; acquire skills and develop habits of mind and positive disposition toward learning [22]. As such, it requires an understanding of cognitive, social and developmental theories of learning and how they are utilised in classroom situation.
3. *Pedagogical Content Knowledge:* as consistent to what Shulman in his theory conceived as 'knowledge of pedagogy' applicable to a particular subject discipline, pedagogical content knowledge (PCK) entails knowing the appropriate teaching methods for specific (topics of the) learning contents and an understanding of how learning contents of subject disciplines can be arranged and rearranged to facilitate the process of classroom teaching and learning. It therefore involves: the development and representation of concepts, values and skills; pedagogical techniques; knowledge of what makes concepts, values and skills easy or difficult to understand and learn; knowledge of students background in the subject area and epistemological theories of the subject discipline. It requires teachers to have knowledge of teaching strategies that incorporates appropriate conceptual representations to address learners' difficulties and misconceptions [22]. It involves:

a. Knowledge of what the learner brings to the learning environment may be either facilitative or dysfunctional to the learning activities at hand.

b. Knowledge of students learning strategies, prior conceptions (naïve and instructional).

c. Knowledge of possible misconception that students may have on specific areas.

d. Knowledge of possible misapplication of previous knowledge and learning experiences.

4. *Technological Knowledge:* is the knowledge that teachers and pre-service teachers need to have about 'standard technology' and 'advanced' technology; particularly, those considered to have potential usability in educational practices. 'Standard Technology' as conceived in the TPACK framework refers to the conventional instructional materials such as the chalk board, books, pictures, manual projectors, posters and maps as used by teachers in traditional classroom settings. The 'Advanced Technologies' on the other hand is referred to the computer, internet, software and digital video (digital technology or modern ICT). For the later, it implies the need for teachers to have:

a. Knowledge and skills of operating systems and computer hardware.

b. Knowledge and skills of using the internet; the ability and competence to use the tools and facilities in computer software/applications.

c. Knowledge and skills of software instillation and removal.

d. The ability to attach and remove computer peripheral devices.

In teacher education programme, this implies the need for teacher educators to make provisions in their pedagogical practices that would help the pre-service teacher in acquiring this knowledge. However, because of the rapid changes of the advanced technologies, the structural framework for the provision of this knowledge to teachers and pre-service teachers need to be dynamic [22, 24].

5. *Technological Content Knowledge:* is a knowledge domain that entails the need for teachers understanding of how 'technology' relates to 'subject content' in pedagogical practices and how knowledge of the two can be integrated and utilised to advantage in pedagogical practices. It involves knowledge of how subject content can be changed or represented by the use and application of technology in classroom instructions.

6. *Technological Pedagogical Knowledge:* is the knowledge of how particular technology can be effectively utilised in facilitating specific teaching-learning process and how instructional processes and pedagogical practices are likely to change as a result of using such technology. Thus, teachers and pre-service teachers need to know and understand that lots of digital tools exist that can be used in facilitating instructional delivery. Teachers should therefore have the skills and knowledge of selecting appropriate technological tools that can fit into particular pedagogical designs and can facilitate the attainment of instructional goals and objectives. This would require:

a. Knowledge of pedagogical strategies.

b. Knowledge of technology and its application in educational practices.

c. Knowledge and skills of integrating the two in instructional practices.

d. Application of the integrated knowledge for specific instructional delivery in classroom learning.

7. *Technological Pedagogical Content Knowledge:* is all embracing of the six knowledge domains identified above. It is an emergent form of knowledge that goes beyond all the three major components of teacher education. It differs from knowledge of a subject discipline, knowledge of technology and also from general pedagogical knowledge shared by teachers across disciplines [22]. It requires the need of not only understanding the six types of knowledge identified above as being necessary in teacher education and pedagogical practices, but also:

a. the ability to integrate the six types of knowledge into a single knowledge base and framework that can be used for instructional delivery;

b. the ability to utilise the integrated knowledge base effectively in teaching-learning situation to facilitate the attainment of educational goals and objectives and

c. an understanding that the framework of teacher education training and general pedagogical practices in schools and colleges is likely to change as a result of this knowledge and its application in education.

This knowledge should form the foundation needed for technology-based instructional delivery in a twenty-first century teaching-learning environment [22]. The technical application of this knowledge in teaching-learning situations would require:

a. The knowledge and skills of concept representations using technology.

b. The knowledge of pedagogical strategies that accommodates the innovative use of technology for content delivery in classroom instruction.

c. The knowledge of students learning process, what makes concepts difficult or easy to learn and how technology can be used in addressing such learning difficulties in classroom situations.

d. The knowledge of epistemological theories.

e. Knowledge and application of technology in developing epistemological theories.

Instructional design and delivery in the twenty-first century teaching-learning environment requires knowledge of TPACK [26]. The teacher would have to consider the instructional objectives to be achieved in the instruction as stated in the curriculum in relation to the peculiar nature of the learners to be taught [27]. This consideration should guide the teacher in his selection of the learning content to be delivered [28]. The teacher would have to make a decision on what teaching method (pedagogy) to be used in delivering the selected learning content [29]. This decision should be influenced by the learning objectives to be achieved, nature of the learning content and characteristics of the learners [30]. Then, select suitable technologies that can on one hand facilitate the delivery of the instruction and, on the other hand, facilitate learning [31]. The choice of technology to be used has to be influenced as well by the nature of instructional objectives to be achieved, characteristics of the learners to be taught, nature of the subject content to be delivered and the pedagogy to be deployed [32]. Above all, the teacher

would have to consider the overall philosophy, goals and objectives of education of the nation as may be defined in the national policy on education [33]. This complex process of decision making as influenced by quite a number of interdependent considerations in the design of instructional delivery has necessitated the emergence of innovative pedagogical designs. Consequently, a number of instructional models guiding the application of the TPACK theory in different subject areas have emerged of recent. In this chapter, an instructional model guiding the use of TPACK in instructional designs for arts and social science education is presented under the 'model of instruction for twenty-first century pedagogical design'.

