GENDER EFFECTS OF REFLECTIVE TEACHING AND PROBLEM-BASED LEARNING ON STUDENTS' ACQUISITION OF 21ST CENTURY SKILLS IN BASIC TECHNOLOGY

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Abstract

The study focused on the relative effects of reflective teaching (RT) and problem-based learning (PBL) on gender in relation to students" acquisition of 21st century skills in Basic Technology. Four research questions and four hypotheses guided the study. The non-equivalent control group design was adopted. Two JSS 3 intact classes were used. The pretest and posttest consisted of the construction of a building model, and the installation and activation of solar panels for green energy, respectively. The projects were validated by three industrial technical education experts from the University of Nigeria, Nsukka and Rivers State University of Science and Technology, Portharcout. The reliability of the projects was determined using the Kuder-Richardson Formular 20 technique and the coefficients were .84 for the construction of a building model and .81for the installation and activation of solar panels. The projects were assessed through process evaluation using an adapted instrument on four domains of 21st century skills namely, digital age literacy, inventive thinking, effective communication and high productivity. Mean and standard deviation were used to answer the research questions while the hypotheses were tested using ANCOVA at .05 level of significance. The findings indicated that though there was general improvement in the performance of the students following the application of the two instructional strategies, boys taught with reflective teaching performed significantly better on inventive thinking and high productivity skills while girls taught with the same method performed significantly better on digital age literacy and effective communication skills. However, in the PBL, boys performed significantly better than girls on inventive thinking while no significant difference was observed in their mean scores on digital age literacy, effective communication and high productivity skills. Among the findings is that gender has some influence on the extent to which each of the two teaching methods affects students" acquisition of 21st century skills in Basic Technology. However, PBL should be given more emphasis as it has shown to be less gender-biased than the reflective teaching method.

Introduction

The 21st century is witnessing dynamic changes in education and other dimensions of life. These changes are expected to blossom in the coming years of the century. The revolutions in

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Information and Communications Technology (ICT), rapidity in technological development, and globalization, have combined to make the 21st century a sophisticated era. Currently, there is a revolutionary paradigm shift from receiving to creating, from individual to partnership, and from routine to innovation and creativity (Soh, Osman & Arsad, 2012). Therefore, the 21st century requires skills that will enable students face the challenges of the era and beyond. According to Osman and Marimuthu (2010), students' academic achievement must be broadened to include those skills that will enable students thrive in the 21st century as academic excellence alone is no longer sufficient.

The skills needed for success in the 21st century according to NCREL in Soh, Osman and Arsad (2012), include: digital age literacy skills,

tools; and ability to produce relevant and high quality products which are informative and original. According to Yusuf (2008), people who are educated and have the courage to change and innovate are highly regarded within an organization, and are ready assets for economic and educational advancement. Therefore, the above skills are a-must-have for students since according to Arsad, Osman and Soh, (2011), those who lack or fail to acquire them will likely face stiff competition as the skills needed in the work place will continue to increase with economic and technological development in the global market.

However, indications are that 21st century skills have already been integrated into all levels of the Nigerian education system. For instance, basic technology is one of the curriculum contents of the Basic Education System in Nigeria, and a sub-set of Technical Vocational Education and Training (TVET) meant to

inventive thinking skills, effective communication skills, and high productivity skills. The above skills come in clusters. According to Soh, Osman and Arsad (2012), digital age literacy consists of basic literacy, scientific literacy, economic literacy and multicultural/global awareness. Inventive thinking, according to Arsad, Osman & Soh (2011), include: adaptability and managing complexity, self-direction, curiosity, creativity, risk taking, higher-order thinking and sound reasoning. On the other hand, Osman and Marimuthu (2010) identify effective communication to include: teamwork and collaboration, interpersonal skills, personal responsibility, social and civic responsibility, and interactive communication. Furthermore, high productivity is seen by Soh, Osman and Arsad (2012) to consist of prioritizing, planning and managing results; effective use of real world

inculcate saleable skills into students. It is offered from the primary to the junior secondary school levels. The overall objectives of the Basic Education System in Nigeria include to:
- inculcate permanent literacy, numeracy and the ability to communicate effectively;
- lay a sound basis for scientific, critical and reflective thinking;
- inculcate values and raise morally upright individuals capable of independent thinking, and who appreciate the dignity of labour;
- provide opportunities for the child to develop life manipulative skills that will enable the child function effectively in the society within the limits of the child's capacity; and

- provide the child with diverse basic knowledge and skills for entrepreneurial and educational advancement (FRN, 2013: pp 7 & 9).

