Aspects of Collaborative Learning Model for Developing 21st Century Skills in Building Technology Students

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Abstract
This study identified aspects of collaborative learning model (CLM) for developing 21st century skills in Building Technology students for efficiency of practice after graduation. Two research questions and one hypothesis guided the study. The study adopted survey research design. The population for the study was 22 comprising of 15 lecturers and 7 instructors in the three tertiary institutions offering building technology courses in Enugu State. No sampling was done as the population was of a manageable size. A structured questionnaire of 31 items was used to elicit information from the respondents on four-point rating scale. The internal consistency of the instrument was computed using Cronbach Alpha reliability formula and it yielded a value of 0.86. The research questions were answered using mean and standard deviation while the null hypothesis was tested using t-test at 0.05 level of significance. The study revealed that Lecturers and Instructors utilize aspects of CLM and are aware of 21st century skills but are not mindful of developing these skills. Also, most 21st century skills needed by building technology trainees can be developed using CLM. The study recommended among others that assessment should more than ever focus on development and mastery of 21st century skills for functionality in the changing world of work.

Keywords: collaborative learning, collaborative intelligence, collaborative learning model, instructional delivery practices

Introduction

The need to inculcate 21st century skills into graduates to meet the demands of the changing world of work has remained a quest for possible solution over two decades now. While researchers agree that 21st century skills are not new (Larson & Miller, 2011; Rotherham & Willingham, 2010), its urgency and inevitability has been compounded by globalization, low civic engagement and economic necessity (Saavedra & Opfer, 2012). The 21st century skills refer to a broad set of knowledge, skills, work habits, and character traits that are believed - by educators, school reformers and employers to be critically important to success in today's world of work, particularly in collegiate programmes, contemporary careers and workplaces (Great School Partners, 2016). The 21st century skills (21st-CS) includes critical thinking and problem-solving skills; communicative skills, information and media literacy skills; contextual learning skills, learning and innovation skills; collaboration, research and information fluency; digital citizenship, technology operations and concepts (International Society for Technology in Education [ISTE], 2007; Partnership for 21st Century Skills [P21], 2009, 2011). Amidst the variations and discrepancies concerning the definition of 21st-CS and what constitutes these skills, the focus is fully on what students could do with knowledge and their

effectiveness in authentic contexts (Kaufman, 2013). In addition to the much desired critical thinking, innovative and creative skills, technology friendliness etc., communication and collaboration skills are much desired (Lai, 2011) especially in building technology whose students are expected to graduate and work amidst team members; hence no single person carries out a building project.

Building technology is a study concerned with the extensive technological skills which go hand in hand with the capacity to manage man, machines and products in order to carry out building tasks effectively and efficiently. Building technology as offered in higher institutions of learning share the same goal with Technical Vocational Education and Training (TVET) as outlined in the National Policy on Education, by the Federal Republic of Nigeria (FRN, 2013). TVET is used as a comprehensive term referring to those aspects of educational process involving, in addition to general education, the study of technologies and related sciences and acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various sectors of economic and social life (FRN, 2013). The anticipated outcomes include: pursuing further education, setting up their own businesses or securing employment (FRN, 2013). The attainment of these goals largely depends on the quality of graduates and their awareness of societal demands for future impacts in the face of technological advancements.

Advancements in technology have significant effects on the teaching and learning of building technology. Laurillard in Kaufman (2013) noted that technology creates important pressure for change. It is changing both what we need to know and how we come to know it. Some of the advancements in building technology field include the movement from: table, paper and pencil drafting to Automated Computer Aided Designs (AutoCAD); carton, wood and glue modeling to Building Information Modeling (BIM); structural and sectional detailing to structural analysis with software among others. Expertise to solve problems using technology is therefore a core requirement of the 21st century skills hence media and Information and Communication Technology (ICT). In addition to the changes, Larson and Miller in Kaufman (2013) argued that of great importance is for students to be able to research, organize, evaluate and communicate information with technology. The need or essence of technology therefore transcends 'playing with gadgets' (Larson, Miller, & Ribble, 2010) to include personal responsibility, personal productivity, adaptability, creativity, collaboration and communication. It is worth noting that knowledge and information in this era of technology also transcend individuals. Hence the availability and accessibility of the Internet affords every student of building technology the opportunity to reach out beyond the class boundaries and contribute to the body of knowledge thereby overriding learners' passiveness. In the face of individual contributions towards the actualization of a given task/building project, the importance of collaborative intelligence is realized, which in turn fosters collaborative learning. Therefore, the 21st century skills of individualized knowledge creation, team work, team management, team spirit etc. with wider community of learners can only be developed through collaboration and are sustained with clarity of its model.

