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Research Article

Assessing teachers' competencies in teaching and learning using distance education

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ABSTRACT

Educators responded to the corona epidemic period by using virtual education. This article examines the perceptions of first three grade teachers in Jordan toward attaining teaching competencies in the field of distance education. Data were collected using a survey technique and a questionnaire with a reliability coefficient of 0.82. The results suggested competencies linked to online teaching. The results provided insight into the skills and experiences that were possessed to varying degrees: e-course management placed first in terms of relevance with a relative mean (65%), followed by computer applications (50%), networks (47%), and educational materials design (42%). There were no statistically significant differences based on gender and academic qualifications. Therefore, the findings improve teachers' lack of distance learning professional competencies.

Keywords: competence, teachers, online learning, educational technology

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INTRODUCTION

The usage of ICT in our everyday lives is significant; it has impacted every aspect of our culture. Schools benefit from the myriad of new ways in which students may use ICT to communicate, learn, and exchange information (Pingel, 2010). As communication technologies advance technologically, online education has become a realistic alternative; learners connect with teachers, classmates, and subject matter in a setting that provides many of the benefits of conventional face-to-face contact without having to leave their home or workplace (Keegan, 2002; Rudestam, 2004). Online learning is defined as "the use of the internet to access learning materials; to interact with learners, the content, teacher, and other learners; and to obtain support during the learning process, to acquire knowledge, to construct personal meaning, and to grow from the learning experience" (Ally, 2005).

Many teaching approaches, including distance education, virtual education, e-learning, web-based learning, and distributed learning, are referred to as "online learning". Distant education however is defined broadly as the use of technology to create, administer, and deliver electronic educational activities to students through the Internet (Aljhani et al., 2018). It is the method of exchanging knowledge with the learner while at a location other than the teacher's location (Holmberg, 1995; Keegan, 2002; Tapia-Ladino et al., 2016).

The presence of teachers with quality teaching competencies that replicate their reality is critical to the success of distance education because teaching in the digital world is a procedure of preparing and developing teachers to be able to move at a steady speed to face the difficulties of attracting and teaching all pupils (Al-Qatami, 2019), this is due to the direct relationship between the technically qualified teacher and the achievement of the objectives of distance learning (Hoq, 2020).

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Several studies have found that the risks, issues, changes, and improvements that education is experiencing in the present day as a result of the use of modern and advanced technology are mostly focused on the technique through which teachers develop their competencies. (Ling et al., 2005). Online learning does not abolish the function of the teacher but rather enhances it (Febriyani et al., 2022). Teaching is still one of the most coveted vocations in the USA (Kearns et al., 2021).

The first three grades are regarded as one of the most significant phases of education since they serve as the foundation for the development of children's personalities and equip them with the fundamental information and skills necessary for success. Many studies have found that the dangers, problems, changes, and advancements that education is facing in the contemporary age as a result of the use of advanced and modern technology are mostly centered on the process of improving teachers' competence in the field of digital learning (Megat Abdul Rahim et al., 2021). The purpose of this study was to shed light on the teacher's professional competencies at Jordanian schools.

Theoretical Perspective

Distance learning is a teaching and learning system that includes the design, construction, planning, implementation, management, evaluation, and delivery of educational activities to learners anywhere

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and at any time via electronic educational platforms, desktops, laptop computers, smartphones, and other digital equipment (Hussien et al., 2020). And during the corona epidemic, most nations employed distance learning to address the crisis of students' suspension from schools, and to compensate for this disruption. Jordan, like other countries, worked by adopting distance learning to enable students to access educational content (Al-Sharari, 2020; Shaub, 2020).

Distance learning was recognized by Jordanian educators to be one of the teaching methods that preserved educational continuity in the setting of the corona outbreak (Albadawi & Sabbah, 2022). Competencies can assist teachers in achieving their distance learning goals (Adnan & Anwar, 2020). According to the educational literature, a competent teacher is qualified to fulfill his function as a consequence of understanding the skills, concepts, and tendencies inherent in competencies, and therefore the actual execution of the role he is qualified to play (Adăscăliței et al., 2020).

The current research aims to investigate the following competencies for the first three-grade teachers: computer and its' application, networks, electronic course design and preparation, and Electronic course management (Abdulhaq, 2016; Al-Daghim et al., 2021; Allah et al., 2022; Fowler, 2018).

Online Competences

Previous research defines online competencies as personal, social, educational, and technological. Research also has established four kinds of online competencies:

- (1) content,
- (2) design,
- (3) communication, and
- (4) management (Baran & Correia, 2014; Guasch et al., 2010; Palloff & Pratt, 2011; Smith, 2008).

Dobbin et al. (2009) grouped them into eight categories:

- (1) content management skills,
- (2) technical skills,
- (3) instructional design,
- (4) social processes and attendance,
- (5) assessment management,
- (6) student orientation,
- (7) institutional knowledge, and
- (8) pedagogy.

Salam et al. (2011) proposed a framework that incorporates preteaching competencies like preparation, planning, and design. He also proposed intra-teaching competencies like facilitation, interaction, provision, and feedback seeking. Finally, Bigatel et al. (2012) classified online teaching competencies into seven categories based on successful online teaching tasks:

- (1) active learning,
- (2) management and leadership,
- (3) active and responsive teaching,
- (4) multimedia technology,
- (5) classroom adequacy,
- (6) technological competence, and
- (7) policy application.

COAT has also developed nine online teaching competencies:

- (1) instructing pupils in online learning,
- (2) digital competence,
- (3) teaching/learning management,
- (4) basic course design principles,
- (5) pedagogy and pedagogy,
- (6) sociocultural process and existence,
- (7) the Internet security for grades K-12,
- (8) evaluation and assessment, and
- (9) legal and institutional policies and practices (Habibi, 2021).

Previous research agreed on the following competencies for teachers while teaching online: pedagogy, technology, design, content, management, institutional, communication, and social (Koehler et al., 2013).

According to TPACK, successful online teaching happens when teachers have a body of knowledge developed from a complex interplay between content knowledge, pedagogy, and technology. In this article, distance teaching competencies are classified as one of four types of performance (e.g., computer and its applications, course design, management, and networking). Previous research agreed on the following competencies for teachers to have while teaching online: pedagogy, technology, design, content, management, institutional, communication, and social (Koehler et al., 2013).

Importance of the Research

This study is important for many reasons:

- The Ministry of Education's important role in preparing a generation of teachers who, in turn, contribute to the service of their country by possessing Supervisory skills, design of educational materials, integration of educational technology, and skills in managing the educational process.
- 2. Informing teachers in the first three grades about distance education skills can raise their understanding of the competencies that should be focused on in distance teaching and demonstrate them as behaviors in teaching practices.
- Determining such competencies aids in assessing the strengths and weaknesses of instructors at all levels of study in this discipline in schools locally and internationally in the future.
- 4. Considering the set of competencies as factors of evaluation to enhance the performance of online learning teachers in the first three grades.
- 5. Keeping this study in line with contemporary worldwide trends and developments in the educational area.

Purpose of the Study

In many places worldwide, teacher competency has surfaced as a critical concern, 60 million teachers globally require career development to develop their teaching skills (Jallade et al., 2001). In developing nations, half of the teachers were unprepared compared to their country's stated teacher education criteria (Sinclair, 2002). In Jordan, the 1st Educational Development Conference in 1987 proposed that every primary and secondary school include a computer lab. As a result, all schools received a computer to coexist in the technological world. Despite these attempts, many Jordanian primary three-grade teachers have academic backgrounds unrelated to online instruction.

Table 1. Mean, SD, and relative mean (RM) values for all items of the computer application domain

Item	s Competency	Mean	SD	RM
1	Create and save files and folders on your computer.	3.81	1.10	76%
2	Compressing and decompressing compressed data.	3.76	0.84	75%
3	Use of Microsoft Office apps (for word processing, presentations, and tables).	3.76	0.88	75%
4	Setting data processing stages (inputs, operations, outputs).	3.65	0.82	73%
5	Knowing how to utilize a computer to present data.	3.59	0.68	72%
6	Recognizing file extensions.	2.66	1.01	53%
7	Understanding of the prerequisites for developing successful digital educational materials.	2.10	1.01	42%
8	Knowledge of computer capabilities and limits.	2.00	0.99	40%
9	Maintaining the operating system (Windows) and the many versions of it.	2.00	0.89	40%
10	Utilizing a computer and its countless programs.	1.89	0.68	38%
11	Recognizing virus detection and prevention methods.	1.88	0.54	38%
12	Formatting the output for display on the screen using the desktop and taskbar.	1.78	0.99	36%
13	Keep up with the latest versions of different computer programs.	1.68	1.01	34%
14	Managing many apps, whether downloading or uninstalling.	1.61	1.23	32%
15	Understanding of the foundations of various programming languages.	1.45	1.17	29%
Over	all	2.50	0.42	50%

According to Esposito and Sinatora (2022), Jordan's group for digital dialogues, Jordanian teachers generally agreed that no unqualified teachers should be engaged in online education. According to some Jordanian policymakers, the standard of education in Jordan has declined significantly as a result of losing schools during the COVID-19 epidemic and the inadequacy of online learning to accomplish its aims. They claim that Jordan will require two decades to make up for academic losses and return to pre-pandemic norms (Kawar et al., 2022). However, until recently, the distance learning abilities of teachers were not reviewed in remote learning experiences in Jordan during the epidemic. This research will result in an evaluation of instructors' competence to teach by and learn utilizing distance education.

The purpose of this research is to examine the competencies of the teachers of the first three grades in the context of the distance learning program in schools in Jordan. As well as the reflection of gender or experience in English as a second language as independent variables. The research attempts to answer the following research questions:

- 1. **Q1.** What is the degree to which primary school teachers achieve distance learning competencies?
- 2. **Q2.** Are there statistically significant differences in the achievement of distance learning efficiencies by primary school teachers due to, academic qualification, and gender variables?