The above objectives clearly indicate the direction of the current education policy in Nigeria. The Forward to the 2013 edition of the National Policy on Education (NPE), confirms that the curriculum is designed to produce graduates who can compete globally, and who will be fit and relevant to the 21st century. Therefore it is clear that 21st century skills are already in the curriculum.

Unfortunately, despite the inclusion of these skills in the curriculum, TVET graduates have been observed not to possess broad-based skills needed for survival or success in the present real world situations (Yalams, 2017 & Osinem, 2018). The authors specifically pointed out that the current TVET in Nigeria lacks the capacity to develop the type of skills that can outlast the shifts in the world of work. According to UNESCO-UNEVOC cited in Yalams (2017), the hopes of many young people who gain access to basic education are not being satisfied due to skills mismatch, leading to high job insecurity and growing youth unemployment. Osinem (2018) also laments the unfortunate skills mismatch among TVET graduates by revealing that while job openings continue to increase in industries, the graduates lack the skills required to fill the openings. This should not be allowed to continue considering the dangers associated with the trend. According to UNESCOUNEVOC cited in Yalams (2017), the present skills situation has given rise to TVET graduate unemployment and high risk of social exclusion. Therefore, effort should be made to check the

current skills mismatch among Basic Technology and TVET graduates if the risks associated with youth unemployment and social exclusion such as armed robbery, kidnapping, rape, prostitution, gambling and many more, are to be curbed.

In an effort to proffer solutions to the current situation, scholars have proposed some options which they consider viable. Arsad, Osman and Soh (2011), and Yalams (2017) were of the Opinion that teachercentered instructional strategies should give way to learner-centered ones. To verify this proposal empirically, it is necessary to determine the relative effects of two instructional strategies, one teachercentered and the other learner-centered, on students' acquisition of 21st century skills in Basic Technology. Reflective teaching (RT) and problem-based learning (PBL) will stand for the teacher-centered approach and learner –centered approach respectively. The choice of these two instructional techniques was informed by the fact that they have been highly advocated for their effectiveness in the impartation of life-changing skills to students.

Reflective teaching has some key characteristics and benefits. According to Zakariya (2009), reflective teaching consists of the following steps: planning an activity, teaching by putting the plan into action, observing how the lesson goes, recording your observations, discussing your observations with colleagues, reflecting on what happened, revising your plan or making a new one, putting the revised or new plan up for teaching, recording and reflecting again, among others. Similarly, Serra (2015), Bosire (2015), and Olitoquit (2014), observe that reflective teaching possesses many attributes which include peer observation, written account of

experiences, open-mindedness, whole-heartedness, activeness, and persistent search for information to problems. Others are care and concern for self and others, positive and nurturing classroom environment, self evaluation and evaluation by others, and the use of ─why‖ questions. According to Igboko and Kalu (2017), reflective teaching is a viable instructional strategy in a knowledge- based economy. Reflective teaching also has many other benefits. It helps learners gain the ability and confidence for selfdirected learning in which they learn to manage and monitor their own learning, thereby demystifying knowledge development (Garrison, 2003). It also helps them develop reflective and meta-cognitive skills, including higher-order thinking skills that enable them think in both abstract and concrete terms and apply specific strategies to novel tasks (Hinelo & Ferrai, 1997).These according to the authors, will help students tackle the complex situations that arise in their everyday life.

Problem-based learning (PBL) on the other hand, is a student-centered instructional strategy inwhich students collaboratively solve problems and reflect on their experiences (Achuonye, 2010). PBL places emphasis on thinking skills; integrates knowledge, skills and behaviours; and promotes the sharingof learning within a group (Aspy et al., 1993; Koh et al., 2008). Though, PBL hinges on problem-solving, theultimate goal is learning. It is process-oriented, requires self-directed and problem-driven learning; and characterized by learning driven by challenging, open-ended, ill-defined and ill-structured problems (Achuonye, 2010). In PBL, students generally work in collaborative groups while teachers take on the role of ─facilitators‖ of learning.