3. The changing role of teachers and learners in the twenty-first century teaching-learning environment

The use of computer and internet in educational practices over the years has encouraged the changing role of teachers in the teaching-learning process. During the pre-computer and internet age, the teacher in a face-to-face classroom instruction is considered a source of knowledge for learners. The teacher who is expected to have a good mastery of the subject content of his discipline is expected to provide learners with information and explain concepts, theories and demonstrate procedures where applicable. The learner on the other hand is expected to sit, listen and watch the teacher to understand the information being provided by the teacher. The teacher in this process is the provider of knowledge. Teaching and learning is therefore teacher centred. The students rely on the teacher as the source of subject content for learning. The classroom in this system is a place for giving and receiving lectures. This approach to instructional delivery only appeals to the cognitive development of the learner and rely heavily on paper-pencil examination technique in evaluating learners achievement in the instructional process; thus, undermining the process of developing learners critical thinking skills and innovation. The traditional teacher-centred pedagogy as largely practiced lay emphasises on acquisition and retention of knowledge rather than on it application. With advanced information technologies deployed in the twenty-first century teaching-learning environment, the situation is no longer the same.

With computer, internet and the World Wide Web, learners no longer need to rely on the teacher for information on subject content. Learners can on their own access wide range of information for their learning anytime and anywhere on the web [34]. Learners now have unlimited access to learning content in word/pdf, video and audio formats. Students can chat, discuss and share learning resources through different online communication channels. With technology, learners have the information they need for their learning at their fingertips. With this development, the role of the teacher has to change from that of a knowledge provider and a source of information to that of a facilitator in the students learning process. The passive role of students listening to the teacher for learning content would also have to change. Learners would now have to be actively involved in the process of building and construing knowledge for themselves through the process of scientific inquiry: data collection, interpretation, analysis and interactive discussions. Interaction between teachers and learners would have to take a new direction. The classroom should no longer be a venue for lecture but a place where learners and teachers meet for reflection, critical discuss, problem solving, decision making

and to work on learning projects. The instructional model presented in the next section after the methodology should help teachers to assume their proper role as facilitators of students learning process in instructional delivery that is students centred, inquiry-based, project and problem-solving oriented.

4. Methodology

Qualitative research approach using documentation, interviews and observations were used as sources of data collection for this study sequentially. Documentation in a qualitative research design has to do with document analysis where the researcher identify, review, analyse and interpret or make meaning out of relevant documents for specific reasons. Such reasons may be for the purpose of gaining a deeper understanding of issues or situations under investigations; to clarify issues of interest; verify an assumption or to provide evidence that can help in answering research questions as may be applicable. In the case of this study, document analysis was used to verify the basic assumptions that provided the justification needed for this study. At the preliminary stage of the study, existing documents on theories of educational technology, theories of instructional designs and research findings relating to technology integration in educational practices were reviewed and analysed using 'content and thematic analysis'. Content and thematic analysis of documents has to do with critical review of documents and coding the content of the documents into themes and subsequent interpretation of the themes based on the understanding of the researcher. Three types of documents were analysed at the preliminary stage of this study. The first category of documents analysed was published articles in learned journals relating to technology integration in educational practices, theories of educational technology and instructional design. The second category of documents analysed is public documents available in schools, colleges of education and universities. Such documents provide information on curriculum content, the approved scheme of work for instructional delivery for the curriculum content; instructional objectives to be achieved and the recommended instructional strategy and resources to be employed in the instructional delivery process. Personal documents of school teachers and faculty members are the third category of documents analysed. The documents in this category provide the researcher with information about the kind of instructional strategy and resources that teachers and faculty members used in their instructional approach. Content of the three types of documents mentioned above was critically reviewed, interpreted and coded into emerging themes by the researcher.

Interpretations made by the researcher on the first category of documents analysed reveal that there are in existence quite a lot of varying theories of educational technology and instructional designs. However, detailed explanation and procedure of how such theories can be applied in instructional delivery for specific subject disciplines (particularly in the Arts and Social Sciences) in relation to specific curriculum content are needed. For example, the TPACK theory as discussed in item 2 in Section 2 provided a general justification for the inclusion of educational technology as a core component of teacher education domain to facilitate pre-service teachers' preparation for the use of technology in educational practices. But the theory

did not provide the model of application for instructional delivery at the pre-service teacher training level or for subject disciplines at the school level. The researcher's interpretation of document content of published research findings relating to technology integration reveals that not much of the technologies provided in schools and institutions of higher learning are being effectively used in instructional delivery. It also reveals that technology integration in educational practices at all levels of learning is faced with varying challenges that differ over time and space. Interpretations of the content of the second category of documents analysed in this study reveal that teachers at all level are encouraged by the curriculum documents to shift away from the use of teacher-centred pedagogy to learner-centred pedagogy. The documents encourage teachers to develop skills of critical thinking, inquiry and problem solving among learners. But on the contrary, analysis of documents in category three shows that the use of teacher-centred pedagogical approach is still a dominant practice in schools and among faculty members. Teachers and faculty members still prefer the use of traditional lecture and demonstration approach at most using power point slides. Based on these interpretations, the researcher find justification to uphold the basic assumptions earlier developed to guide this study. Meaning that, there are justifications based on the document analysis conducted to develop technology integration instructional model for specific subject disciplines. Instructional models that can help teachers to assume the role of facilitators and learners to be actively involved in the process of building knowledge by themselves through inquiry and project-based learning in the instructional process.