METHOD

Instrumentation

Based on the nature of the problem posed, the study adopted a descriptive approach. A two-part instrument was used to gather data; the first section deals with collecting information about gender and teachers' academic qualifications. The second section of the questionnaire included 69 items assessing the teacher competencies with a point Likert scale, with 1 being strongly disagreed, 2 being objected, 3 being neutral, 4 agreeing, and 5 strongly agreeing. It takes roughly 10-15 minutes to collect data on this scale. A panel of eight judges from the field of specialization verified the instrument. The questionnaire items were modified by the judges' recommendations. The reliability of the questionnaire was tested using the test-retest procedure on a sample of 25 teachers from the study population, and

these teachers were omitted from the original study sample. Cornbrash's alpha was applied to the data, yielding a reliability coefficient of 0.82

Participants

A random sample of 206 male and female teachers from public elementary schools in Jordan's Irbid Governorate was chosen. With an 80% response rate, 164 teachers completed the survey. There were 76 (46.3%) men and 88 (53.7%) females in the sample. There were 62 teachers with a bachelor's degree (37.8%), 62 teachers with a master's degree and a Ph.D. (37.80%), and 40 teachers with a higher diploma (24.39%). The sample's mean age was 39.8 years (standard deviation [SD]=1.13; range=24 to 52).

Data Analysis

To address the first question, the means and SDs for each item as well as the total mean value were calculated. To address the second question, a one-way analysis of variance (ANOVA) was used to assess if there were variations in distance learning competencies due to levels of academic qualification. For the gender variable, a t-test was utilized.

RESULTS

To answer the first question related to determining the competencies of primary school teachers in the field of distance learning in Jordan, the means, SDs, and relative means were calculated for each item and each division of study; a higher mean value implies a higher degree of competence, whereas lower mean value suggests a lesser level of competence. In this study, a mean value of less than 2.50 is considered a low value, 2.5-3.49 is a moderate value, 3.5-4.49 is a high value, and more than 4.49 is a typical value.

Computer Applications

Table 1 displays the means, SDs, and relative means for each item in the field of computers and its applications competencies. The overall mean value of all items is arranged from highest to lowest. The means of the first five items that appear on the table were between 3.59-3.81, demonstrating a high degree of competency in the field of computers and their applications fundamentals regarding files and folders, storing, compressing, and using Word application. However, the rest of the items had low values ranging from 2.1 to 1.45. The overall mean is 2.50.

Table 2. Mean, SD, and relative mean (RM) values for all network domain elements

Item	s Competency	Mean	SD	RM
1	Understanding how to delete any unread or unwanted emails.	2.66	0.79	53%
2	Download apps from the Internet that contain files.	2.61	1.01	52%
3	Searching for catalogs and libraries on educational institution websites.	2.57	0.99	51%
4	Send and receive data via Internet continuously.	2.49	0.88	50%
5	I am familiar with the Internet chat room services.	2.49	1.01	50%
6	-	2.48	1.01	50%
7	Know how to utilize several search engines to get information.	2.48	0.98	50%
8	Recognizing the many methods of Internet communication.	2.45	1.02	49%
9	The best approach to send the content is via email.	2.34	0.45	47%
10	On the Internet, you may get the most recent literature & research on the issue of specialty.	2.34	0.12	47%
11	Knowledge of the network's search engine.	2.34	0.89	47%
12	Using electronic libraries to strengthen skills.	2.28	0.88	46%
13	Understanding the different Internet connection ways.	2.23	0.87	45%
14	Subscriptions can be made to one or more websites.	2.23	0.84	45%
15	Communicating with students and school officials over the Internet.	2.14	0.99	43%
16	English proficiency is required to facilitate Internet use.	2.14	1.01	43%
17	I am acquainted with the file transfer service.	2.13	1.10	42%
18	Create new volunteer and group projects.	2.12	0.89	42%
19	Understand that academic forums have a chat option.	1.89	0.89	38%
Over	all	2.34	0.87	47%

Table 3. Mean, SD, and relative mean (RM) values for all items of the e-course management scale

is Competency	Mean	SD	RM
Reply on student e-mail queries.	4.50	0.31	90%
Develop a time calendar plan including most important course events (midterm & activity receipt).	4.50	0.89	90%
Assigning exercises to pupils depending on their past experiences.	4.45	1.03	88%
Organizing the course's incoming students into homogeneous clusters.	4.40	0.87	88%
Managing resources in educational environment for students using course's educational platform.	4.39	1.23	88%
Observing student's progress while he studies courses online to determine amount of knowledge he has gained.	4.10	1.21	82%
Coordination of weekly sessions and activities with students is required to ensure interaction.	4.00	0.56	80%
Check that the e-learning systems (teacher/student devices) are compatible.	3.40	0.89	68%
Assessing learning objectives regularly.	3.25	0.12	65%
Managing the argument in network-based group discussions for experience exchange.	2.10	1.01	42%
Create a dictionary of essential terminology related to the course using the website.	2.00	0.89	40%
Encourage participation in synchronous and asynchronous media platforms.	2.00	1.12	40%
Use the student portfolio-e.	1.98	0.56	40%
Test administration for e-courses through network (scheduling & prevention of cheating).	1.76	1.01	35%
Giving feedback in various formats raises the student's scientific level.	1.58	0.71	32%
all	3.23	0.41	65%
	ss Competency Reply on student e-mail queries. Develop a time calendar plan including most important course events (midterm & activity receipt). Assigning exercises to pupils depending on their past experiences. Organizing the course's incoming students into homogeneous clusters. Managing resources in educational environment for students using course's educational platform. Observing student's progress while he studies courses online to determine amount of knowledge he has gained. Coordination of weekly sessions and activities with students is required to ensure interaction. Check that the e-learning systems (teacher/student devices) are compatible. Assessing learning objectives regularly. Managing the argument in network-based group discussions for experience exchange. Create a dictionary of essential terminology related to the course using the website. Encourage participation in synchronous and asynchronous media platforms. Use the student portfolio-e. Test administration for e-courses through network (scheduling & prevention of cheating). Giving feedback in various formats raises the student's scientific level. "all	is CompetencyMeanReply on student e-mail queries.4.50Develop a time calendar plan including most important course events (midterm & activity receipt).4.50Assigning exercises to pupils depending on their past experiences.4.45Organizing the course's incoming students into homogeneous clusters.4.40Managing resources in educational environment for students using course's educational platform.4.39Observing student's progress while he studies courses online to determine amount of knowledge he has gained.4.10Coordination of weekly sessions and activities with students is required to ensure interaction.4.00Check that the e-learning systems (teacher/student devices) are compatible.3.40Assessing learning objectives regularly.3.25Managing the argument in network-based group discussions for experience exchange.2.10Create a dictionary of essential terminology related to the course using the website.2.00Encourage participation in synchronous and asynchronous media platforms.2.00Use the student portfolio-e.1.98Test administration for e-courses through network (scheduling & prevention of cheating).1.76Giving feedback in various formats raises the student's scientific level.3.23	is CompetencyMeanSDReply on student e-mail queries.4.500.31Develop a time calendar plan including most important course events (midterm & activity receipt).4.500.89Assigning exercises to pupils depending on their past experiences.4.451.03Organizing the course's incoming students into homogeneous clusters.4.400.87Managing resources in educational environment for students using course's educational platform.4.391.23Observing student's progress while he studies courses online to determine amount of knowledge he has gained.4.000.56Check that the e-learning systems (teacher/student devices) are compatible.3.400.89Assessing learning objectives regularly.3.250.12Managing the argument in network-based group discussions for experience exchange.2.101.01Create a dictionary of essential terminology related to the course using the website.2.000.89Encourage participation in synchronous and asynchronous media platforms.2.001.12Use the student portfolio-e.1.980.56Test administration for e-courses through network (scheduling & prevention of cheating).1.761.01Giving feedback in various formats raises the student's scientific level.3.230.41

Field of Network

Table 2 shows the means, SDs, and relative means for each item in the network competencies category. The aggregate mean value of all elements is listed in descending order. Teachers of the basic three grades have access to three competencies with means ranging from 2.50 to 2.66. The rest of the items received a low degree, with a mean ranging from 2.49 to 1.89. The overall mean is 2.34.

E-Course Management

Table 3 displays the means and SDs for each item in the e-course management field competence category. The mean value of each item is displayed in descending order. The table displays four high-level competencies in the field of e-course management, with means ranging from 4.40 to 4.50. Three competencies with means ranging between 4.00 and 4.39. Two competencies with means 3.25-3.40. For the other competencies, there are means ranging from 1.58 to 2.10. The overall mean is 3.25.

E-Course Design

Means, SDs, and relative means of the items in the field of e-course design are shown in **Table 4**. It shows that there is only one competence rated high with a mean of 4. items and one item with a mean of 2.80. The rest of the items received a poor rating, ranging between 2.49 and 1.17. The overall mean is 1.98.

To answer the second question, are there statistically significant differences in the achievement of distance learning efficiencies by the first three grades teachers at α =0.05 in the opinions of male and female teachers due to gender and academic qualification?, the researcher calculated the arithmetic means and SDs associated with independent variables.

Effect of gender on the first three grades schoolteachers' skills

The arithmetic mean, SDs, and the t-test were calculated to measure the effect of gender on the degree to which primary school teachers in Jordan possess the skills necessary to teach online, and the results are shown in **Table 5**.

Table 4. Mean, SD, and relative mean (RM) values related the to design of the electronic courses

Item	s Competency	Mean	SD	RM
1	E-mailing student activities and homework.	4.10	1.01	82%
2	-	2.80	1.23	56%
3	Organizing ideas, facts, and rules.	2.40	1.00	48%
4	Instructional web page design and development.	2.10	0.82	42%
5	Developing educational activities related to desired outcomes & appropriate for the level of students & their thinking patterns.	2.09	0.74	42%
6	On the course website, provide students with a course overview.	2.09	0.72	42%
7	Choosing how to present material on the educational website in a way that is simple to access and utilize.	2.01	1.24	40%
8	Determining the suitability of the course and its content for presentation through the Internet.	2.01	1.11	40%
9	Choosing the type of engagement by which students connect with their college, learning materials, & instructor.	2.0	1.00	40%
10	Develop instructional activities that are compatible with online education's capabilities.	1.98	0.79	40%
11	The general objectives of the course should be created on the school's platform.	1.90	0.78	38%
12	In the first pages of the electronic course, include meaningful and quantifiable course objectives.	1.89	0.79	38%
13	Develop appropriate evaluation tools for the content provided on the course website.	1.88	1.12	38%
14	Recognize the multimedia elements (music, images, text, etc.) utilized in the course.	1.88	1.01	38%
15	-	1.87	0.98	37%
16	Recognizing feedback patterns that improve e-learning performance.	1.87	0.88	37%
17	Identifying the material and personnel needed to create the online course.	1.87	1.02	37%
18	The ability to insert pertinent topic links (links).	1.68	1.01	34%
19	Creating a script using course content that may be programmed to upload to the web.	1.59	0.92	32%
20	Using an online course management system.	1.51	0.23	30%
Over	all	1.98	0.89	42%

Table 5. t-test results comparing competencies scores of male & female teachers

Sex	n	Mean	SD	t-test
Male	76	2.24	2.25	2.34
Female	88	1.99	0.48	
Female	88	1.99	0.48	

Note. α≤0.05

Table 5 shows that there are no statistically significant differences between the level of significance ($05.0 \le \alpha$ in the opinions of teachers of the first three grades on the degree to which they possess the skills necessary to use them for distance teaching due to the variable (gender), t=2.34, p<0.05, meaning, the gender had no bearing on the degree to which teachers in the first three grades acquired the competencies required to teach online.