Yalams (2017) observed that PBL helps students to develop creativity, innovation, critical thinking, collaboration and communication skills. According to Palmer (2015), PBL also helps students to produce high quality and authentic products. These skills are essential for success in the 21st Century. However, the problem of skills mismatch among Basic Technology and TVET graduates may not be exclusively traceable to wrong choice of instructional strategies. Other factors may be contributory to the problem, one of which may be gender.

Therefore to make the investigation very comprehensive, the influence of gender on the acquisition of 21st century skills needs to be explored. This informs why genderis a major issue to be investigated in this study. Leahey (2006), views specialization in research as a measure of productivity and concludes that women specialize less than men thereby losing out on an important means of increasing their productivity. According to Fox (2001) and Fox & Stephen (2001), women‖s lower productivity relative to men‖s is largely responsible for other forms of gender inequality observed in the society. The large gender difference in productivity also contributes to women‖s disadvantage in terms of salary and promotion (Fox, 2005 & Prpic, 2002).

However, Baer (1999) after reviewing some studies on divergent thinking among men and women, found that in half of the studies there was no difference, while in about two-thirds of the remaining studies, girls scored higher and in the other third, boys scored higher. But in a study to determine gender differences in creative thinking, Matud, Rodriguez & Grande

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(2007) found that men with primary or secondary education scored higher than women with the same level of education. However, women with a university level education scored higher than men at the same level, yet statistically significant differences were only found for verbal fluency.

In terms of communication, women tend to talk about their thought processes as they unfold while men tend to wait until they have the answer before they say very much about the subject (Gamble and Michael, 2005). Again, according to Tannen (1990), women tend to desire a sympathetic response to their troubles while men tend to respond to problems with solutions. Contributing, Sandoval-Lewis (1998) observed that fathers and sons tend to talk about sports and construction-oriented matters which make men and boys more likely to engage in directive and task-oriented communication while mothers and daughters tend to talk about feminine-stereotyped activities such as playing house and therefore, are more likely to engage in collaborative communication. Therefore, male conversational style reflects need for independence while that of females reflect their need for connectedness (Von Hippel, etal 2011).

On digital age literacy, Fraillon, Schilz and Ainley (2013) found that, contrary to commonly held belief of boys having better computer skills than girls, 14 year old girls out-performed boys in computer and information literacy. However, Punter, Meelissen & Glas (2016) found that boys were better than girls on computer literacy while girls out-performed boys on information literacy.From the foregoing, it can be deduced that gender may likely affect the findings of this investigation.

The findings of the study will be of great benefit to basic technology students in particular and TVET students in general as it will help to determine the appropriate instructional strategies that will help them acquire the necessary skills for success in the 21st century. Male and female students in particular will benefit from the findings of this study when suitable instructional techniques that can help each group acquire the relevant 21st century skills are discovered and applied. It will also benefit parents, industries and the society at large. This will be possible with the determination of appropriate instructional strategies that will instill into students skills needed for success in today's family, industry and society. Generally, it will curb youth restiveness, unemployment and crime thereby enabling them to invest their time and energy in meaningful activities.

Purpose of the study

The study was designed to determine the gender effects of reflective teaching and problem-based learning on students' acquisition of 21st century skills in Basic Technology. Specifically, the study aimed to:

1. Determine the relative effects of reflective teaching and problem-based learning on Basic Technology male and female students' acquisition of digital age literacy skills.
2. Determine the relative effects of reflective teaching and problem-based learning on Basic Technology male and female students' acquisition of inventive thinking skills.

3. Determine the relative effects of reflective teaching and problem-based learning on Basic Technology male and female students' acquisition of effective communication skills.
4. Determine the relative effects of reflective teaching and problem-based learning on Basic Technology male and female students' acquisition of high productivity skills.

Research questions

1. What are the mean differences and standard deviations of the scores of male and female students taught with reflective teaching and those taught with problem-based learning on digital age literacy?
2. What are the mean differences and standard deviations of the scores of male and female students taught with reflective teaching and those taught with problem-based learning on inventive thinking?
3. What are the mean differences and standard deviations of the scores of male and female students taught with reflective teaching and those taught with problem-based learning on effective communication?
4. What are the mean differences and standard deviations of the scores of male and female students taught with reflective teaching and those taught with problem-based learning on high productivity?