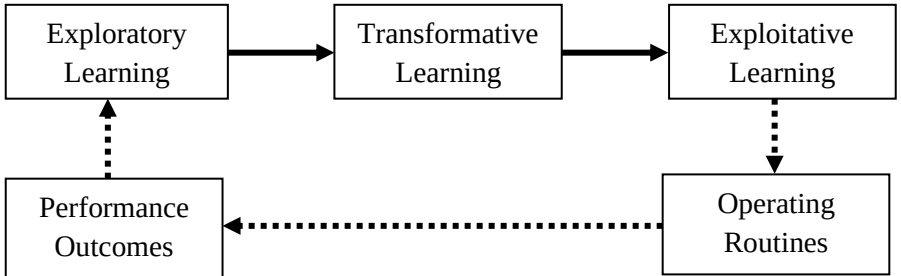
Collaboration and Collaborative Learning Model

Collaboration focuses on bringing two or more persons together for the purpose of learning towards completing a given task (Dillenbourg, 1999). 'Collaborative Learning' could be in many forms: face-to-

face, computer mediated (Computer Supported Collaborative Learning, CSCL), joint or labour divided, synchronous or asynchronous etc. Each form of collaborative learning is simply a mutual engagement of participants in a coordinated effort to solve a problem together (Lai, 2011). It involves activities such as reading, building, predicting, and mechanisms which include induction, deduction, and compilation (Dillenbourg, 1999). The overall outcome of collaborative learning is not personally based but an integrated ability of persons to reflect on the same task. Using the variance abilities and skills of individuals in their best dispositions to achieve a common goal underpins collaborative intelligence while the extent to which these individuals learn from each other on the delivery processes of the given task further highlights collaborative learning. Markova and McArthur (2016) define collaborative intelligence as the capacity of an individual to think with others towards accomplishing a unique project that matters to everyone in the group. However, collaborative learning and collaborative intelligence could be further detailed leaning on dynamic learning capability.

The concept of dynamic learning capability is the capacity of an organization to purposefully create, extend or modify its knowledge base through reconfiguring learning routines that explore, retain and exploit knowledge inside and outside organizational boundaries (Manley & Chen, 2015; Lewin, Peters & Massini, 2011; Lichtenthaler & Lichtenthaler, 2009). Furthermore, integrating internal and external knowledge in dynamic learning capability require that opportunities for knowledge exploration, transformation, and exploitation are created and underpinned. Knowledge exploration in this case emphasizes individual identification of valuable new knowledge from external sources and thus combines with internally generated ideas derived from existing learning routines, to select thoughts through discussion, analysis and debate (Manley & Chen, 2015; Lewin *et al*., 2011; Zollo & Winter, 2002). Exploratory learning occurs when organizational members identify, acquire, analyze and process new knowledge, which is critical for business operations (Lewin, *et al.*, 2011). The indispensable team skills of sharing explored information, ascertaining open communication, building relationship and achieving mutual understanding of the given task are realizable in collaborative adventures (Alashwal & Abdul-Rahman, 2014; Eriksson, 2010). More so is knowledge exploitation which entails the applicability and integration of newly assimilated knowledge to reshape the outcome and satisfy emerging needs in projects/buildings while knowledge transformation on the other hand balances the external and internal knowledge intake, thus linking exploratory and exploitation learning (Manley & Chen, 2015; Lewin et al., 2011; Lichtenthaler & Lichtenthaler, 2009; Noteboom, 2009).

Manley and Chen (2015) adopted the opportunities for knowledge exploration, knowledge transformation, and knowledge exploitation to create a circular model of dynamic learning which was refined to collaborative learning model (Figure 1). The model depicts that improvement in exploratory learning, improves transformative learning which also improves exploitative learning; exploitative learning effectively readjusts operating routines (how things are done). These improvements cumulatively impact on performance outcomes, positive outcome invariably motivates to renew exploratory learning (Manley & Chen, 2015).