The impact of academic qualifications on the competencies of the first three-grade schoolteachers

ANOVA was conducted to assess whether there were statistically significant differences among the degrees of approval of the availability of distance learning competencies for teachers of the first three grades in Jordan. The results are presented in **Table 6**.

It was noted from **Table 6** that there were no statistically significant differences in the educational qualification, as the significance value was F=0.084, p<0.05), meaning that the educational qualification did not affect the degree to which teachers of the first three grades possessed the skills necessary to teach online.

DISCUSSION

Improving teacher competencies in online education would increase education quality and make it for students more fascinating and engaging. It would also remove the stagnation of the classroom setting. The results of the study will enable teachers to communicate unique perspectives by drawing their students' attention to the real world: teaching and learning will be contextual condition-specific, and **Table 6.** ANOVA of the degree of availability of distance learning competencies among teachers of the first three grades in Jordan

1	0		0	2	
Variances	SS	MS	df	f	р
Between groups	0.038	0.019	2	0.084	0.923
Within groups	19.243	0.243	79		
Total	19.284	81.01	-		

Note. MS: Mean squares; SS: Sum of squares; & ∞0.05

student-centered. This study examined the extent to which teachers of the first three grades in Jordanian schools achieved the competencies of online teaching. These competencies were grouped into four categories: computer applications, networking, e-course management, and e-course design. The results showed that course management was the most important, with a mean of 3.23 and a relative value of 65%. Computer applications, with a mean of 2.50 and a relative mean value of 50%. The field of networks received a mean of 2.34 with a relative mean of 47%, and the design of the electronic course received a mean of 1.98 with a relative mean of 42%. Finally, the total score with a mean of 2.58. The findings show that the four domains and total scores had an almost equal arithmetic mean, meaning teachers have a poor level of competence in online teaching, which should be used in teaching the first three grades. The cause for this weakness is a lack of direct possession of teaching competencies owing to a lack of financial capacities in schools such as computer devices, networks, and others. Attention must be made to current school conditions in terms of providing computer devices, the Internet, and materials required for use of distance education, which indicates the presence of teachers' lack of these skills, which may have an impact on the emergence of such a result.

Since the field of course management for online teaching first emerged, it is posited may largely date the era of COCID-19 in a large way, when most schools attempted to meet the need to convert teaching to distance education by focusing on managing materials online, and they directed teachers to some YouTube that relate to in this field with simple operating skills. As a result, this field has importance among the four categories. It came in last place in the discipline of creating and assessing electronic courses. This might be due to two factors: The first is a shortage of computers, and equipment in schools, and poor internet connections that support the use of online education. The other problem is that most teachers' residences lack computers, inadequate networks, and internet access, particularly in rural areas. On the one hand, the teacher's requirement for training courses in this subject motivates him to possess and implement such competencies.

These results are consistent with the study of Huda et al. (2017), which showed that the degree of teachers' achievement of e-learning competencies in Gaza schools was moderate. It also differed from the study of Al-Enezi (2021) and Megat Abdul Rahim et al. (2021), which found that the achievement of e-learning competencies in light of the corona pandemic among teachers was high. It also differed from the study of Alenezi (2012) and Harijanto et al. (2021), all of which were conducted in an Arab environment.

The results showed five competencies of computer application competencies, which came in the first place and in a medium degree, which are dealing with files, compressing them, saving them, retrieving them, and making use of them. While the remaining competencies turned out to be rated poorly, even though they represent important competencies that teachers need to teach online. The reason may be because these skills are present in most of the courses on introduction to the computer and its applications, and perhaps some teachers took this course during their studies, and perhaps some dealt with the computer to print their school papers such as exams and others, while having weak knowledge of the rest of the paragraphs may be due to the lack of teachers trained enough. The study suggests focusing on the field of computer applications in the teacher training program for teachers of the first three grades in Jordan.

In the field of networks, the study showed three competencies (interacting with e-mail and downloading files from the Internet) that were moderately evaluated by teachers of the first three grades. This is because these competencies are considered essential for a distance learning teacher (Tamm, 2019). As for the remaining competencies in this field, they were perceived weak. This study suggests emphasizing the importance of these competencies in teacher training programs. In the field of e-course management, four competencies related to organizing students, distributing them on the educational platform, monitoring their progress and color, and donating them were perceived as very high. The rest of the competencies in this field were perceived as low.

Finally, in the field of designing electronic courses, there is one competence related to the use of e-mail in homework, which was rated high by teachers. The rest of the items received a poor rating, which means that the field of designing electronic courses did not receive any attention from the ministry of education in Jordan. Therefore, this study suggests focusing on these competencies and including them in the pre-service teacher training programs.

The findings revealed that there were no statistically significant differences in the average attainment of teaching competencies due to the teacher's gender. This conclusion coincides with Alazmi et al. (2016) research but contradicts Adolf et al. (2021) and Al-Hadlaq's (2003) studies, which were both high and favored males. The outcomes might have been influenced by the school's environmental circumstances. Comparable in male and female schools, as well as similar in teachers' economic and home circumstances. The study's findings revealed that there were no statistically significant variations in the ways of acquiring online teaching competencies based on educational degrees. This outcome is linked to the fact that the functional needs of the instructor, as well as the school and environmental settings, are the same for everybody, independent of educational qualification. This study varies with Cartelli et al. (2010) and Grammens et al. (2022), which found statistically significant differences in favor of higher degrees owing to the educational qualification variable.

The results of this study can be considered important in benefiting from contemporary distance learning competencies during the development of teacher training programs so that teachers who teach via electronic platforms can keep pace with the transformations that occur in education as a result of the challenges of the corona epidemic (Alghamdi & Alghamdi, 2021). This study recommends focusing on teacher training programs, especially in the field of computer applications, instructional design, management of electronic courses, and internet networks. The results of this study also point to the development of distance learning programs and link them to the competencies that teachers should possess in distance education (Hejase & Chehimi, 2020).

CONCLUSION AND IMPLICATIONS

Following the global epidemic of the corona, most educational institutions worldwide and locally have made online education over the Internet essential. Teachers may feel uneasy teaching online courses due to the competencies of online teaching and teacher roles and responsibilities in distance learning. As a result, there is a need to evaluate teachers' skills in distance teaching so that teachers can effectively use and activate distance learning resources. The findings of this study advocate for teacher rehabilitation and training in online teaching skills to increase the quality of distance education, particularly for teachers in the first three grades. This may be accomplished through establishing teacher training and qualifying programs, as well as professional development for in-service teachers.

According to the current study's findings, teacher competencies are classified into four categories: e-course administration, computer applications, networking, and e-course design. Decision-makers at Jordan's Ministry of Education can utilize these skill sets to prioritize the academic quality of all teachers, particularly those in the first three grades. Furthermore, these findings inspire decision-makers in the Ministry of Education and schools to provide more technical support to teachers, provide advisory services on their teaching competency, conduct seminars, and provide more technical guidance for online learning to teachers with low salaries. Furthermore, these skills motivate the ISP to provide better internet services and watch for internet cut-offs in Jordan.

The current study has limitations in that it was done in just one region in Irbid Governorate, which is situated in northern Jordan, and it has a limited amount of technological equipment and frequent internet outages. The findings are based solely on the perspectives of teachers in the first three grades, but they should aid teachers' perspectives in future research in terms of design and study instruments. A new date for participation in a greater number of schools should be established, and this study should be replicated in other Jordanian directorates. **Funding:** The author received no financial support for the research and/or authorship of this article.

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Research Article

Influence of Dick and Carey instructional model on secondary school biology students' performance in Katsina State, Nigeria

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ABSTRACT

The focus of this research is on the impact of Dick and Carey instructional model on the performance of secondary school biology students in Katsina State, Nigeria. Gender was also considered in the study to see if the Dick and Carey model could improve performance in biology regardless of gender. The study used a quasi-experimental design with pre- and post-test control groups. The study's population consists of all senior secondary II (SSII) biology students in Katsina State. The study's sample size is 140 SSII biology students. Purposive sampling was used to select four schools from the Funtua Educational Zone to participate in the study. Each school's intact SSII class was used for the study. Two schools were assigned to experimental and control groups at random. The instruments for the study were Dick and Carey instructional model guide (DCIMG) and biology performance test (BPT). BPT was validated by experts from Usmanu Danfodiyo University's biology department and experienced secondary school biology teachers. The split-half method yielded a reliability index of 0.71 for BPT. The study was guided by three null hypotheses, and the data collected was analyzed using descriptive statistics and t-test analysis. The results showed that the experimental group treated with DCIMG outperformed the control group treated with the traditional method. Furthermore, gender has no effect on student performance in biology. Thus, it was recommended, among other things, that DCIMG be used in biology teaching regardless of gender, especially when dealing with difficult concepts in biology.

Keywords: Dick and Carey instructional model, biology, traditional method, biology performance Received: 07 Jul. 2022 • Accepted: 06 May 2023

INTRODUCTION

Globally, a fruitful teaching and learning process necessitates an unquestionably qualitative and effective teacher force. This assertion is not limited to a particular level of education but has permeated all levels of education. No education can rise above the quality of its teachers, according to Nigeria's national policy on education (NPE, 2013); thus, teachers are essential to any meaningful educational system. According to Ajayi (2017), effective educational delivery requires good teachers, which leads to social change and national development. This is due to the fact that teachers actively facilitate learning by putting educational policies into action.