Hypotheses

The following hypotheses were tested at .05 level of significance.

HO₁: There is no significant difference in the mean scores of male and female students taught with reflective teaching and those taught with problem-based learning on digital age literacy.

HO₂: There is no significant difference in the mean scores of male and female students taught with reflective teaching and those taught with problem-based learning on inventive thinking.

HO₃: There is no significant difference in the mean scores of male and female students taught with reflective teaching and those taught with problem-based learning on effective communication.

HO₄: There is no significant difference in the mean scores of male and female students taught with reflective teaching and those taught with problem-based learning on high productivity.

Methodology

The study was a quasi-experimental design.

Specifically, the non equivalent control group, pretest, post-test design was used. Ali (2006) recommends this design where intact classes are used. This design was adopted because the students used for the experiment were already in intact classes. The design involved two experimental groups, pre-test, post-test and two treatments. It is represented as follows: Experimental group 1: $O_1 X_1 O_2$

Experimental group 2: $O_3 X_2 O_4$

$O_1, O_3,$= Pre-tests (practical project)

$O_2, O_4,$= Post tests (Practical project)

X_1 & X_2 = Treatments (Reflective teaching and problem-based learning).

The study was carried out in Ahoada-East Local

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Government Area of Rivers State, Nigeria. AhoadaEast Local Government area was chosen because it has adequate number of technical institutions with the facilities and equipment needed to carry out the experiments. The area was also chosen because it has many co-educational schools as the variable of gender is of interest to this study. The population for the study was 160 junior secondary school (JSS) three students of Federal Science and Technical College Ahoada, and Government Technical College Ahoada, both in Ahoada-East L.G.A of Rivers State, Nigeria. However a sample of 80 students was used. The distribution is as follows: one stream of the JSS 3 class in the first school had 21 boys and 18 girls, giving a total of 39 students while the JSS 3 class in the second school had 19 boys and 22 girls, giving a total of 41 students. Using a random sampling technique, one stream from each school was assigned to a particular experimental group.

Each experimental group was taught Basic

Technology using the instructional method assigned to it. To avoid experimenter bias, the regular class teachers in the participating schools were made to teach the students in both groups. This way, the researchers were not directly involved in the experiment.

Furthermore, a three-week training programme was organized for the regular class teachers to equip them with the skills required for effective implementation of the two instructional methods. After the training programme, micro teaching sessions were organized for the teachers to ensure the internalization of the required skills.

Before the commencement of the actual treatment, a pre-test, involving the construction of a building model evaluated based on 21st century skills items adapted from Osman and Marimuthu (2010) was administered to the students. This was to determine the pre-treatment entry points of the students. The actual treatment lasted for eight weeks after which a post-test, comprising of the installation and activation of solar panels for green energy was administered to the two groups. The project was also evaluated based on 21st century skills items adapted from Osman and Marimuthu (2010) (See appendix). The class teachers with the help of resource persons carried out demonstrations on the two projects before allowing the students to commence work. Both the pre-test and post-test projects were processevaluated by observing students while at work. This was in line with Okoro (1994) who opined that assessment of practical projects is more effective when done through process evaluation, using students' works and observations. So while the two projects lasted, the skills of digital age literacy, inventive thinking, effective communication, and high productivity were assessed and scored. The scoring was done through a rating scale of 5, 4, 3 (satisfactory) and 2, 1 (unsatisfactory). This, according to Okoro (1994), is the most suitable rating scale for process-evaluation. The assessment lasted for two weeks – one week for each project. Earlier, the designs for the two projects were sent to three senior lecturers of industrial technical education, one from the University of Nigeria, Nsukka and the other two from the Rivers State University of Science and Technology, Port Harcourt for validation. They were specifically asked to assess the designs and find out if the execution of the projects will elicit 21st century skills from Basic Technology

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Table 1: Mean differences and standard deviations of the scores of male and female students taught Basic Technology with reflective teaching and those taught with problem-based learning on digital age literacy.