Although the Manley's Collaborative learning model focused on infrastructure construction organizational project life cycle, the learning model could be adopted in building technology classrooms to foster the development of 21st century skills in the students. According to Chamizo (2013), model refers to a representation, usually based on analogies, which are built contextualizing certain portions of a domain with specific goal. The representation could be essential ideas, phenomenon or object generated by an individual or group; analogy depicts similarity of properties or features in a model while specific goals are the purpose for which the model is proposed or designed (Chamizo, 2013).

The purpose of the model is derived from the manipulation of its features to enable the learning of how and why it is first created (Morgan & Morrison, cited in Chamizo, 2013). Collaborative learning model as the focus here represents prototypical flow of knowledge into the classroom environment from both the teacher and students beyond boundaries of the classroom environment. Collaborative learning model in building technology proposes a learning approach that affords students the opportunity to create, extend or modify their knowledge base through reconfiguring learning routines that explore, retain and exploit knowledge inside and outside the school coverage. The purpose would be to make the learners active and creators of their own knowledge; exploit the advancements within their individual environment thereby making an artifact creator out of every learner; and ultimately transform the approaches to tasks/projects, as a result improve outcome of the person and his product.

The integration of collaborative learning model in teaching and learning building technology will alter the approach to instructional delivery practices on-going. By instructional delivery practices, one refers to course of action in which a teacher personalizes teaching approaches as it suits his or her expectations, students and school demands. It is a process by which teachers apply a repertoire of instructional strategies to communicate and interact with students around academic content, and to support students' engagement (California Community Colleges, n.d). Varieties and differentiations in instructional delivery practice afford the teacher opportunities to make instruction relevant to real-life problems which directly allow students to explore, inquire, and create knowledge. Effective 21st century teacher avoids the one-

size-fits-all approach with the understanding that students are from different backgrounds, with variance of interests, abilities and experiences.

The explorative, transformative and exploitative aspects of the collaborative learning model when utilized in classroom will among other benefits open up students active participation, build on existing knowledge and skill, foster creativity and imaginative skills, evaluate personal performances, integrate technological approaches, build effective teamwork and communication skills. These affordances of collaborative learning model are strong thrusts of 21st century skills which are necessary for adaptability and advancement in employments. This study therefore thrust on this background to determine aspects of collaborative learning model for developing 21st century skills in building technology students.

Problem of the Study

The expectation from a graduate of building technology includes being able to secure an employment, set up a self-reliant business or pursue further education in the building construction career. In addition, the students of building technology are expected by business leaders, construction contractors, politicians, educators and the world of work in general to possess 21st century flexible skills over basic skill set.

However, the outcome of the training given to the students while in school fails to match up thereby leaving the students short of 21st century skills - broad set of knowledge, work habits, and character traits – believed to be critical in today's world of work. On the part of the students, there seem to be lack of awareness of these salable skills and it is attributed to the fact that 21st century skills are neither taught explicitly nor assessed over factual retention (Schleicher, 2012; AT21CS, 2012). Consequently, the students are left to pick up 21st century skills by chance without a conscious design of the school system to inculcate these skills (Rotherham & Willingham, 2010). Hence, the teachers' choice of instructional delivery approach has favoured teacher-centered over students-centered approaches and without a model to foster problem-based, project-based, community engagement and collaboration methods of learning which are much advocated for the actualization of 21st century skills inculcation in the students. It is against this backdrop of failure to meet the need of equipping students of building technology with the workforce most demanded set of skills that it becomes important to investigate the introduction of the aspects of collaborative learning model in building technology classrooms to facilitate the development of 21st century skills in the students.

Purpose of the Study

The main purpose of the study is to determine aspects of Collaborative learning model for developing 21st century skill in students of Building Technology in Enugu State. Specifically, the study is:

1. to determine the collaborative learning approaches utilized in building technology instructional delivery practices.
2. to ascertain the 21st century skills that can be developed in building technology students using collaborative learning model.