Adedoyin and Tayo (2018) argued that interaction between teachers and students, as well as the use of innovative instructional strategies to sustain greater positive outcomes, is critical in science education. Wasagu (2019) emphasized the significance of innovation in science education in boosting productivity and global competitiveness. According to some, science education is an unavoidable means of achieving national development. Thus, biology, chemistry, and physics are the building blocks of science education. Biology, like chemistry and physics, is an essential component of science education. It is one of the core science subjects taught to secondary school students worldwide. It is a branch of biology that studies living things, including their structures, functions, and behavior (Matazu, 2021). To achieve biology curriculum objectives, teachers have no choice but to use an activity-oriented or learner-centered approach. This is enhanced when biology teachers employ a meaningful and effective interactive process involving the teacher, students, and relevant teaching and learning materials (Matazu, 2021). National policy on education was explicit in its biology objectives, which included, among other things (NPE, 2013):

- Meaningful and relevant biological knowledge is required for successful living in a scientifically and technologically advanced world, as well as making room for technological advancement.
- 2. The ability to apply scientific knowledge in real-world situations such as personal and community health, agriculture, and the environment, to name a few.

The biology curriculum's content and context are expected to enable the achievement of these goals. This, however, will only be possible if biology teachers employ meaningful and effective teaching

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methods (activity-based approach). According to Awobodu (2016), most biology teachers teach biology to their students using traditional methods. This approach does not promote biological content retention and internalization, and has reportedly resulted in poor student performance or, at best, regurgitation of content in the area, necessitating the need for a better alternative approach for effective learning and better student performance in biology.

INSTRUCTIONAL DESIGN

It should be noted that Dick and Carey instructional model is only one of many available. An instructional design (ID) process incorporates instructional principles and processes into teaching and learning plans through the differentiation of materials, activities, resources, and evaluation (Morrison et al., 2001; Smith & Ragan, 2004). In this systematic and reflective process, ID tasks include the analysis of knowledge and skills in a variety of contexts; the design of the learning situation and environment; and the evaluation of learning outcomes.

An ID model explains how to create instructional programs that adhere to appropriate learning theories and how to effectively teach content (Dijkstra, 1997, 2001). In other words, ID assists instructors and/or teachers in visualizing the instructional problems they are likely to face during their educational experience by breaking learning activities down into discrete and practicable units, allowing instructors and teachers to systematically analyze and adapt instruction. Furthermore, designers must understand and inquire about learning theories, systematic learner analysis, management techniques, and the ability to use information technology efficiently as part of ID process. Ability to evaluate teaching and learning process is required for systematic ID. ID, according to Ozdemir and Uyangor (2011), is process of determining how to learn better: They define ID as considering process, discipline, science, systems, performance, and theory.

The key point here is that an ID approach instructs the expert designer to construct instruction from the perspectives of the learners as opposed to the traditional educational approach of designing instruction from the perspective of content. As a result, learner consideration, objectives (or learning outcomes and attainments), method, and evaluation should be the primary components of an ID process. Three major questions that instructional designers should consider are: where instructors are going with instructional outcomes; how instructors will get there; and how instructors will know that students have mastered instructional outcomes (Duchastel, 1990; Merrill, 2001; Ozdemir & Uyangor, 2011; Sims, 2006).

Popular early design models include those proposed by Goksu et al. (2014), Merrill (1983), and Reigeluth (1999). Educators have long pondered the implications of applying ID principles to educational design as well as criticized emerging design practices. Some argue that early ID-models were useful for designing a single unit of content, but they were limited in their ability to integrate multiple units of content and guide learners to use flexible units of analysis to solve problems in complex educational contexts. According to Goksu et al. (2014), four of the most well-known ID models are those proposed by Dick et al.'s (2005), Morrison et al. (2001) (generally abbreviated as Kemp's), Posner and Rudnitsky's (2006) (generally abbreviated as Posner's), and Smith and Ragan's (2004). Each of these models has distinct features designed to address specific challenges associated with teaching and learning processes.

DICK AND CAREY'S INSTRUCTIONAL DESIGN MODEL

Some ID approaches reflect a variety of viewpoints. For example, Dick and Carey model (proposed by Walter Dick and Lou Carey) is based on an eclectic mix of elements from behaviorist, cognitivist, and constructivist approaches. This model claims to be adaptable to a wide range of learners, goals, aims, learning outcomes, instructional content, and learning performances (Dick et al., 2005). This model's proponents believe that realizing and formalizing an instruction event necessitates looking at the instructional setting as a whole rather than as a collection of isolated parts. Dick and Carey (1996) believe that the whole is greater than the sum of its parts in a learning environment.

The uniqueness of their model stems from their attempt to support interrelationships between learning context, content, learning, and instruction. Their instructional approach is based on the notion that system components include the learner, the instructor, any equipment or instructional tools, instructional activities, transfer systems, learning and performance environments, and so on. They go on to say that in order to support each student's learning attainments and instructional learning outcomes, these components must be compatible with one another. Dick and Carey (1996) propose three formative evaluation strategies: small group, field trial, and one-to-one evaluation. To identify learners' entry behaviors, an instructional analysis considers learners' current skills and prerequisite knowledge, as well as learners' preferences and attitudes. Following the analysis, the design process tries to exert control over the instructional environment. Dick and Carey model explicitly states performance learning objectives, and assessment tools are aligned with the designer's instructional objectives. The designer selects materials to deliver the instruction after determining the instructional strategy, such as text, videotape, or hypermedia. The final steps in Dick and Carey model are revision of instruction, if necessary, and summative evaluations (Dick et al., 2005).

It is important to note that ID is defined as a set of procedures used to improve education and training programs on a consistent basis (Gustafson & Branch, 2002). Analysis, design, development, implementation, and evaluation are widely accepted as the foundation for ID. Dick and Carey model, in general, follows the steps of this basic ID model (Akbulut, 2007). In Dick and Carey's model, a series of events identify the designer's learning goals and the instructional strategies required to achieve those goals.

Dick and Carey model is relevant, according to Adedoyin and Tayo (2018), because

- 1. learners know what they are expected to learn,
- 2. the model aids in the pursuit of maximum and effective utilization of both human and material resources,
- 3. it provides feedback that serves as a foundation for determining whether educational goals have been met, and
- 4. it enables teachers to adequately prepare for lesson.

Dick and Carey instructional model, as depicted in **Figure 1**, is composed of nine elements, each exerting a significant influence over the others, as described below:

1. **Identification of instructional goals:** This is a statement that states what a learner is expected to do at the end of a given instruction.



Figure 1. Dick and Carey instructional design model (Dick & Carey, 1996)

- 2. **Instructional analysis:** The breakdown of various components of teacher-student activities during teaching and learning is known as instructional analysis.
- 3. Learner and context analysis: This includes the context in which the skills are learned and used.
- 4. Behavioral objectives: This is a presentation of the expected change in behavior at the end of the instruction. Development of assessment instruments: In consideration of the stated objectives, learners are evaluated to find attainment.
- 5. **Development of instructional strategies:** Learners' oriented strategies are developed and utilized for effective attainment of objectives.
- Instructional materials development and selection: Relevant original or improvised instructional materials are provided for an effective and meaningful teaching and learning process.
- 7. **Formative evaluation design and implementation:** This includes both diagnostic and ongoing (formative) evaluation of instructional materials and learner performance.
- 8. **Correction:** Because feedback information is obtained in step 7 above, areas of difficulty encountered by learners are easily identified and measures are taken to correct them.
- 9. **Summative evaluation:** This is final assessment performed to determine the value of the entire instructional process.

The preceding explanations demonstrate that Dick and Carey instructional model is a very strong ID capable of significantly improving students' academic performance, particularly in the sciences, because it contains elements conducive to science teaching and learning. In a related development, Bello and Aliyu (2012) examined the impact of Dick and Carey instructional model on the performance of electrical and electronic technology education students in some selected concepts in Northern Nigerian technical colleges and discovered that students taught with the model performed better. Adedoyin and Tayo (2018) discovered that students exposed to Dick and Carey instructional model outperformed those exposed to the lecture method.

When a teacher directs students to learn through memorization and recitation techniques, they are not developing critical thinking, problem-solving, or decision-making skills, according to the traditional method. As a result, traditional education is focused on the teacher.

Traditional, also known as conventional, teaching methods are still widely used in schools. Traditional teaching methods, according to Matazu (2021), require students to recite and memorize the study content and what they teach in the classroom, and students recite the lesson one by one when their turn comes. With the exception of those who are reciting, the other students listen and wait their turn. In this manner, students complete the entire lesson. The students are then asked to memorize the lesson, and the teachers assign homework, write tests, or give oral exams based on this recitation.

Traditional teaching methods are used in the classroom to reward students for their efforts in the classroom during the periods of each subject. Rules and regulations are enforced in the classroom in order to keep students' behavior in check. These rules and regulations were derived from long-standing customs that had been used successfully in schools for many years. Teachers are in charge of imparting knowledge and enforcing school-wide behavior standards.

Gender is thought to be a potential variable that can influence student performance, particularly in science. However, there is some debate over the effect of gender on student performance. In their separate studies, Adedoyin and Tayo (2018) and Ogunleye and Babajide (2011) found no differences in performance between boys and girls. This implies that students, regardless of gender, perform significantly better. Adekunle (2005) discovered that girls performed significantly better than boys in a related development.

Statement of the Problem

Science education, particularly biology education, cannot be overstated. However, as important as biology is to the pursuit of pure and related science disciplines at higher institutions of learning, secondary school student performance in biology, which is the foundation, is not encouraging. This is reflected in the observed decline in student performance, particularly in the biology external examination (WAEC, 2017).

Clearly, the bleak scenario of this decline in performance may not be entirely due to problems with students; it may also be traceable to ineffective/insufficient instructional methodologies used by biology teachers. Effective teaching and learning in biology, according to Adedoyin and Tayo (2018), cannot be achieved without positive and meaningful interaction between the teacher, students, and environmental resources. Dick and Carey instructional model has been shown to be effective in other fields of endeavor, but little research has been conducted on it in relation to biology teaching and learning. Despite several other relevant and efficient methods used by biology teachers, this study used Dick and Carey instructional model to improve biology teaching and learning and possibly offer a more viable solution to students' persistent decline in biology performance.

Objectives of the Study

To guide this study, the following objectives are put forward:

- 1. Determine impact of Dick and Carey instructional model and the traditional method on the academic performance of biology students in Katsina State.
- 2. Determine impact of Dick and Carey instructional model on the academic performance of male and female biology students in Katsina State.
- 3. Determine impact of traditional method on academic performance of male and female biology students in Katsina State.