Gender	N	Reflective Teaching Method (1a)					N	Problem-based Learning (1b)				
		Pretest		Post-test		Mean Gain		Pre-test		Post-test		Mean Gain
		X	SD	X	SD			X	SD	X	SD	
Female	18	4.42	1.55	33.46	1.67	29.04	22	2.79	.83	33.79	1.38	31.00
Male	21	3.85	1.55	27.45	1.44	24.00	19	3.00	.70	35.21	2.31	32.21

students. After some amendments, the validators approved and confirmed that the projects had high content of 21st century skills. The projects were then trial-tested on 20 JSS 3 students of Community Junior Secondary School Rumuji in Emuoha local government area of Rivers State to determine the internal consistency of each of them using Kuder-Richardson Formular 20 technique. The reliability coefficients were therefore found to be .84 for the building model and .81for the installation and activation of solar panels. The pre-test and posttest scores were analyzed using mean and standard deviation to answer the research questions while the hypotheses were analyzed using Analysis of Covariance (ANCOVA). According to Ali (1996), ANCOVA is an appropriate statistical tool when randomization of subjects or research conditions is not possible. It removes the initial differences between the pre-test groups, thereby making them equivalent at last.

Results

Research Question 1

What are the mean differences and standard deviations of the scores of male and female students taught with reflective teaching and those taught with problem-based learning on digital age literacy?

Table 1 shows that girls taught with reflective teaching (RT) had a pretest mean score of 4.42, standard deviation 1.55, a post test mean score of 33.46 and standard deviation of 1.67, and a mean gain of 29.04 while boys taught with the same teaching method had a pretest mean score of 3.85 and standard deviation of 1.55, a post test mean score of 27.45 and standard deviation of 1.44, and a mean gain of 24.00. On the other hand, girls taught with problem- based learning (PBL) had a pretest mean score of 2.79 and standard deviation of .83, a post test mean score of 33.79 and standard deviation of 1.38, and a mean gain of 31.00 while boys taught with the same method had a pretest mean score of 3.00 and standard deviation .70, a post test mean score of 35.21 and standard deviation of 2.31, and a mean gain of 32.21. The result indicates that there is a general improvement in the performance of the students following the application of the two instructional methods. However, girls taught with RT performed significantly better than boys taught with the same method on digital age

Table 2: Mean differences and standard deviations of the scores of male and female students taught Basic Technology with reflective teaching and those taught with problem-based learning on inventive thinking skills.

Gender	N	Reflective Teaching Method (2a)					N	Problem-based Learning (2b)				
		Pretest		Post-test		Mean		Pre-test		Post-test		Mean Gain
		X	SD	X	SD	Gain		X	SD	X	SD	
Male	21	4.09	1.61	29.61	1.66	25.52	19	2.92	.78	28.73	2.02	25.81
Female	18	4.15	1.64	19.49	3.65	15.34	22	2.90	.84	22.64	4.81	19.72

literacy while there is no significant difference in their mean scores when taught with PBL.

Research Question 2

What are the mean differences and standard deviations of the scores of male and female

Table 2 shows that boys taught with RT had a pretest mean score of 4.09 and standard deviation of 1.61, a post test mean score of 29.61 and standard deviation of 1.66, and a mean gain of 25.52 while girls taught with the same method had a pretest mean score of 4.15 and standard deviation of 1.64, a post test mean score of 19.49 and standard deviation of 3.65, and a mean gain of 15.34. This result shows that boys performed significantly better than girls on inventive thinking. On the other hand boys taught with PBL had a pretest mean score of 2.92 and standard deviation of .78, a posttest mean score of 28.73 and standard deviation of 2.02, and a mean gain of 25.81 while girls taught with the same method had a pretest mean score of 2.90 and standard deviation of .84, a post test mean score of 22.64 and standard deviation of 4.81, and a mean gain of 19.72. The result also shows that boys performed significantly better than girls on inventive thinking. However there is a general improvement in the performance of

students taught with reflective teaching and those taught with problem-based learning on inventive thinking?

the students following the application of the two instructional methods as shown in their mean gains.

Research Question 3

What are the mean differences and standard deviations of the scores of male and female students taught with reflective teaching and those taught with problem-based learning on effective communication?

Table 3: Mean differences and standard deviations of the scores of male and female students taught Basic technology with reflective teaching method and those taught with Problem-based learning on effective communication.