Focus group interviews were conducted at the second phase of the study. Focus group interview is a method of data collection in qualitative research. The method allows the researcher to interact with all the selected participants as a group to discuss over issues of interest to the researcher. Such an interaction of the researcher and members of the focus group can be face-to-face or online as may be preferred. Members of the group can listen and make comments on each other's response to the questions raised. This approach encourages free flow of ideas, and each idea presented is shaped by the critique of others in the group. In this study, eight (8) participants were selected for the focus group interview using purposive sampling technique. All the selected participants are faculty members from two different universities. Two of the participants are faculty members in the Department of Arts Education; two from the Department of Social Sciences Education; two from the Department of Multimedia Education and two others from the Department of Educational Technology and Instructional Design. Four focus group interview sessions were conducted at weekly intervals. The four interview sessions were moderated by the researcher and lasted for about two to two and half hours each. The objective of the first focus group interview session was to generate data that can help the researcher to develop an instructional framework for Arts and Social Science subject disciplines where the teacher would only be a facilitator in the teaching-learning process. During the interview session, a research assistant was employed to write down the ideas presented. The transcribed ideas generated during this interview was later reviewed, interpreted and coded into themes. The second interview session was scheduled a week later. During the second interview session, the researcher presented an instructional framework that was developed from the ideas presented by the group during the first interview session. The group examines the framework presented and made further observations on how it can

be improved. The group suggested that each instructional activity in the framework should have a clear objective. Members of the group provided ideas on what should be the objective for each instructional activity in the framework. The research assistant was writing down the ideas presented. The session lasted for two and half hours. The transcribed data generated were sorted out, interpreted and coded into themes by the researcher after the session. The third interview session focuses on generating ideas on what kind of technology to be used for each instructional activity in the framework and how the framework can be tested. The session lasted for 2 hours. The fourth focus group interview session also scheduled a week thereafter lasted for 2 hours. The objectives of the last focus group interview was to generate ideas that can help the researcher in designing and developing an observation checklist and an interview protocol to be used for data collection during and after the testing period. The data collected during the third and fourth focus group interview sessions were also transcribed, sorted, interpreted and coded into themes. Thus, the ASSIM Model presented in the next section was developed from the ideas generated during the focus group interview sessions.

The ASSIM Model was tested for a period of 3 years—2014, 2015 and 2016—by faculty members. It was used in teacher education instructional delivery in the Arts and Social Sciences in four Colleges of Education. One week workshop on how to use the model was organised for the faculty members (in the department of Arts and Social Sciences Education) that tested the model in pre-service teacher training. Thirty-four faculty members attended the training workshop; 8 of the 34 faculty members who attended the training workshop adopt the use of the model for instructional delivery in their teaching. The pre-service teachers who participated in the testing of the model were randomly selected. Observation checklist and interview protocol earlier developed from the data generated during the focus group interview sessions explained above were used in collecting data during and after the testing period. The observation checklist was used during the testing period to observe how faculty members apply and use the ASSIM model in their instructional delivery. The observation checklist was also used after the testing period to observe how pre-service teachers apply and use the ASSIM model during their 1-year teaching practice assessment period. The interview protocol was used in collecting additional data from the participating pre-service teachers at the end of the testing period. Eight (8) pre-service teachers were randomly selected for the interview. Four of the pre-service teachers (two males and two females) were selected from the Department of Arts Education. The other four of the pre-service teachers (two males and two females) were selected from the Department of Social Science Education. The transcribed data collected from the observations checklist were sorted, interpreted and coded into themes. The orally recorded data collected from the interviews were transcribed, sorted, interpreted and coded into themes. Based on the interpretation of the researcher, findings from the data collected and analysed show that the use of the ASSIM instructional model in pre-service teacher training facilitates: 1. development of inquiry skills; 2. development of critical thinking skills; 3. development of problem-solving skills and 4. the use of information technology in teaching among the pre-service teachers who participated in this study during their teaching practice. The researcher considered the four items listed above as the emerging themes of the study to be presented and discussed in detail as findings of the study in Section 6 of this article.

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5. Model of instruction for twenty-first century pedagogical design

The presence of information technology in our institutions of learning has transformed educational practices in its totality. Education in general is now geared toward preparing the learner for global citizenship [35]. To achieve this, the education industry is now directing its effort toward the development of life-long learning skills [36], critical thinking skills and reasoning [37, 38], skills of informed decision-making and problem-solving skills [39]. The Arts and Social Sciences Instructional Model (ASSIM) presented in **Figure 1** is designed to facilitate the design and development of twenty-first century pedagogy that caters for the changing role of the teacher, the learner, the learning environment and the use of information technology in the teaching-learning process.