Null Hypotheses

The following hypotheses were generated for purpose of the study:

- 1. There is no statistically significant difference in the mean score of Katsina State biology students taught using Dick and Carey instructional model versus the traditional method.
- 2. There is no statistically significant difference in the mean score of male and female Katsina State biology students taught using Dick and Carey instructional model.
- 3. There is no statistically significant difference in the mean score of male and female Katsina State biology students taught using the traditional method.

METHODOLOGY

A pre-test, post-test quasi-experimental non-equivalent design was used for this study. This method was chosen over others because it was one of the best for dealing with significant differences between variables, testing hypotheses, and developing universally valid generalizations. The study included all Funtua Educational Zone senior secondary school II (SSII) biology students. They are 14 to 17 years old. Four secondary schools were purposefully chosen for the study: two coeducational, one male and one female, and one intact class of SSII from each. Each class has 35 students, for a total of 140 participants in the study. Biology performance test (BPT) was one of the study's instruments, and it consisted of 30 multiple-choice questions drawn from the SSII biology curriculum.

Experts from biology department at Usmanu Danfodiyo University Sokoto and some experienced secondary school biology teachers validated it. The split-half method was used to assess the instrument's reliability, yielding an index of 0.71. Dick and Carey instructional model guide (DCIMG) was reviewed by some Educational Psychology experts before being used as an intervention guide for the experimental group. The treatment was carried out for four weeks prior to the administration of the instrument, using SSII biology curriculum content. At the 0.05 level of significance, t-test statistics were used to test the null hypotheses.

Data Presentation and Analysis

Null hypothesis 1 (H_{01}): There is no statistically significant difference in the mean score of Katsina State biology students taught using Dick and Carey instructional model versus the traditional method.

Table 1 summarizes t-test analysis performed to compare the academic performance of the experimental and control groups. **Table 1** revealed that the p-value of 0.001 is less than the p-value of 0.05 ($p=0.001\leq0.05$), implying that the null hypothesis is correct. There is no statistically significant difference in the mean score of Katsina State biology students taught using Dick and Carey. The traditional method and instructional model were rejected, while the alternative hypothesis (H1) was retained in favor of the experimental group.

Null hypothesis 2 (H_{02}): There is no statistically significant difference in the mean score of male and female Katsina State biology students taught using Dick and Carey instructional model.

Table 2 summarizes the t-test analysis performed to compare the academic performance of male and female biology students taught using Dick and Carey instructional model. The results revealed that the p-value of 0.074 is greater than the p-value of 0.05 at the 0.05 level of significance, implying that the null hypothesis, which states that there is no significant difference in the mean score of male and female Katsina State students taught biology using Dick and Carey instructional model, is retained, and the alternative hypothesis (H1) is rejected. This is due to the fact that the p-value is greater than the alpha value. As a result, Dick and Carey instructional model is gender neutral.

Null hypothesis 3 (H_{03}) : There is no statistically significant difference in the mean score of male and female Katsina State biology students taught using the traditional method.

Table 1. Summary of analysis of mean score of Katsina State students taught biology using Dick & Carey instructional model & traditional method

Groups	n	Mean	SD	df	t-cal	p-value	α -value	Decision
Experimental	70	18.145	2.5842	120	5.07	0.001	0.05	Deterry
Control	70	14.478	5.5131	138	5.07	0.001	0.05	Rejected
Note Source Field	1 Work (2022)							

Note. Source: Field Work (2022)

Table 2. Summary of analysis of mean score of male & female Katsina State students taught biology using Dick & Carey instructional model

Gender	n	Mean	SD	df	t-cal	p-value	α -value	Decision
Male	35	17.779	2.8799	(0)	1.75	0.054	0.05	D. 1
Female	35	18.589	2.1130	68	1.75	0.074	0.05	Retained

Note. Source: Field Work (2022)

Table 2 Summan	r of anal	min of mo	an coore of	Emala (forma	la Vataina	State students	tought	hiclory		traditional	mathad
Table 5. Summar	v of anal	vsis of me	an score of	male d	x iema	ie Katsina	State students	taugnt	D10102	v using	traditional	method

Gender	n	Mean	SD	df	t-cal	p-value	α -value	Decision
Male	35	11.550	3.5600	(0)	1.42	0.0//	0.05	D . 1
Female	35	10.430	3.3400	68	1.43	0.066	0.05	Retained
Note Source Fie	14 W/ork (2022)							

Note. Source: Field Work (2022)

Table 3 is a summary of the t-test analysis performed to compare the academic performance of male and female biology students taught using the traditional method. The results revealed that the p-value of 0.066 is greater than the p-value of 0.05 at the 0.05 level of significance, implying that the null hypothesis, which states that there is no significant difference in the mean score of male and female Katsina state students taught biology using traditional methods, is retained, and the alternative hypothesis (H1) is rejected. This is due to the fact that the pvalue is greater than the alpha value. As a result, the traditional method is also gender neutral.

DISCUSSION OF FINDINGS

The findings of this study revealed a significant difference in the mean score of Katsina state students taught biology using Dick and Carey instructional model versus the traditional method. This study's findings agree with those of Adedoyin and Tayo (2018), who discovered that students exposed to Dick and Carey instructional model performed significantly better than those exposed to the lecture method. The findings revealed that biology students in Katsina State secondary schools who were taught using Dick and Carey instructional model outperformed those who were taught using the traditional lecture method of teaching biology. This implies that Dick and Carey instructional model is a better approach to presenting biological concepts if the goal is meaningful and effective teaching and learning. Traditional methods for improving student performance, on the other hand, are unappealing, particularly in biology.

The study also discovered no statistically significant difference in mean scores between male and female Katsina State biology students taught using Dick and Carey instructional model. The results are consistent with those of Ogunleye and Babajide (2011); Adedoyin and Tayo (2018) discovered no differences in performance between boys and girls in their separate studies. This means that, regardless of gender, students perform significantly better when Dick and Carey instructional model is used. The results showed that using the Dick and Carey instructional model in biology class improves students' academic performance. This implies that Dick and Carey instructional model is gender agnostic when it comes to improving performance. On the contrary, the findings contradict Adekunle's (2005) findings, which found that girls performed significantly better than boys. When the traditional method was used, no gender discrimination was discovered, but no improved performance was either. This is due to the findings of the study, which revealed no significant difference in the mean score of male and female Katsina State biology students taught using the traditional method. This is consistent with Matazu's (2021) findings that traditional methods do not improve students' biology performance.

CONCLUSIONS

The following conclusions were drawn from the study's findings:

- 1. Dick and Carey instructional model is a successful method for teaching biology to secondary school students in Katsina State.
- 2. There is no statistically significant difference in mean scores between male and female Katsina State biology students taught using Dick and Carey instructional model.
- 3. There is no statistically significant difference in the mean scores of male and female Katsina State biology students taught using the traditional method.

Recommendations

The following recommendations are made based on the findings and conclusions of this research:

- Biology teachers in secondary schools should use Dick and Carey instructional model because it results in a meaningful understanding of biology concepts and improved academic performance in biology among students.
- 2. That the government and other relevant stakeholders promote the use of several activity-based approaches to biology teaching, such as Dick and Carey instructional model.
- 3. Gender should not be an impediment to teaching and learning science, especially biology, because evidence shows that all that is needed is a relevant teaching model or approach, such as Dick and Carey instructional model.

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Research Article

Sensing anthropology: A critical review of the sensorial turn in anthropology

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ABSTRACT

This article aims to present the existing epistemological ties between the *sensorial turn* in anthropology and collaborative forms of production of knowledge in the framework of shared anthropology. From this perspective, the major debates in anthropology regarding the senses and emotions and their epistemological implications will be critically analyzed. The focus firstly lies on questioning those approaches that approach the senses and the body as another traditional subject for anthropological studies. Secondly, on exploring the existing misconceptions in the sensory approach. Thirdly, on claiming that the most valid form of exploring and presenting the state of experience is through integrating collaborative engagement of the subject, optimally through the framework of shared anthropology. Lastly, the potentials and advantages of audio-visual media and art in general as the medium of (re)presentation will be explored.

Keywords: shared anthropology, sensorial turn, emotions, senses Received: 25 Jan. 2023 ◆ Accepted: 27 May 2023

INTRODUCTION

12 years ago, I visited an ethnology department presenting my PhD proposal to a potential supervisor. During the presentation, I explained the relation between my work and the 'crisis of representation' in anthropology. The first reaction I received was:

"'Crisis of representation?' ... It was 20 years ago! I thought we were over it!!"

Writing culture: The poetics and politics of ethnography (1986), edited by James Clifford and George Marcus, has been one of the most influential texts in anthropology. The book highlights several problematic aspects within the discipline: It raises questions regarding the colonialist character of ethnography and anthropology, unequal power relationships in fieldwork, self-reflexivity of the research process and its reflection in representation. It also criticizes the positivistic gaze on 'others' in search of objective reality. Hence, Writing culture: The poetics and politics of ethnography chronicles the critical elements that have highlighted the so-called "crisis of representation" in anthropology ever since its release. Advocates have called for a major shift in the discipline's methods of knowledge creation and mediation. Applying the theoretical tools derived from post-structuralism and literary criticism, the authors in the volume most prominently problematized the methods of text-production. The volume has highlighted, as Pink (2009) articulates,

"[t]he constructedness of ethnographic texts, the importance of attending to the process by which ethnographic knowledge is produced and the need to bring the local voices into academic representations" (p. 14).

Despite all the new inspirations that these critics injected into the discipline, they did not find themselves immune to criticisms imposed by other scholars who expressed their dissatisfaction with its 'logocentric' character, giving privilege to language and leaving out the body, its senses, emotional or affective states, and the role they play in processes of experience and perception. Some of these aspects have for a long time been ignored in most anthropological bodies of works and theories, as Crawford (2010) puts it:

"The significance of the 'body' has, alongside questions of aesthetics, throughout most of the history of anthropology in its modern sense, been neglected or, rather, regarded as subject matters belonging to other academic disciplines, such as psychology, or to the domains of art" (p. 23).

In contrast, in the last two decades of the previous century several anthropologists have published numerous publications emphasizing the importance of an increased attention to sensory experiences, which has resulted in a growing body of work on the anthropology of the senses (Howes, 1991; Ingold, 2000; Pink, 2009). However, Schneider and Wright (2010) problematize that these works,

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"with few exceptions, have remained studies of the role of senses in various cultural settings and have sadly not been read for their implications for anthropological methodologies and strategies of representation and exhibition" (p. 6).