Gender	N	Reflective Teaching Method (3a)				N	Problem-based Learning (3b)				
		Pretest X	SD	Post-test X	SD		Pre-test X	SD	Post-test X	SD	Mean gain
					Mean Gain						
Female	22	6.84	4.86	25.00	5.18	18.16	18	8.70	4.92	11.48	4.96	2.78
Male	19	5.13	5.23	18.25	3.41	13.12	21	9.43	6.20	11.74	4.67	2.31

Table 3shows that girls taught with RT had a pretest mean score of 6.84 and standard deviation of 4.86, a post test mean score of 25.00 and standard deviation of 5.18, and a mean gain of 18.16 while boys taught with the same method had a pretest mean score of 5.13 and standard deviation of 3.23, a post test mean score of 18.25 and standard deviation of 3.41, and a mean gain of 13.12. This result shows that girls performed significantly better than boys on effective communication when taught with RT. On the other hand, girls taught with PBL had a pretest mean score of 8.70 and standard deviation of 4.92, a posttest mean score of 11.48 and standard deviation of 4.96, and a mean gain of 2.78 while boys taught with the same method had a pretest mean score of 9.43 and standard deviation of 6.20, a post test mean score of

11.74 and standard deviation of 4.67, and a mean gain of 2.31. This result shows that there is no significant difference in the mean scores of boys and girls on effective communication when taught with PBL. Again, there is a general improvement in the performance of the students following the application of the two instructional methods as shown in their mean gains.

Research Question 4

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What are the mean differences and standard deviations of the scores of male and female students taught with reflective teaching and

Table 4 shows that boys taught with RT had a

those taught with problem-based learning on high productivity?

application of the two instructional methods as

Table 4: Mean differences and standard deviations of the scores of male and female students taught Basic technology with reflective teaching method and those taught with problem-based learning on high productivity.

	Reflective Teaching Method (4a)				Problem-based Learning (4b)			
Gender	N	Pretest X SD	Post-test X SD	Mean Gain	N	Pre-test X SD	Post-test X SD	Mean Gain
Male	21	5.07 4.48	14.924.88	9.85	19	4.833.61	14.294.55	9.86
Female	18	5.17 5.01	8.26 5.83	3.09	22	5.29 4.64	14.404.28	9.11

pretest mean score of 5.07 and standard deviation of 4.48, a post test mean score of 14.92 and a standard deviation of 4.88, and a mean gain of 9.85 while girls taught with the same method had a pretest mean score of 5.17 and standard deviation of 5.01, a post test mean score of 8.26 and standard deviation of

5.83, and a mean gain of 3.09. The result shows that boys performed significantly better than girls on high productivity when taught with RT. On the other hand, boys taught with PBL had a pretest mean score of 4.83 and standard deviation of 3.61, a post test mean score of 14.29 and standard deviation of 4.55, and a mean gain of 9.86 while girls taught with the same method had a pretest mean score of 5.29 and standard deviation of 4.64, a post test mean score of 14.40 and standard deviation of 4.28, and a mean gain of 9.11. This result shows that there is no significant difference in the mean scores of boys and girls on high productivity when taught with PBL. However, there is also a general improvement in the performance of the students following the

shown in their mean gains.

Hypotheses

HO_1: There is no significant difference in the mean scores of male and female students taught with reflective teaching and those taught with problembased learning on digital age literacy

HO_2: There is no significant difference in the mean scores of male and female students taught with reflective teaching and those taught with problembased learning on inventive thinking

HO_3: There is no significant difference in the mean scores of male and female students taught with reflective teaching and those taught with problembased learning on effective communication HO_4: There is no significant difference in the mean scores of male and female students taught with reflective teaching and those taught with problembased learning on high productivity

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Table 5: Summary of Analysis of Covariance (ANCOVA) for test of significance of three effects: treatments and gender on students' acquisition of 21st century skills in basic technology.