Hypothesis

The study was guided by the following null hypothesis tested at a significant level of 0.05:

H_{O1}: The mean responses of Lecturers and Instructors in colleges of education and universities on the aspects of collaborative learning model utilized in their instructional delivery practices do not differ significantly.

Method

The study adopted survey research design. Survey design was necessary as the study sought opinions of Lecturers and Instructors on the aspects of collaborative learning model utilized by educators for developing 21st century skills in building technology students. The area of study was Enugu State, Nigeria; involving the tertiary institutions offering building technology. The institutions include: Enugu State College of Education (Technical), (ESCET), Enugu; Enugu State University of Science and Technology, (ESUT) and University of Nigeria, Nsukka (UNN).

The population for the study (N) was 22; made up of 5 lecturers, 2 instructors from ESCET; 3 Lecturers and 1 Instructor from ESUT and 7 Lecturers and 4 Instructors from UNN. No sampling was done as the population was of a manageable size. The instrument used for the study was a structured questionnaire with two sections A & B. Section A elicited personal information of the respondents while Section B had 31-item statements that sought information to answer research questions 1 and 2. The responses in section B were designed based on 4-point scale which ranges from 4 to 1. The responses to research question 1 comprised of the following - *Highly Utilized (HU) = 4, Utilized (U) = 3, Not Utilized (NU) = 2* and *Highly Not Utilized (HNU) = 1*; while Research question 2 had responses of: *Strongly Agree, SA = 4; Agree, A = 3; Disagree, D = 2;* and *Strongly Disagree, SD = 1*. The questionnaire was face validated by three experts in the Faculty of Vocational and Technical Education, University of Nigeria, Nsukka.

The research questions were answered using mean and standard deviation while the null hypothesis was tested using t-test at .05 level of significance. The data was analyzed using IBM Statistical Package for Social Sciences (SPSS). The decision rule was based on a mean benchmark of 2.50; where items with mean response of 2.50 and above implied utilized or agreed, while items with mean value below 2.50 was considered not utilized or disagreed.

Results

Table 1

Mean and Standard Deviation of Lecturers and Instructors ratings on the aspects of collaborative learning model utilized in building technology instructional delivery practices.

S/N	Collaborative Learning Approaches	M	SD	Remark
A	**Exploratory Learning**			
1.	Use guided inquiry in the teaching	3.45	.51	Utilized
2.	Encourage individualized articulation in building technology courses	3.32	.48	Utilized
3.	Make use of peer-to-peer learning in classroom instructional delivery	3.09	.68	Utilized
4.	Employ cooperative learning in teaching building technology students	2.91	.53	Utilized
5.	Carry every student along through active and participatory learning	3.32	.48	Utilized
B.	**Transformative Learning**			
6.	Organize real-life project workshops within the class	3.64	.49	Utilized
7.	Conduct problem-based discussions /debates	3.09	.29	Utilized
8.	Ensure that students do systematic reporting as means of evaluation/feedback	3.36	.85	Utilized
9.	Take students on field trip as a routine to learning best industrial practices	3.41	.80	Utilized

10.	Organize micro-exhibitions for students to showcase their ingenuity	2.95	.65	Utilized
C.	**Exploitative Learning**			
11.	Test students' knowledge using project-based learning	3.18	.66	Utilized
12.	Teach/create new concepts through design-based learning	2.95	.79	Utilized
13.	Develop students' ability through problem-based learning	2.91	.75	Utilized
14.	Support students to learn through programmed instructions	2.95	.49	Utilized
15.	Teach students personal responsibility using independent learning approach	2.82	.85	Utilized

Key: total number of respondents, *N* = 22; *M* = Mean; *SD* = standard deviation

Table 1 presents the mean rating of the opinions of the Lecturers and Instructors in the 3 tertiary institutions offering building technology courses in Enugu state. The fifteen items recorded mean rating higher than 2.50 benchmark; indicating that every aspect of collaborative learning model listed is utilized in teaching of building technology. Also, the standard deviation which ranges from 0.29 – 0.85, indicates that the responses were close to one another.