The ASSIM model of instruction presented in **Figure 1** is suitable for twenty-first century teaching-learning environment that is technology-driven as influenced by the philosophy

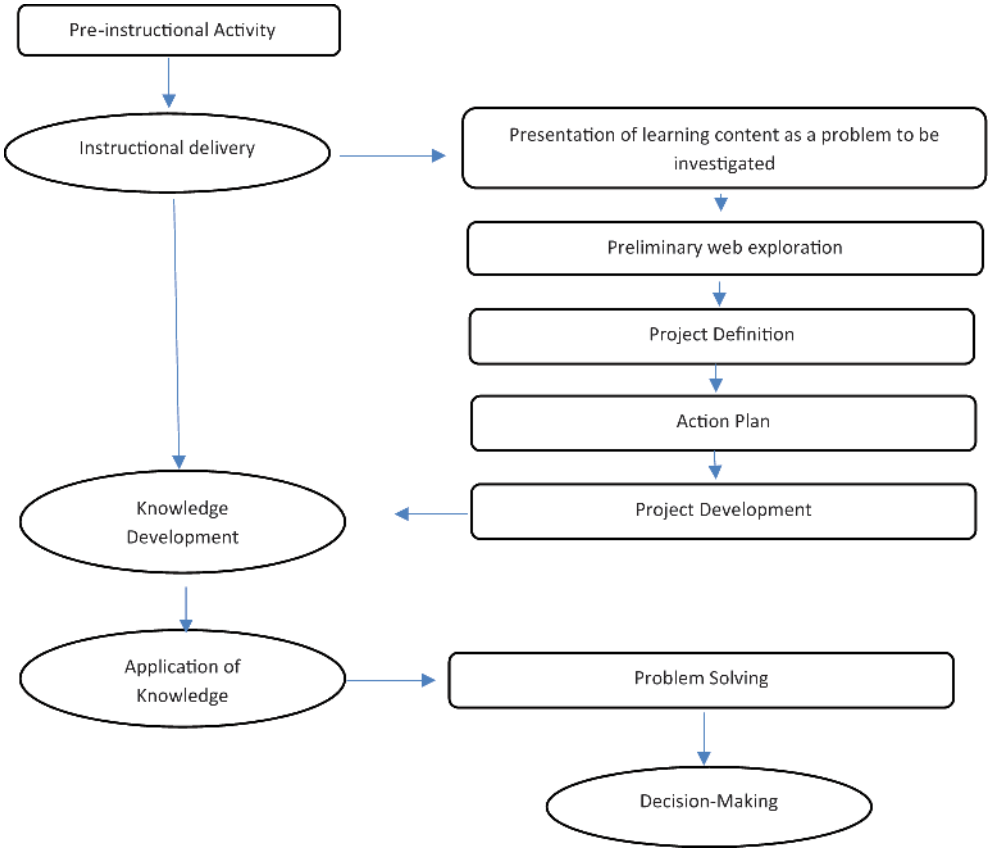

Figure 1. Arts and Social Science Instructional Model (ASSIM) for twenty-first century teaching-learning environment.

of globalisation. The model entails the blending of variety of teaching methods with the use of technology in a single pedagogical design for the teaching and learning of Arts and Social Sciences subject content in the twenty-first century teaching-learning environment. The model limits the role of the teacher to that of a facilitator in the teaching-learning process and promotes students' web-based inquiry, critical thinking, collaboration and team work in accessing and managing information to construe knowledge. Learning using the pedagogical design as presented in the ASSIM model would be learner centred and activity oriented using technology. Design of the model is influenced by the TPACK theory and the GPM instructional model.

6. Operational use of the model and its instructional benefits

6.1. The pre-instructional activity

As suggested in the model, teaching and learning in the Arts and Social Sciences should start with 'Pre-instructional Activity'. At this stage, the teacher should upload the summary of learning activities for the week in the student learning portal or the course website as may be applicable. In the absence of students learning portal or course website, email or alternative online means of communication can be used. The information to be uploaded or communicated to students prior to the commencement of face-to-face classroom interaction should consist of:

1. Summary of the course content to be covered for the week.
2. Learning activities scheduled for the week.
3. The learning objectives to be achieved for the week.
4. List of relevant concepts and theories.
5. List of web links for student's exploration.
6. The pre-instructional task to be completed before the commencement of the face-to-face classroom interaction.

The pre-instructional activity aims at helping the learner to have a picture of the overall goal of the course in view; and in particular, the learning objectives to be achieved on weekly basis and per learning content. The list of relevant concept and theories; web links for relevant learning content provided and the pre-instructional task to be completed would help the learner to utilise the web on his own to explore information that can help him/her (the learner) to have preliminary general understanding of the course and the learning activity for the week.

6.2. The face-to-face instructional delivery process

Step 1. Presentation of learning content as a problem to be investigated.

This is a teacher-centred face-to-face classroom activity. The teacher at this stage should make a short presentation of the learning content combining the use of lecture and demonstration

methods as well as questioning technique. The presentation can be supported with the use of video clips, projected images and powerpoint slides. The presentation should not be aimed at explaining concepts, theories or procedures, rather a presentation of facts that depicts issues and problems in real-life situation related the learning content in view. At the end of the presentation, learners should be able to see real-life issues and problems that need to be addressed. The teacher should be skilful in his presentation to guide learners in understanding that there is the need for further investigation of the issues and problems presented if lasting solutions are to be suggested. Learners should understand from such presentations that critical thinking, inquiry and use of knowledge are the basis of decision-making for problem solving. At the end of this stage, therefore, learners should be able to identify real-life issues and problems requiring attention as relate to the course learning content. Thus, this stage is evaluated by the ability of learners to picture and identify issues and problems for further investigation. Once this is achieved, the teacher can proceed to the next step in the instructional delivery process that is 'preliminary web exploration'.