Source	Sum of squares	df	Mean	F	Sig
Corrected model	3742.034	4	935.509	68.868	.000
Intercept	8036.005	1	8036.005	591.575	.000
Pretest	20.284	1	20.284	1.493	.224
Gender (1a)	162.704	1	162.704	15.635	.000
Gender (1b)	42.979	1	42.979	3.164	.077
Gender (2a)	5465.897	1	5465.897	515.622	.000
Gender (2b)	3188.441	1	3188.441	233.990	.000
Gender (3a)	10.762	1	10.762	0.081	.041
Gender (3b)	993.1347	1	993.1347	151.8787	.392
Gender (4a)	301.7457	1	301.7457	10.121	.0409
Gender (4b)	35.068	1	35.068	0.365	3.920
Error	1888.188	75			
Total	131892.000	80			
Corrected Total	5630.222	79			

Significance at Sig of F< .05

In table 5, the F-calculated value for gender (1a) is 15.635 with a significance of F at .000 which is less than .05. Again, the F-calculated value for gender (1b) is 3.164 with a significance of F at .077 which is higher than .05. With this result, the null hypotheses Ho_1 is rejected for gender (1a) and upheld for gender (1b). This follows that there is a significant difference between the mean scores of boys and girls taught with the reflective teaching method on digital age literacy. This indicates that girls performed significantly better than boys in this particular skill. On the other hand, there is no significant difference in the mean scores of boys and girls taught with problembased learning on digital age literacy. The Fcalculated value for gender (2a) is 515.622 with a significance of F at .000 which is less than .05 while the F-calculated value for gender 2b is 233.990 with a significance of F at .000 which is less than .05. With this result, the null hypothesis Ho_2 is rejected for both gender 2a and 2b. This follows

that there is a significant difference between the mean scores of boys and girls taught with reflective teaching on inventive thinking. There is also a significant difference between the mean scores of boys and girls taught with PBL on the same skill. This indicates that boys performed significantly better than girls in both groups. The F-calculated value for gender 3a is 0.081 with a significance of F at .041 which is less than .05 while the F-calculated value for gender 3b is 151.8787 with a significance of F at .392 which is greater than .05. Following this result, the null hypotheses HO_3 is rejected for gender 3a and accepted for gender 3b. This shows that there is a significant difference between the mean scores of boys and girls taught with reflective teaching on effective communication, with the girls excelling. On the other hand, there is no significant difference between the mean scores of boys and girls taught with problem-based learning on effective communication.

The F-calculated value for gender 4a is 10.121 with a significance of F at .0409 which is less than .05 while the F-calculated value for gender 4b is 0.365 with a significance of F at 3.920 which is greater than .05. With this Result, the null hypothesis HO_4 is rejected for gender 4a and upheld for gender 4b. This shows that there is a significant difference between the mean scores of boys and girls taught with reflective teaching on high productivity while there is no significant difference between the mean scores of boys and girls taught with problem- based learning on high productivity.

Discussion of the Findings

The findings indicated that boys taught with reflective teaching displayed higher inventive thinking skills and higher productivity skills than girls taught with the same method in basic technology. These findings are wholly in line with Fox (2001) and Fox & Stephen (2001), but partly in line with Baer (1999) and Matud et al (2007). The findings also indicated that girls taught with reflective teaching displayed higher digital age literacy skills and higher effective communication skills than boys taught with the same method. These findings agree with Gamble and Michael (2005), Tannen (1990), Von Hippel et al. (2011) and Fraillon et al. (2013). Therefore, reflective teaching is gender-biased when it is used as a teaching method for imparting 21st century skills to Basic Technology students. The findings also indicated that boys taught with problem-based learning displayed higher inventive thinking skills than girls taught with the same method. The findings also showed that the use of problem-based learning did not produce statistically significant mean score differences between boys and girls in digital age literacy skills, effective communication skills and high productivity skills. Therefore, problem-based learning is not as gender sensitive as reflective teaching in the impartation of 21st century skills to Basic Technology Students. This particular finding is a clear indication of PBL's superiority over reflective teaching and should be taken seriously. The results of the four hypotheses tested also supported the findings of the study.