Scholars such as Paul Stoller, David Howes, Steven Feld, Keith Basso, and Nadia Seremetakis were

"involved [in] the exploration of both the sensory experiences and classification systems of 'others' and of the ethnographer" (Pink, 2009, p. 11).

ANTHROPOLOGY OF THE SENSES: A KEY DEBATE

Howes (1991), alongside Classen (1993), has developed a project of cross-cultural comparison investigating the diversity of the patterns of sense experience in different cultures based on the attribution of meaning to the modalities of perception. Howes (1991) and Classen (1993) tend to identify

"the influence such variations have on forms of social organization, conceptions of self and cosmos, the regulation of the emotions, and other domains of cultural expression" (p. 3).

Howes (2010) criticizes the phenomenological approaches to the study of the senses, as he believes it has a tendency towards

"universalizing the subjective sensations of individuals [therefore] it ignores the extent to which perception is a 'cultural construct' and therefore has little to offer concerning the politics of perception" (p. 335).

Hence, Howes (2011b) calls for moving beyond the phenomenology of perception, which simplistically considers the

"existential grounding in one world"

as a basis for claiming that we share the same experience, which enables us to

"an understanding of perception, which allows for the cultivation of 'ways of sensing the world" (p. 320).

By stating that one of the principles of the cultural study of the senses is to

"attend and to respect indigenous experiences and understandings of perceptions" (ibid),

he demonstrates his reluctance to the claim that anthropologists should consider neurology as the essential understanding of sensory perception and experience. As this approach disregards or downgrades indigenous beliefs about perception, he admits that:

> "... dialogue between anthropologists and neurologists can be informative for both sides (indeed, anthropologists might be able to tell neurologists something about how culture tunes the neurons), it is important to keep in mind that neuroscience is itself a product of culture in its particular research aims, methods and interpretations, and therefore cannot provide an

a-cultural, a-historical paradigm of understanding cultural phenomena" (Howes, 2010, p. 335).

In the process of his cross-cultural projects, Howes (2011a) refers to a cultural psychiatrist, Laurence Kirmayer, who states that mind and experience in recent cognitive neuroscience are considered, as phenomena,

> "not confined to the brain but also through body and the environment, most crucially, through a social world that is culturally constructed" (p. 166).

Subsequently, and in his effort to build a "cross-cultural handbook of multisensory process", a culturally patterned investigation of the sensory processes is required to draw

"... an inventory of the range of cultural practices and technologies that generate different sensory combinations across different cultures and historical periods" (ibid).

Therefore, to depict the different synesthetic combinations across different cultures, Howes (2010) uses as evidence the metaphors and symbolic terms different people use in their language. As one speaks of 'hearing smell' in many Melanesian languages, Howes (2010) states, that is the sign of auditory-olfactory synesthesia

> "since most communication occurs ... face-to-face ... and odoriferous substances ... are used to augment the power of a person's presence and words" (ibid).

In his book The perception of the environment (2000), Tim Ingoldbased on Merleau-Ponty's (1964) philosophy of perception and the ecological psychology developed by Gibson-has a critical view of Howes' program of comparison of the varying hierarchies or sensory orders in different cultures. Ingold (2000) believes this approach situates the sensory modalities in 'disembodied culture' and it is at odds with the anthropology that conceives its knowledge as an embodied practice. In the same way, Ingold (2000) also rejects the work of Classen (1993), who, in her book Worlds of senses, insists that 'sensory models' are 'culturally models' and 'sensory values' are 'culturally values', which are shaped up by the expressive ways the sensory experiences have been selected metaphorically to stand for those values and models. These are what she considers as the cultural 'shaping' or 'conditioning' of perception. Denouncing Classen (1993) and Howes' (2010) objectification of the bodily experiences and their conversion into metaphorical resources for the expression of extra-somatic, cultural values, Ingold (2000) states that singling out the sensory modalities as vehicles for symbolic elaboration, this does not mean that people will see, hear or touch any differently in consequence (p. 283). He therefore concludes that these approach

> "reduces the body to a locus of objectified and enumerable sense, whose one and only role is to carry the semantic load projected onto them by a collective, supersensory subject– namely society–and whose balance or ratio may be calculated according to the load borne by each" (ibid, p. 283-284).

Ingold (2000) furthermore stresses that he finds that the representational theory of knowledge is at the heart of this approach and adds:

"The theory rests on a fundamental distinction between physical and cultural dimensions of perception, the former having to do with the registration of sensations by the body and the brain, the latter with the construction of representations in the mind" (ibid, p. 282-283).

He believes accordingly that project of cross-cultural comparisons of Classen (1993) and Howes (2010), and similar anthropologists, are rather committed to the Cartesian dualism. They are more concerned with the way sensory experiences are ordered and how

> "meanings and understandings of the world gained through perceptual activity are '*expressed symbolically*' by way of metaphors drawn from one or another domain of sensory experience" (ibid, p. 283).

As a result, the diversity and varieties of these experiences and bodily engagement with their life world have been left behind. This is how he proposes an anthropology of the senses should primarily be concerned with, how these diverse lived experiences of individuals affect and influence their metaphysics and the way they shape our perception of the world around us. Ingold (2000) believes that Howes' (2010) criticism of phenomenology is based on the premise that it prevents the possibility of converting indigenous knowledge and understandings into comparative analysis. By refuting Howes' (2010) comments in accusing phenomenology for universalizing the subjective sensations of individuals, Ingold (2000) states that all human beings, as living organisms, perceive the world by way of sensory engagement in one way or another, and this is what he calls the "universality of human corporeal experience". But this does not imply that these experiences are the same everywhere, because (Ingold, 2000):

> "... thinking, perceiving, remembering, and learning have to be studied within the ecological contexts of people's interrelations with their environments ... [the] mind and its properties are not given in advance of the individual's entry into the social world, but rather fashioned through a lifelong history of involvement in relationship with others, ... and it is through the activities of the embodied mind–or enminded body–that social relationships are formed and reformed" (p. 171).

To enrich the perspective on this critical review on the anthropology of the senses, we can refer to the works of Jackson (2013), who has developed his anthropological body of work as 'existential anthropology', based on a phenomenological approach to 'body praxis', which tends to

"avoid naïve subjectivism by showing how human experience is grounded in bodily movement within a social and material environment" (p. 56-57).

He states that

"... our humanity is at once shared and singular. This paradox of plurality means that we both identify with others and differentiate ourselves from them ... the particular person cannot be 'disappeared' into a discursive category without violence ... Accordingly, human beings seek individuation and autonomy as much as they seek union and connection with others" (ibid).

In what he calls

"the subjugation of the bodily to the semantic",

Jackson (2013) criticizes the

'intellectualist tendency' in asserting that "the physical channel supports and agrees with spoken one" (ibid, p. 55).

Thereby, he asserts the body's pre-lingual process of perception and mediation that, consequently, does not necessarily need to be 'intentional' in the linguistic sense and therefore

> "an understanding of a body movement does not invariably depend on an elucidation of what movement stands for" (ibid).

The second problem, Jackson (2013) argues, is reducing body to the

"status of a sign as a 'medium of expression or communication' an object of purely mental operations, a 'thing' onto which social patterns are projected" (ibid, p. 55-56).

As a result, and in the same way that Ingold (2000) proposes, this leads us to the Cartesian dualism. Also,

"through a reification of the unknown subject, which is made synonymous with 'society' or 'the social body' society is made to assume the active role of governing, utilizing, and charging with the significance the physical bodies of individuals" (ibid).

Furthermore, Jackson (2013) refers to Starobinsky (1982) who stated that

"[i]t was thus not the body that imposed its law on the mind. It was society that, through the intermediary of language, took the commands of the mind and imposed its law on the body" (Starobinsky, 1982 in Jackson, 2013, p. 291).

These views, Jackson (2013) states, finally lead us to the third problem, which leaves the body as a

"neutral and ideographic means of embodying ideas or it is dismembered so that the symbolic value of its various parts in indigenous discourse can be enumerated" (p. 56).

According to Jackson (2013), this is the consequence of treating the body in various anthropological studies as

"passive and static", derived from "mechanical rules or innate programming" (ibid).

He rather calls for further attention to the domain of 'bodily existence' within which the studies can focus on the dynamics of lively bodily interaction and exchanges.

SENSORY ANTHROPOLOGY: A CRITICAL REVIEW

As a point of departure from an anthropology of the senses, Pink (2010) introduced the term *sensory anthropology*, supporting the critical perspectives towards

"traditional forms of cross-cultural comparison" and explaining that sensory anthropology "implies a re-thought anthropology, informed by theories of sensory perception, rather than a subdiscipline exclusively or empirically about the senses" (p. 331).

The advocates of sensory anthropology argue about the interconnectedness of the senses that are originated in one

"organism, as the process of embodiment is one and the same as the development of that organism in its environment" (Ingold, 2000, p. 170).

To strengthen this argument, Pink (2009) draws on two reports from neurobiologists Shimojo and Shams (2001), who state that the

"cross-modal interactions are the rule and not the exception in perceptions" (in Pink, 2009, p. 28).

To expand this argument Pink (2009) refers to another study by Newell and Shams (2007), which indicates that

> "[o]ur phenomenological experience is not of disjointed sensory sensations but is instead of a coherent multisensory world, where sounds, smells, tastes, lights and touches amalgamate. What we perceive or where we perceive it to be located in space is a product of inputs from different sensory modalities that combine, substitute, or integrate. ... [furthermore] these inputs are further modulated by learning and by more cognitive or top-down effects including previous knowledge, attention, and the task at hand" (qtd in Pink, 2009, p. 28).

Although this argument seems to be not so far away from Laurence Kirmayer's statements mentioned earlier and referred to by Howes above, Pink (2009) concludes that the interconnectedness of the senses offers us the capability of sense making, and how similar meanings may be expressed in different contexts. Furthermore, she underscores the appreciation that the sensory ethnographer should have towards the

> "... cultural and-biographical-pecificity of the sensory meanings and modalities people call on and sets of discourse through which they mobilize embodied ways of knowing in social contexts. ... But at the same time she stresses that culture itself is not fixed. Rather human beings are continuously and actively involved in the processes through which not only culture, but also the total environments in which they live are constituted, experienced, and changed continually over time" (Newell & Shams 2007, in Pink, 2009, p. 28).