Step 2. The preliminary web exploration (hands-on-technology).

This activity is learner-centred and web-based. Now that learners were able to identify issues and problems, the teacher should give the learners some time to explore the web for information that can help them understand further the nature of the issues and problems identified. This should be done in the classroom and students can work individually or in groups depending on the size of the class and as may be agreed upon by both the teachers and the learners.

This activity should end with an interactive session or discussion under the guidance of the teacher. During the interactive/discussion session, learners should be guided to:

1. define the issues and problems identified;
2. establish the scope of each problem identified;
3. arrange the problems in their order of importance based on their magnitude;
4. decide on which issue or problem to work on as a project of the week.

Step 3. Project definition.

This step is still a learner's interactive session under the guidance of the teacher. Learners are to decide on what they want to do in addressing the issue or problem they have chosen to work on as a project. Learners at this stage should be able to:

1. develop basic assumptions, raise research questions and hypotheses if applicable;
2. decide on how and where to collect data or materials for the project;
3. decide on what to do with the data or materials collected for the project;
4. share responsibilities and
5. set rules of participation in the project.

Step 4. The action plan.

Learners at this stage are to breakdown their project work into units of activities and set timeline. They are also to decide on how many times the group members are to meet (face to face or online) as they may prefer.

Step 5. The project development.

This is an out of class learner's activity. The teacher has little or no role at this stage. Learners are to work on their project based on their action plan. The activity may involve data collection and analysis to answer research questions or test hypothesis depending on what they wanted to do.

6.3. Knowledge development

This is the second stage of the instructional delivery process where learners individually or in group present their findings. Learners are to critically examine their findings and suggest how it can be applied as knowledge. This may involve developing a model or building a knowledge-based procedure for addressing the issue they were investigating.

6.4. Application of knowledge, problem solving and decision making

Learners at this stage are to work on how to apply the knowledge construed/developed practically (pilot-testing) in addressing the issue under investigation. Learners are also to decide on what is needed in applying their solutions. It is at this stage that learners should develop and write their project report for submission to the teacher. The report should have a problem statement, objectives, methodology and solutions.

7. Findings of the study

7.1. Development of inquiry skills

Findings from this study show that the use of the ASSIM model in pre-service teachers training instructional delivery helps in developing skills of inquiry among the pre-service teachers. Continuous engagement of the pre-service teachers in preliminary web exploration during the second stage of the face-to-face instructional delivery process helps them to acquire and master the skills of web search. One of the interviewees reported that 'I was having difficulty with this activity at the initial stage but with the help of my friends in the class and constant practice; I have now mastered how to use keywords in different ways to search for the information I need on the web'. 'The web exploration activity in the classroom has helped me to understand the importance of the internet as a source of information. Instead of asking people for information now I prefer to Google' said another interviewee. Exposing the pre-service teachers to the web exploration activity has also helped them to acquire the skills of screening and sorting out online information. Data collected from the interview shows that most of the interviewees indicated that the result of a single search gives you an option of so

much information that you get confused of which information to click and read. One of the interviewees reported that, 'when I realised that most of us have this problem of not knowing how to handle the result of our web search result in the classroom. I seek for help on my Facebook page and my friends on Facebook responded with lots of ideas and web links to articles that can help me with the skills of web search and data screening. The next day I share with the rest of the class members'. Another interviewee said 'this activity help us to have a more informed and wider view of the issues under investigation. It helps us to look at issues more from a global perspective'.

The use of the ASSIM model helps the pre-service teachers involved in the study to acquire the skills of building basic assumptions to guide research project. 'The information we gather during the preliminary web exploration help us build assumptions and we use such assumptions as guide for our literature review' said one of the interviewees. Analysis of the observation checklist shows that pre-service teachers were able to build basic assumptions and develop research questions and possible hypotheses from the assumptions. It was also observed that participants in the study (pre-service teachers) have acquired the skills of using the basic assumptions they have developed as a guide for their literature review. Analysis of the observation checklist also indicated that the pre-service teachers involved in this study have learnt to use different methods of data collection for their project and have learnt different methods of analysing their data. 'Sometimes we use the Facebook for data collection. It is very effective and very fast way of getting feedback' said one of the interviewees.

7.2. Development of critical thinking skills

The use of the ASSIM model helps to improve the critical thinking skills of the pre-service teachers involved in the study. Critical thinking is the objective, rational and unbiased analysis of situations or information to build factual evidence as a base for decision making and problem solving. It is a rational reasoning and reflection over information or situations. It is generally described as the ability to think clearly and rationally about what to do or what to believe [39]. It is a complex mental process that requires one to identify, construct and evaluate arguments; understand the importance and relevance of ideas and the logical connections between ideas presented as information, as well as to reflect on the justification of one's belief and values [40]. A critical thinker is any person with the ability to source and use information (knowledge) for problem solving and is able to deduce consequences from what he has known [41]. Critical thinking in educational practices is a mental process of rational reasoning and reflection that requires certain skills as listed below:

a. *Seeking Information*: meaning the ability to search for evidence, facts and knowledge. Based on the analysis of the observations made during the study, it was noted that the use of the ASSIM model has helped to improve the participants' skills of searching for information both online and offline. Engagement of the pre-service teachers in the preliminary web exploration activity in the ASSIM instructional design was particularly instrumental for the observed improvement in the skills for online information search. The pre-service teachers who participated in the study were also engaged in the process of data collection offline

using questionnaires, interview and observations for various learning projects. This activity has helped to improve their skills of offline data collection.