However, the findings revealed general improvement in students' acquisition of 21st century skills following their exposure to the two instructional strategies. This finding is in line with Achuonye (2010), Palmer (2015), Yalams (2017), and Koh et al. (2008), who observed that the PBL instructional strategy has the potential to instill life-enhancing skills into students. The finding is also in line with Garrison (2003), Hinelo and Ferrai (1997), and Igboko & Kalu (2017) who observed that reflective teaching has the potential to develop in students the skills needed for tackling everyday life challenges. This could be as a result of the fact that in reflective teaching, other people such as fellow teachers and even students make inputs into the teaching/ learning process through observations, corrections and suggestions. These, in addition to the teacher's self -reflective practices, can lead to general improvement in teaching and learning which will ultimately translate to improved and deeper learning by students. Indeed a lot of positive things could result from the observations and suggestions especially as students and other teachers are involved. For instance, the important elements of other methods could be brought in during the process to reinforce and enliven teaching. This goes to show that not all teacher-centered instructional strategies should be

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discountenanced in the quest to inculcate 21st century skills into students.

Conclusions

The following conclusions are drawn based on the findings of the study: the use of reflective teaching helps boys learn more inventive thinking skills and high productivity skills in basic technology than girls while the use of reflective teaching helps girls learn more digital age literacy skills and more effective communication skills than boys in basic technology. Though the boys had a mean score significantly higher than the girls in inventive thinking skills from the use of problem-based learning, the differences in their mean scores in digital age literacy, effective communication and high productivity skills from the use of problem-based learning are not statistically significant. Therefore, the use of problem-based learning (PBL) was consistent in producing better results of the 21st century skills across gender in Basic Technology. There was also general improvement in the performance of the students following the adoption of the two instructional

strategies

Recommendations

Based on the findings, the following recommendations are made:

1. Seminars, conferences and workshops should be organized to sensitize and train teachers on the proper use of reflective teaching and problem-based learning in teaching 21st century skills in Basic Technology to ensure that the best in each method is harnessed for maximum effects on students' learning.

2. Problem- based learning should be given more emphasis as it has shown to be less gender- biased than reflective teaching.

3. More studies should be carried out to determine the interaction effects of gender on the two instructional methods in relation to the learning of 21st century skills in Basic Technology.

4. More studies should be conducted to determine the relative effects of other teacher-centered and student-centered instructional approaches on students' acquisition of 21st century skills in Basic Technology.

5. Teachers of Basic Technology should provide equal opportunities for male and female students to learn the 21st century skills in Basic Technology as both can achieve relevant skills with the use of appropriate methods.

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Appendix

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21st Century skills Instrument adapted from Osman & Marimuthu (2010)

Domain of 21st century skills	Element	Satisfactory Unsatisfactory 5 4 3 2 1
Digital Age Literacy	1. Ability to demonstrate basic literacy and numeracy skills necessary to function on the job and in society to achieve one's goal and develop one's knowledge and potential. 2. Ability to demonstrate knowledge and understanding of the scientific concepts and processes required for personal decision making. 3. Ability to identify economic problem, alternatives, costs and benefit and predict the effect of economic changes 4. Ability to upgrade the skills and apply technology in day to day life. 5. Ability to demonstrate visual literacy to interpret, use, appreciates and creates images. 6. Ability to understand differences in culture and respect individuals beliefs to find opportunity to interact. 7. Appreciates the uniqueness of different cultures and taking into consideration its impacts in decision making 8. Ability to integrate and to use various types of media to communicate and to share information effectively.	
Inventive Thinking	1. Ability to handle multiple goals, tasks, inputs and modify one's thinking, attitude to be better suited to current environment. 2. Ability to demonstrate independence, able to plan for achievement and manage time effectively. 3. Ability to demonstrate the desire to know and show interest that leads to inquiry. 4. Highly creative to invent genuinely either personally or culturally. 5. Willing to tackle challenging task in problem solving 6. Ability to use technology resources to problem solving and decision making.	
Effective Communication	1. Ability to demonstrate cooperative interaction among individuals in a group and possess leadership qualities. 2. Ability to read, manage the emotions of oneself and others during social interaction. 3. Ability to apply knowledge to achieve balance, integrity and quality of life. 4. Ability to manage technology that promotes public good and protects society and environment. 5. Ability to demonstrate priority in telecommunication usage to work in a team and to interact with working colleagues and others.	

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High Productivity	1. Ability to manage problems effectively and efficiently to achieve goals.
	2. Ability to analyze, evaluate information, new resources and suitable technology devices for work.
	3. Ability to produce high quality products and application of technology to increase welfare and general well being of mankind.