Table 2

Mean and Standard Deviation of Lecturers and Instructors ratings on the 21st Century skills that can be developed in building technology students using collaborative learning model

S/N	21st Century Skills for Building Technology using CLM	Mean	SD	Remark
1.	Critical thinking skill	3.77	.49	SA
2.	Problem solving skill	3.63	.49	SA
3.	Creativity and imaginative skill	3.73	.46	SA
4.	Leadership and Team management skill	3.50	.51	SA
5.	Research and information fluency skill	3.77	.43	SA
6.	Media literacy skill	3.36	.85	A
7.	Technological literacy skill	3.77	.43	SA
8.	Communication skill	3.50	.51	SA
9.	Contextual Learning skill	3.64	.73	SA
10.	Innovative skill	3.59	.50	SA
11.	Flexibility and adaptability skill	3.23	.92	A
12.	Personal productivity and responsibility skill	3.55	.74	SA
13.	Analytical skill	3.45	.86	A
14.	Evaluative skill	3.32	.89	A
15.	Environmental literacy skill	3.27	.94	A
16.	Business and entrepreneurial literacy skill	3.59	.67	SA

Key: total number of respondents, *N* = 22; *M* = Mean; *SD* = standard deviation

Results presented in Table 2 shows the agreement of the Lecturers and Instructors on the 21st century skills that could be developed in building technology students using collaborative learning model. Table 2 shows that all the 16 items listed had mean values above the 2.5 benchmark, precisely a range of 3.27 – 3.77. Also the standard deviation ranged from .43 to .94,

indicating that the respondents were close to one another in their opinions.

Table 3

T-test analysis of the ratings of Lecturers and Instructors on the aspects of Collaborative Learning Model utilized in Building Technology instructional delivery practices

S/N	Aspects of CLM	DESIGNATION	N	t-cal	df	Sig.	Remark
1	Cluster A (Explorative Learning)	Instructors	7	-.124	20	.903	NS
		Lecturers	15				
2	Cluster B (Transformative Learning)	Instructors	7	-1.385	20	.181	NS
		Lecturers	15				
3	Cluster C (Exploitative Learning)	Instructors	7	1.451	20	.162	NS
		Lecturers	15				
	Cluster mean	**Instructors**	**7**	**-.595**	**20**	**.559**	**NS**
		Lecturers	**15**				

Key: Total number of respondents, *N* = 22; *T-cal* = Calculated T-test value; *Df* = Degree of freedom; *Sig.* = Significant level; *NS* = Not Significant

Table 3 shows the cluster (A, B and C) analysis as well as the total cluster means of the overall items. The *t*-cal value was found not significant at .05 level of significance: *t*-cal (2, 22) = -.559; $p < .05$. The *t*-cal of -.595 with *p* value of .559 calculated at .05 level of significance and at 20 degree of freedom was greater than .05. The null hypothesis was therefore accepted. Hence, the mean response of Lecturers and Instructors in College of Education and Universities on the extent to which the aspects of collaborative learning model is utilized in instructional delivery practices do not differ significantly. This implies that the respondents in tertiary institutions have similar opinions regards the utilization of the aspects of collaborative learning model in teaching building technology.

Discussion of the Findings

The findings revealed that explorative, transformative and exploitative aspects of collaborative learning model are utilized in instructional delivery practices by Lecturers and Instructors in building technology. Explorative learning used in building technology instructional delivery practices include: guided inquiry, peer-to-peer learning, cooperative learning as well as active and participatory learning. None of the items of this cluster was rated a mean value less than 2.90 which indicates an impressive extent of utilization. More so, transformative learning includes instructional delivery practices such as: real-life project workshops, problem-based discussions/debates, systematic reporting, routine field trip and micro-exhibitions for students. Among the items, only one item (micro-exhibition with mean of 2.95) had a mean less than 3.0 which also indicates that Lecturers and Instructors in building technology utilize the CLM aspects. Exploitative learning which includes instructional delivery practices such as project-based learning, design-based learning, problem-based learning, programmed instructions and independent learning approaches. This cluster returned a minimum mean value of 2.82 for the item which shows the extent respondents teach students personal responsibility using independent learning approach. However, the overall responses indicate that these aspects are utilized in building technology

instructional delivery. These findings are in line with the statement made by Rotherham and Willingham (2010) that teachers know some instructional delivery practices that foster 21st century skills. Also, Burke (2011) in support of active and participatory approaches in higher education stated that collaborative learning is good for: students who are more likely satisfied with better grades; teachers who teach independence, responsibility, creativity among others and for employers who desire that students develop skills in teamwork.