Based on a discussion of the work of different anthropologists, Pink (2009) diverges to some extent from the conventional classic methods of ethnography, grounded in data collection methods, participant observation and other related technical strategies. Proposing the term sensory ethnography, she refers to the tendency to engage with the field through the interactively embodied and sensory experience but also to be reflexive

> "to conceptualize their meanings theoretically and to seek ways to communicate the relatedness of experiential and intellectual meanings to others" (Pink, 2009, p. 26).

Therefore, one can say that the necessity of thinking *about*, and *through* the body in anthropology, which leads us to reconceptualize the relationship between human individual and sociocultural structure/convention, is at stake. In this sense, the body plays a central role in the process of perception and is considered the site of knowledge and meaning making. This time it is not only the body of the subject under study, but also the anthropologist's body that is acknowledged as the medium and means to experience making sense and meaning of other peoples' life experiences.

I support the major debates of embodiment that reject the mindbody dualism and emphasize the importance of the body as an intelligent organism that is conscious and creative. It carries and communicates meanings through its own grammar and organic systems. Nonetheless, despite the innovative methods proposed and implemented in sensory ethnography, there are still some unresolved questions left to these approaches, which may sound similar to the criticisms that were expressed on the heyday of the crisis of representation. If the questions of anthropology about senses and emotions stay limited to what Howes called 'the politics of perception' or the collective representation in different cultures, discussed earlier, then it would lead us to narrow down the research domain into the definitions that different people use as an interpretation of sensory and emotional experiences, as cultural categories, and keep it in the realm of discourse. This seems indeed like how Howes himself criticized the Writing culture debates because of their verbo-centric character. Jackson (2013) critically describes this condition in an eloquent and comprehensive manner:

"Anthropology also sought definition in delimitation. In the same way that societies protect their identities and territories by excluding persons and proclivities that are perceived as threats, so discursive regimes seek definition by discounting experiences that allegedly lie outside their purview. In the establishment of anthropology as a science of the social or the cultural, entire domains of human experience were occluded or assigned to other disciplines, most notably the lived body, the life of the senses, ethics and the imagination, the emotions, materiality and technology. Subjectivity was conflated with roles, rules, routines, and rituals. Individual variations were seen as deviations from the norm. Contingency was played down. Collective representations determined the real. Experience was deduced from creeds, charters, and cosmologies" (p. 3-4).

But if we want to get an insight into the more diverse layers of experience, how can we move beyond these limitations as well as the problematic and critical aspects of the process of knowledge making: interpretation and/or representation? How and to what extent (if possible at all) could anthropologists gain access to the embodied knowledge and make sense of the experience of the others, in the context of their lifeworld and subsequently turn this (yet to be discovered) knowledge into a form of representation?

What is certainly true is that acknowledging the theory of embodiment does not give us easier access and methods to understanding others. In contrast, it stresses how complicated and hard to accomplish this mission (if ever possible) is. The fact that we as researchers tend to experience the daily practice of others' lives while negotiating it with them to make the subsequent interpretation and conceptualization in the process of meaning making, is helpful. It can be considered as a step forward compared to what has been traditionally practiced in fieldwork (such as the classical methods of ethnography). Nevertheless, because of the varieties of horizons and contexts of lives, what is experienced by the researcher in the field and in the framework of 'sensory ethnography,' still is definitely a different experience. Therefore, the meanings that it produces and tries to convey to other people do not necessarily reflect what the subject experiences and means, as Merleau-Ponty (1964) states,

"[h]ow can we understand someone else without sacrificing him to our logic or it to him" (p. 115).

Indeed, through long-term involvement and experiencing other people's life practices in the context of their intersubjective lifeworld, one may reach some extent and level of understanding of his or her life's conditions. However, this after all shows a significant difference with conditions and qualities of engagement with the life that another person lives in, or in Ingold's (2000) term, with their "dwelling perspective," (p. 154), which is an inescapable condition of existence that one "organismperson" immerses in and inhabits. This is the characteristic, which makes the difference; the 'inescapability', which forms and gives direction to the process of experiencing life with its own particular sensorial, emotional, and rational-quality. Thus, I argue that a researcher-anthropologist, artist, educator-who tends to experience people's lives with embodied engagement-has fewer or no similar circumstances of life condition. This prevents them from experiencing the condition of inescapability as a fundamental characteristic of this dwelling perspective and imposes major constraints in the process of sense and meaning making from the experience.

One may argue that the experiential part of the research is supposed to be supported and complemented by communication and negotiation with the subjects who are participating in research, and through this, there are better chances of grasping the meaning. However, the dilemma remains in how these processes of negotiation occur, by whom and under which formats. How would the outcome be induced, interpreted, and mediated or represented to the people who are about to consume this knowledge? Several anthropologists have implemented experimental methods and strategies, such as collaboration with other scholars from other related disciplines and or with artists (more information in Schneider & Wright, 2010). Much research is also being done on participation or collaboration with the subjects themselves (Ginsburg, 1995; Rouch, 2003). These methods, considered as 'traditional', especially in field of visual anthropology. But it is striking that with very few exceptions, it is researcher with his/her colleaguese.g., another 'professional' collaborator from other disciplines-who eventually becomes the author of 'created knowledge' on the identified 'truth' and 'reality', justifying them into theories and subsequently turning them into any form of discourse and representation.

SHARED ANTHROPOLOGY: AN ALTERNATIVE APPROACH

Here, with a critical view on these methods, I would like to present the experimental approach I have been developing in recent years inspired by the notion of 'shared anthropology', introduced by Rouch (2003), to find my point of departure from these predicaments and their political and ethical consequences. The late filmmaker and

anthropologist Rouch (2003) developed the concept of shared anthropology in the 1950s, to give voice to the people who were the voiceless subjects of study. Rouch (2003) made several films in collaboration with his subjects, mainly about the stories they wanted to be made. To respect their authorship, he received their feedback on the edited version of the films and applied the changes accordingly. Rouch (2003) chose film as his medium, as it was the only way, he believed, that he could show his subjects the way he saw them - since obviously they were not able to read and use the 'scientific' written texts, which were being produced almost solely for academic consumption. Through this, they were also able to reflect and play a role in the process of creation and production and furthermore, it provided work in hand that could be useful for them and other non-academics as well. His wish was to see the people who were always the Westerner's subjects of study, through the advent of new technology-namely video camerasbeing capable of representing themselves in way they saw it themselves.

In 2011, I initiated a project exploring what 'home' might mean to us in the transcultural life condition based on my personal dilemma about this concept and the role it plays in human life, at both personal and emotional, as well as social and political levels. The project has been inspired by Rouch's (2003) method of collaboration and authorship, with the problematic issues mentioned earlier in the debates related to the theories of embodiment and centrality of the body in perceiving life. Yet the aim was to develop a newer approach to the concept of shared anthropology. I therefore argue, that to make sense of experiences people make in their lives, each individual has the best access to those experiences. Hence, they are the most eligible person to interpret and express those states of being. I also argue that in any form of knowledge production, after all, what a researcher as well as the consumer of the product (audience, reader, viewer, etc.) does is to interpret the lives of the people who have been the subject of the study. Therefore, it is politically and ethically more relevant to attempt to project or manifest the interpretation of the collaborators themselves rather than use the information and 'data' gathered from them as the raw material for the interpretation by the researcher. Furthermore, to establish a research project and following the idea of shared anthropology, I question whether anthropological research is thought of as a conscious and intentional process of investigation in the quest for understanding aspects of life, or as I argue, why the subjects of study should not be conscious and aware of this process and be able to reflect on it accordingly. Therefore, in building up a long-term communication on various occasions, locations and conditions, each participant was exercising auto-ethnography that is "both process and product" (Rutten, 2016, p. 300). I find the concept and the idea behind this approach to ethnography very well-articulated by Jackson (2013), who argues:

> "Ethnographic understanding simply means that one may glimpse oneself as one might be or might have been under other circumstances and come to the realization the knowledge and identity are emergent properties of the unstable relationship between self and other, here and there, now and then and not fixed and final truths that one has been privileged to possess by virtue of living in one particular society at one particular moment in history" (p. 10).

To proceed with this process, which can be considered as an intersubjective simulation of the lifeworld, each collaborator as well as myself at some point, reached a level in which to express ourselves in different ways. Subsequently, each of us managed to realize these experiences in an audio-visual form-through a mutual interactive process. I intended to create room for each collaborator to be the authors of their own part. Each person created the idea of how to express him/herself as far as they were able to, but nevertheless, each was present and had the final word on the process of realization and editing his or her own ideas. The intention was to have them, rather than me myself, express and interpret their own experience of 'Home' and subsequently what it meant to each of them - and myself. Eventually these works altogether became one film called 'Parallax' (Omrani, 2011). A collage of diverse self-reflections and interpretations about 'home'; a 'collective auto-ethnography'.

Taking part in the process of investigation as a collaborator and expressing the personal experience of the subject of study by the anthropologist-here I mean, rather than studying other people, I see the urge in studying *with* them-plays a vital role in preserving a more integral reflection on the inter-subjectivity, diversity and variety of extrapolations from the created and experienced situation. Also, selfreflexivity, which is considered one of the essential elements of modern anthropology, appears not only to reveal the intention and political aspects of the work more transparently to the audience, but also in being reflexive towards the participants, it modifies and regulates the hierarchical positions among those involved in the project and leads us to a more democratic relationship and knowledge production.

Due to the nature of the subject of our investigation, several sensorial and emotional connotations had been evoked for each collaborator at various moments and levels. Thus, the affective circumstances of these experiences were clearly active and effective in the process of sense-making and conceptualization that each of us could experience. Those which occurred either during moments of sharing and communicating their feelings and thoughts, or when tracing them back inside the body and most notably, in memories. One could also consider it as the imagination of memories, as they indeed do not appear only as images and visual patterns, but rather as multi-sensorial reemergence of recalled experiences. Moments of nostalgia, insecurity, hope and desire ... Most remarkably the time that some of us, in the middle of the process, noticed that what was discovered was a different feeling and perception of 'home' than what had been pre-supposed. This eventually led to a completely different direction in conceptualization and interpretation expressed on the subject by that person.