b. *Interpretation*: is the ability to understand given information and the ability to communicate the meaning of the information to others. It is a process of decoding and communicating information with clarity. Pre-service teachers involved in the study were engaged in interpreting the data they collected during the preliminary web exploration and the main data they have collected through questionnaire, interviews and observations for their learning project. Doing these activities over and over again for 3 years has helped them to master the skills and art of interpreting data for different purposes.

c. *Analysis*: breaking things (situations, information or objects) into components/segments in order to determine and understand their features, functionality and relationships. It is the ability to assemble bits of information together to determine the meaning of what the information represents (that is the ability of a person to identify the hidden meaning of information). It has to do with the ability to examine pieces of information, assemble them and make a meaning out of them. Anytime the pre-service teachers involved in this study collected data for their project, they have to analyse the data and make a meaning out of it in their attempt to answer the research questions they have raised earlier for their project. Performing this activity over time has made the participant skilful in the process of data analysis using both qualitative and quantitative approaches (statistical analysis for quantitative research designs and thematic analysis for qualitative research designs).

d. *Discriminating:* ability to identify differences and similarities between information, situations, issues and objects. It also has to do with the ability to rearrange things, situations, issues or objects in an orderly manner that makes a meaning based on a given principle. Participants in this study were engaged in this kind of activity regularly. The ASSIM model of instruction is an activity-oriented pedagogical approach for instructional delivery. One of such activities in the instructional design is the engagement of learners in the process of generating or collecting data for problem solving. Whenever data are collected, learners have to sort and group the data based on their similarities and differences and then rearrange them in an orderly manner that it can make a meaning related to the basic assumptions guiding the project at hand. As observed during the study, doing this activity has improved the participants' skills of discriminating data as a preliminary requirement for effective decision making in problem solving.

e. *Evaluation*: ability to assess the credibility of series of data (in written documents or oral records) that makes up information to determine the validity of the information being presented. It is the ability of an individual to measure the reliability of information by checking and assessing the credibility of the source of the information. Evaluation of information after data collection is one of the instructional activities to be performed by learners when using the ASSIM model of instruction. Learners would have to evaluate the information they have collected during the preliminary web exploration and during the main data collection. This activity is to make sure that all information used in the learning process was reliable. This activity in the learning process has made the participants in this study (pre-service teachers) to learn and use different evaluation methods in screening the data they have collected.

f. *Applying Standard*: the process of assessing and judging things, situations, issues and information based on established rules, theory or criteria. The use of the ASSIM model of instruction facilitates the development of this skill among the participants. The data collected from observation and interview in this study show that the pre-service teachers who participated in the study always employ the use of theoretical and conceptual frameworks. They have learnt to do this on their own. One of the interviewees said during an interview session that, 'after each preliminary web exploration we analyse and interprets what we jotted during our interactive session with the aim of understanding the nature and scope of the problem or issue under investigation. Once this is done we still go back to the web to search and find out if similar investigations were conducted before. It is during this process we learn about the use of operational models, conceptual and theoretical frameworks in research studies; and now we use them a lot whenever applicable'.

g. *Explanation*: ability to add clarity and perspective to information that can help others understand the meaning of the information. It is the ability of an individual to present information in a manner that the listener or target audience can easily understand. An ability to present complex information that is education related (or scientific knowledge) in a simple manner or words that an ordinary or an average person can understand [42]. The use of the ASSIM model promotes inquiry and project-based learning for problem solving. Learners would therefore have to interact with the wider community for data collection and to communicate their findings. These activities have made the participant learn the art and skills of explanation. The researcher observed that the participants in this study (pre-service teachers) use a variety of methods in communicating their findings either to the college community or the wider society at the end of each project. Such methods include creating posters and flyers, Facebook page, organising public lecture and radio programs. Because of these activities, the participants have acquired reasonable skills of presentation to explain their findings in such a way that it is understood by the general public.

h. *Inference:* an ability to make meaning and draw conclusion that can be justified by evidence from an existing information or a situation [43]. The use of the ASSIM model has also helped participant in this study to acquire reasonable skills of making inferences. This is because the use of the ASSIM instructional model encourages the participants in the study to search and collect data for the purpose of building facts and evidence that they can use to address the issues they were working on as their project. They will always have to make inferences at the end of each project.

i. *Predicting:-* envisioning an outcome or a plan and it consequences. The preliminary web exploration activity in using the ASSIM model involves predicting. Participants in the study were engaged in making assumptions at the end of each preliminary web exploration activity. This has help to improve the participants' skills of making knowledge or evidence-based predictions.

j. *Self-regulation:-* ability to assess your own thinking ability, determine your strength and weakness and the willingness to admit and accept responsibilities associated with your weakness [44]. It has to do with the ability and willingness to leave what you cannot do for others that can do better [45]. It also deals with the ability of an individual to

separate or remove personal bias or self-interest when making decisions that involve others. The use of the ASSIM model provides room and encourages learners to practice self-regulation in the teaching-learning process. Teaching and learning using the ASSIM model is learner activity oriented. After the preliminary web exploration activity, learners would have to share responsibilities in carrying out their learning project in groups. This process has made the participants to know and understand their areas of strength and weakness in their respective groups. Thus, responsibilities in each group are given based on proven ability.

Critical thinking is a mental process that helps to improve learner's ability and competence to survive the challenges of living in the present era of globalisation and knowledge-based economy that is technology driven. It helps to improve the creativity of the learner in problem solving and helps the learner to develop life-long learning skills.