The findings further revealed that Lecturers and Instructors in colleges of education and universities in Enugu State, who offer building technology, agreed that 21st century skills can be developed in building technology students using collaborative learning approaches. The 21st century skills include: critical thinking skill, problem solving skill, creativity and imaginative skill, leadership and team management skill, research and information literacy skill, media literacy skill, technological literacy skill, communication skill, contextual learning skill, innovative skill, flexibility and adaptability skill, personal productivity and responsibility skill, analytical skill, evaluative skill, environmental literacy skill and business and entrepreneurial literacy skill. The results showed a mean range of 3.27 – 3.77 which revealed a resonant agreement of all the respondents that 21st century skills could be developed in the students of building technology using collaborative learning model. This finding is in sequence with many findings, campaigns and movements such as the International Society for Technology in Education [ISTE], (2007); Partnership for 21st Century Skills, [P21] (2009), (2011) to ensure that graduates of collegiate institutions possess the set of skills sort after by employers, business men, politicians and entire world of work.

Implications of the findings

The aspects of collaborative learning model, the extent of utilization by Lecturers and Instructors, and the 21st century skills that could be developed in building technology students when collaborative learning model is integrated in teaching and learning is helpful in addressing the one-size fits all approach to teaching, identifying repertoire of instructional delivery practices for enhancing the quality of graduates from tertiary institutions in Enugu State. Although the findings of the study revealed that Lecturers and Instructors utilize the explorative, transformative and exploitative aspects of collaborative learning, yet the implications abounds for Lecturers and Instructors, Undergraduates and Administrators of institutions. For instance, utilization without results implies inefficiency and ineffectiveness in the side of the Lecturers and Instructors. The implication of the situation is seen in poor or non-assessment of the 21st century skills agreed to be developed using collaborative learning model. Consequently, students still graduate without the requisite 21st century skills sought by employers. Also, chance inculcation of 21st century skills in the students of building technology indicates inattentiveness of the Lecturers and Instructors, institutions' administrators alike to the demands of the present world of work. It also designates that conscious efforts should be made in teaching and learning to inculcate and assess the flexible and adaptable skills for self-reliance, employability and career furtherance of building technology graduates.

Conclusion

The study revealed that the explorative, transformative and exploitative aspects of collaborative learning model are utilized by the building technology Lecturers and Instructors in their instructional delivery practices. It also revealed that 21st century

skills can be developed in the students using collaborative learning approaches. However, the observed poor manifestation of these work habits and character traits on side of the students negates the coherence of the Lecturers and Instructors. It goes ahead to validate the fact that 21st century skills are neither taught explicitly nor assessed over factual retention which may be partly attributed to lack of model to serve as guide. Hence, it is necessary that the collaborative learning model be kept as guide and utilized consciously in order to develop the 21st century skills needed by the students of building technology for proper functionality in what lays ahead of them after graduation.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. 21st century Lecturers and Instructors in building technology should imbibe strongly and consciously the explorative learning, transformative learning and exploitative learning in their instructional delivery practices.
2. Assessment of the students should more than ever determinedly focus on development and mastery of 21st century skills for functionality in the changing world of work.
3. Building technology students should be taught from onset the meaning and need for communication, teamwork, group work or collaboration using real-life projects so as to foster their collaborative intelligence.

Limitations of the Study

The limitations of this study include: that the participants utilize virtually all aspects of collaborative learning model which should develop the 21st century skills in building technology students. Secondly, the population of building technology Lecturers and Instructors found in Enugu State appear rather minute and certainly affects the generalizability of this study. Also, the study failed to investigate assessment strategies currently used by Lecturers and Instructors to evaluate 21st century skills in students. The researchers therefore recommend that mixed research method (against just questionnaire) should be used across a larger sample of Lecturers and Instructors. Also, the students whose skills are meant to be improved should be integrated in the study, to validate the Lecturers and Instructors' claims and verify the findings of this study.

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