7.3. Development of problem-solving skills

The ASSIM model of instruction promotes the development of problem-solving skills among learners. Problem solving is a process of proposing solutions to issues and situations based on knowledge and evidence. The process involves a number of step by step activities that can be mentally challenging. The number of steps or stages involved in problem solving differs from one model to another. Though the activities are the same in all the models, what differs among the models is the orderly arrangement of the stages or steps. The activities involved in the process of problem solving require some skills such as creative thinking, decision making and learning skills. Creative thinking has to do with the process of thinking out of the box to generate new ideas and to identify new connections between existing ideas and concepts. Decision-making skills have to do with the ability to choose between options. Learning skills on the other hand as relate to problem solving has to do with the ability to make meaning out of information to construe knowledge and the ability to apply the knowledge in making decision over available options for problem solving. The activities involved in problem solving include:

7.3.1. Understanding the problem

This is the first thing to do in problem solving. Understanding the problem requires one to first identify that there is a problem. There are different ways of identifying a problem depending on the organisation. Issues and problems generally in society are first noticed through observation. For example, a head teacher in a community primary school may notice that the number of pupils coming to school has reduced. This observation is an indication that there is likely to be a problem. The next thing to do is to find out what exactly is the problem. This can also be done in a number of ways depending on the institution and what was observed. Using the example given earlier of the head teachers' observation, the next thing to do is to: (1) find out if actually the observation made was true; (2) find out the actual number of people involved; (3) find out why the pupils involved stopped coming to the school and (4) find out since when has that started. Understanding a problem requires one to know what exactly is the problem: The issue or the concern? Why is the issue or the concern a problem?

How does it the issue or the concern become a problem? What is the implication of the problem, the issue or the concern? What happens if the problem the issue or the concern remain unattended? Finding answers to the questions raised above in an attempt to understand the problem would require some preliminary investigation and data collection. In the case of the head teacher, he can interview the class teachers, parents of the pupils affected and the pupils themselves.

The use of the ASSIM model of instruction provides room for learners to practice the activities described in the paragraph above. The instructional activities for step 1 (Presentation of Learning Content as a Problem to be investigated) and step 2 (Preliminary web exploration) under the face-to-face instructional delivery process in the ASSIM model are designed to accomplish the same objective. Learners are expected to notice and identify a problem requiring an investigation from the introductory presentation of the facilitator in the step 1 activity. The preliminary web exploration in step 2 activity is for learners to make preliminary investigation for the purpose of understanding the problem to be investigated. These two learning activities in the ASSIM instructional model facilitate the development of the skills needed in defining and understanding problems, issues and concerns to be investigated for problem solving. These learning activities also help to improve the participants' skills of developing good problem statement that provide answers to the five questions raised in the paragraph above in a manner and language that can be clearly understood.

7.3.2. Data collection

This is the second step and activity to be performed in problem solving. The activity involved building basic assumptions, raising research questions and developing possible hypotheses as may be applicable. These should be guided by the data collected during the preliminary investigation conducted in the step 1 activity. The basic assumptions, research questions and hypotheses to be developed should be based on the problem statement developed with the data collected at the stage of understanding the problem. The data to be collected at this stage should therefore be directed toward answering the research questions raised and testing the hypotheses developed and to verify the basic assumptions earlier build. There are different methods of data collection depending on the nature and type of the research questions developed. Some research questions may require the use of interview, observations or focus group brainstorming, whereas some research questions may require the use of questionnaire to get the information needed. Once the needed data or information are collected using any of the methods mentioned, the problem-solving activity can move to the next step, that is, 'analysis of data to identify possible solutions'.

Step 3 activity in the ASSIM model of instructional design is for learners to be engaged in the same activity as described in the paragraph above. During this instructional activity, learners are expected to develop basic assumptions, raise research questions and hypotheses if applicable; decide on how and where to collect data or materials for the project; decide on what to do with the data or materials collected for the project; share responsibilities and set rules of participation in the project. Engaging learners in doing these activities would help them to develop the skills of selecting the appropriate population to be used for data collection; choosing

appropriate instrument for specific data collection; designing the procedure for data collection and administering the selected instruments for data collection. The observation data collected for this study indicated that the use of the ASSIM model of instruction has helped the pre-service teachers involved in this study as participants to acquire and master the skills of data collection.

7.3.3. Data analysis

At this stage of the problem solving, the data collected are analysed in relation to the research questions raised earlier and the earlier hypotheses developed. Depending on the nature of the research questions that guided the data collection and the kind of data collected, there are different types of data analysis that the problem solver can use. If the data collected are quantitative in nature, descriptive or inferential statistical methods of data analysis may be used; but, if the data are qualitative in nature (collected through the use interview, observations or documentation), such data may be analysed using content and thematic analysis. Analysis of the data collected should provide answers to the research questions raised; from such answers, possible solutions to the problem, issue or concern under investigation can be deducted.

The instructional activity in step five (5) of the ASSIM model is for learners to be engaged in doing the activity described in the paragraph above. During the step five (5) activity in the instructional design, learners are expected to analyse the data they have collected using the method as may be appropriate to answer their research questions, test their hypotheses (if applicable) and verify the basic assumptions guiding their study. Learners are to draw tentative conclusions from the analysed data as findings to apply in solving the problem under investigation. This activity has helped to improve the skills of data analysis and making inferences among the participants involved in this study.

7.3.4. Selecting the best solution

At this stage of the problem solving, one is required to study, compare and select one out of the possible options available. It is a process of making a choice between two or viable potential solutions to the problem, issue or concern under study. The decision should be based on research findings and pertinent information from the review of existing literature [45]. Before making any choice, one need to consider the consequent implications and merits of each possible solution identified. In doing this, one need to be careful and make sure that he or she is not influenced by his emotions. Effective decision making at this stage requires one to carefully and effectively analyse each possible solution. This can be done by considering a flowchart tracing each solution's pathway from inception to conclusion and critique of each possible solution by stakeholders and professional opinion. Stakeholder's confidence over the use of a particular possible solution is an indication leading to a successful decision making and eventually an effective problem-solving approach.

The learning activity in the second phase of the instructional delivery process (knowledge development) of the ASSIM model allows learners to be engaged in doing this activity. At the knowledge development stage of the instructional delivery process in using the ASSIM model,

learners are expected to make a presentation (individually or in group) of their research findings and the tentative conclusions they have drawn from the findings of their study to the class for critique. Each finding is to be deliberated upon by the entire class members. Based on the comments and critique of the class members, learners would be able to make a better decision of which finding or solution should best be selected and applied to the problem, issue or concern under study. This activity has helped the participant in this study to acquire the skills of selecting the best option to be applied in problem solving.

7.3.5. Implementation and review

This is the last stage of the problem-solving steps. It is at this stage that one is expected to come up with the plan on how to implement the application of the best solution chosen and how to get feedback on how well the selected solution is doing. The last instructional activity in the ASSIM model provides learners with the opportunity to practice the use of this skill. Learners at this stage are to work on how to apply the knowledge construed/developed practically (pilot-testing) in addressing the issue under investigation. Learners are also to decide on what is needed in applying their solutions. It is at this stage that learners should develop and write their project report for submission to the teacher. The report should have a problem statement, objectives, methodology and solutions.

7.4. Use of information technology in teaching among the pre-service teachers used in this study during their teaching practice

It was observed that the pre-service teachers involved in this study made effective use of the available information and communication technology equipment at their disposal in their teaching and learning during their teaching practice activities. 'I search the web for relevant and up to date materials to prepare myself for my classes on daily basis and in preparing my lesson' said one of the participants during an interview session. The researcher observed that most of the participants were communicating with their students via emails. They were also sharing learning materials and engaging their students in group discussions using Facebook. They were using powerpoint slides to project images and relevant video clips from YouTube. This, by implications, means that the use of the ASSIM model in pre-service teacher training can help to prepare the pre-service teachers to use technology effectively in their professional practices.

Technology integration in educational practices as used by the pre-service teachers who participated in this study during their practicum can make teaching and learning a fun for the learner as we noticed [46]. We also noticed that the pre-teachers were guiding their students to acquire the skills of using some applications in the computer. In particular, we have witnessed how one of the pre-service teachers was trying to show one of his students how to animate the powerpoint slides he had prepared for his presentation and we noticed the excitement on the students' face as he learns the new skills.

The pre-service teachers' use of technology in their teaching has helped to retain their students' interest in the learning activities they were performing. The researcher also observed

that the pre-service teachers were modelling the use of the ASSIM model with innovative modifications. Because of this, the instructional delivery was more students centred. The students were innovatively engaged in series of learning activities that can help them to construe meaning of certain concepts. This was interesting and the students were happy doing what they were doing. This was an indication that the use of the ASSIM model in teaching can help to motivate learning.

8. Conclusion

The ASSIM instructional model presented in this work is design to promote learner-centred pedagogy in twenty-first century teaching-learning environment that is technology driven. It promotes the integration of information technology in instructional delivery. The model accommodates the use of multiple or blended pedagogy in instructional delivery and facilitates the use of web-based inquiry in developing learners skills for critical thinking and reasoning, problem-solving, life-long learning and informed decision-making skills. The use of the model can help learners to acquire life-long learning skills. That is the ability to learn independently. It promotes interaction between class members as they have to work in team; thus, promoting the spirit of team works. The approach help learners to acquire some values needed in team work. Learners have come to understand the need to tolerate one another in order to accomplish the task of the team. Working as a group help learners to learn to listen to one another and appreciate the views of one another. Team work as necessitated by the use of this model in instructional process would help learners to acquire the skills and values for both leadership and followership. The design of the model is influenced by the TPACK theory and GPM (Giving, Prompting and Making) model.

The inquiry-based and problem solving nature of the ASSIM model of instructional design would help to develop the analytic and creative thinking skills of the learners. This is because problem solving requires the use of both analytic (logical) reasoning and creative reasoning. Some problem solving would require the use of scientific procedures and rules that appeal to logical reasoning, while some would require thinking out of the box that appeals to the use of creative reasoning (lateral thinking—this has to do with using one's imagination to create ideas). Some issues would require doing both simultaneously and sequentially.

Adopting the use of the ASSIM model of instructional design in pre-service teacher training would help to prepare the kind of teachers needed in the twenty-first century teaching-learning environment. The kind of teachers that can assume the role of facilitators; thus, making instructional delivery learner centred, activity oriented, inquiry and project-based. Teachers who can use classroom as not only a place for learning but also a place for acquiring the skills needed to survive the challenges of the twenty-first century. Teachers trained with the use of the ASSIM model would acquire the competence needed to effectively employ the use of technology in their professional practice and would have the expertise of helping the learner to acquire the skills of inquiry, critical thinking, creative thinking, decision making and problem solving.

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