It is worth mentioning that what I consider affect in this process is the intensity, as something that occurs in, and is experienced by the body, because of a somatic interpretation of circumstances. This is unlike the ideas that separate affects and emotions-considering the latter as the secondary, conscious, and a mental reduction and interpretation of the former that is an intensity, which is preconscious and pre-individual. Thus, what I mean by affective circumstances here is, the process of "embodied meaning-making" (Wetherell, 2012). This process of embodied perception functions arbitrarily, that is not necessarily always an act with self-aware intentionality during the moments of occurrence involving unconscious or conscious cognitionnamely memory-because of seamless and intertwined characteristics of the brain/body activity as one organism. Thus, our experience and perceptions contain biological and natural elements as well as social impacts. But it is certainly not yet possible to divide or measure the role that visceral experiences play versus cognitive parts, as well as personal versus socio/cultural impacts as Reddy's (2001) states that

"it has become difficult to sustain the distinction between thought and affect ... [as] no-one has yet found a way to probe or measure an emotion directly" (p. 31).

Langer (1954) metaphorically states in her book '*Philosophy in a new key*' diverging from the logicians and linguists who refuse to go beyond the limits of discursive language that human thoughts at best are:

"... a tiny, grammar-bound island, in the midst of a sea of feeling The island has a periphery, perhaps, of mud-factual and hypothetical concepts broken down by emotional tides into the 'material mode,' a mixture of meaning and nonsense. Most of us live the better part of our lives on this mudflat" (p. 70-71).

Here the question will be then, how to deal with this embodied sensorial, and at the same time, cognitive and semantic amalgam of knowledge. Is it possible to transmit the experience sensorially through abstract scientific text? Which is the most dominant method of representation in human studies. Can we disregard other mediums because of their lack of potentiality to convey arguments and theories, in search of the facts and truths? Is the crisis of representation really over?

In his *Truth and method*, Gadamer (1975) argues that there are truths, which essentially go beyond the knowledge claimed to be grasped by the methodology of human science, which has a tendency towards

"establishing similarities, regularities, and conformities to law, which would make it possible to predict individual phenomena and processes" (p. 3).

"The fact that through a work of art a truth is experienced that we cannot attain in any other way constitutes the philosophic importance of art, which asserts itself against all attempts to rationalize it away. Hence, together with the experience of philosophy, the experience of art is the most insistent admonition to scientific consciousness to acknowledge its own limits" (ibid, xxii).

CONCLUSIONS

I have adopted the same line as the ones who believe that we should consider and apply the potentiality that audio-visual mediums and in general works of art offer. Despite the strong reluctance of many academics in disregarding the attempts to apply different experimental approaches to create, collect, and present truths and knowledge in its contingent, hybrid and temporary quality. Through this, there will be attempts to communicate bodily and to leave room for audiences to experience, by means of their own body with its own unique characteristics, limits, and capabilities to make sense and meaning - not universal but transcultural - of what has been shared with them. Rather than solely hypothesizing, theorizing, and generalizing peoples' lives, which leads to a disregard for individuality, hybridity, and the dynamic aspect of the lives they experience. The kind of works of art that are my concern here, are the ones that privilege the aesthetics, primarily as the "perfection of sensation" (Howes, 2011a, p. 167), and only secondarily and consequently, consider their facets of beauty. In other words, by mastering the creation of beauty, the latter complementary assists the evocation of the former.

The mediums applied in art, especially films or in general multimedia, contain great potential. Inviting and enabling the audience not simply to 'translate' what has been watched and heard, but rather, through moving images and sounds - with their particular conceptions of time and space (Deleuze, 1986), and with the 'haptic' (Marks, 2000) and sensorial quality that can be evoked–experience corporeal knowledge and meaning that MacDougall (2005) states, are:

"concerned with the moment at which these meanings emerge from experience before they become separate from physical encounter. At that point thought is still undifferentiated and bound up with matter and feeling in a complex relation that is often lost in abstraction ... [but at the same time] meaning when we force it on things, can also blind us, causing us to see only what we expect to see or distancing us from seeing very much at all" (p. 1).

It is important though to be cautious and critical of what MacDougall (2005) warns about as well, in that

"... the way we use words all too often becomes a mistake recipe for how to make, use, and understand [visual image one could say in communication in general] by treating images–in painting, photographs, and films–as a product of language, or even a language in themselves, we ally them to a concept of thought that neglects many of the ways in which they create our knowledge" (p. 1).

The shared anthropology I propose, rather than being a methodology, is more an attitude: to experiment and experience life with other people with the hope for a democratization of knowledge that is shared and experienced by the public rather than 'homing' in the bookshelves of libraries.

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Research Article



An assessment of core mathematics performance of selected single-sex schools in the Cape Coast Metropolis, Ghana

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ABSTRACT

This cross-sectional study was designed to compare gender difference in mathematics achievement in four selected single-sex senior high schools in Ghana. Results of 18,781 students from the selected schools were analyzed based on the final examinations, West African senior school certificate examination (WASSCE) data for 2009, 2011, 2012, 2013, 2014, 2015, 2016, 2017, and 2018-year groups. In 2010, there was no examination; thus, the data analyzed excluded that of 2010. The results are graded from grade A1 to F9 so to ensure clarity in the results, grades were coded from 1 to 9. The grades were coded to correspond with the codes, ranging from the highest grade (A1) to the lowest (F9). The findings indicated that girls performed better than boys and the independent sampling t-test also showed there was a significant difference in the performance of girls and boys. This indicates that there is no equality in core mathematics performance of boys and girls. Teachers of mathematics are encouraged to identify underlying factors that account for the disparity in performance and also to ensure that students of both gender exhibit excellent performance in mathematics.

Keywords: core mathematics, single-sex school, performance, Ghana Received: 13 Jan. 2023 ◆ Accepted: 27 May 2023

INTRODUCTION

Mathematics has a significant impact in every nation's growth. Without mathematics, the development of any nation will be in jeopardy as the application of mathematical concepts cut across all the stages of development. Well recognized international societies, for example, program for international student assessment (PISA) and trends in international mathematics and science study (TIMSS) have conducted series of reports on mathematics and gender in relation to performance in several countries (Mullis et al., 2012). Sometimes when the studies in mathematics are carried out, the difference in performance vary based on countries and sometimes these differences are same on gender basis. Hanna (1989) indicated that differences in countries are often larger than differences in gender. All the same, if there exist academic differences, the magnitude of the difference does not justify what area priority should be given to. When there is a more substantial disparity in mathematics achievement among countries than we have for the difference in gender, it does not insinuate that the difference in gender does not matter. A more extensive study should be carried out on gender basis. A country like Norway has educational goals of ensuring equal teaching and learning opportunities for both

males and females hence difference in gender connotes a great deal of academic challenge. Aside a country like Norway, other countries in the northern islands, like Denmark, Finland, Iceland, and Sweden obtain significant higher scores above OECD means (OECD, 2004). For the countries that take part in PISA, reports show that males significantly always outperform females. Considering the countries in the northern islands, although only Norway obtained lower mathematics scores as in relation to the OECD means, findings also showed that males performed better than females with exception of Iceland, where female scores were better in all areas of mathematics than males (OECD, 2004). The differences in performance for some countries like Sweden and Finland was not substantial.

For some countries, studies in performance normally bring out findings based on a test conducted after a short period (example a day test, a test after an academic intervention, an end of academic semester exam) but few investigations have gone into performance of students in Sub-Saharan African countries taking into consideration five-year performance or even longer years. A period-long assessment of the performance of students needs to be clarified and that is what this study seeks to bring out.

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Statement of the Problem

In some countries, roles are shared on gender basis however this idea should not be the case for mathematics learning. Mathew Smith, a lead data journalist, in 2018 revealed that some people are of the view that some subjects are for boys and others are for girls. Outcomes from research have outlined that gender differences in mathematics achievement up to the high school grade have shown inconsistent findings (Goodchild & Grevholm, 2009). Perceptions and hearsays must not be tolerated in academia as it affects students' learning in mathematics (Dowker et al., 2019). Globally, there are several issues surrounding the study of mathematics as a subject. One aspect is gender issues by which this study seeks to examine. Questions on the academic achievement of males and females keep mounting up within the academic space. The facts need to be clear as the educational sphere tends to be transformed occasionally.

An investigation into the performance of students in mathematics is of much precedence. Mathematics at the pre-tertiary level in Ghana, has been grouped as core mathematics and elective mathematics. Since the core mathematics is mandatory for every student at the senior high school, this study intends to focus on this aspect. Thus the study assesses students' performance in core mathematics and also examines the gender difference in core mathematics performance of these students, taking into consideration a 10-year compilation of their mathematics results.

Development of Hypothesis

This study is centralized on the mathematics achievement of learners in four selected senior high schools. Mathematics performance truly varies across different basis, whether it being background of students, age of students or the gender of students. The issue of gender stands tall in this study as students' performance in mathematics is examined to identify which gender outperforms the other. The yearly comparison of their grades are explained and based on that the statistical test on the difference in performance is carried out to make grounds for the study.

LITERATURE REVIEW

Mathematics Achievement

Mathematics achievement is usually assessed by tests, examinations or continuous assessment (Bull & Lee, 2014). In terms of measuring the achievement of students, the best standard may be ignored and hence cannot measure required competency of the student. For instance, the school setting always deny the measure of psychomotor domain and the affective domain but always measure only cognitive domain thereby making the examiner not to achieve the right measure of students' ability. Due to this, the true quality of learners' achievement cannot be measured appropriately. This challenge has not been majorly tackled because the standards for assessment for the cognitive domain has proven to be more reliable and highly measurable. Hattie (2009) also states that mathematics achievement is the consequence of learning that gives evidence of the level to which a learner, teacher or an organization has attained their educational aims that were the center of activities in instructional surroundings, specifically in school, college and university. These outcomes from instructions in the mathematics class clearly match up and measure the level of accomplishment with the objectives set before the beginning of every lesson.

The student has always been the recipient in the mathematics classroom hence outcome of lessons mostly account for that of students. They are meant to inform the teacher or instructor on how much students have achieved from the classroom instructions. Students' achievement may also be used for prognosis purposes.

In the prognosis purposes, it is used to predict how well a student may profit from future training. According to Weidinger et al. (2019), school system mostly defines cognitive goals that either apply across multiple subject areas (example, mathematics and science) or include the acquisition of knowledge and understanding in a specific intellectual domain (e.g., numeracy, literacy, science, history). The goal is used to assess knowledge, skills and other characteristics that serve to determine success in learning.

Gender Differences in Mathematics Achievement

Reports from studies organized in different countries have depicted that boys performed better than girls do in mathematics (Fennema, 2000; TIMSS, 2011). Asante (2010) posited that boys always achieved higher than girls on standardized mathematics tests at the pre-tertiary levels. There always exist differences taking into consideration several samples of study but different samples going in favor for boys are wellknown in mathematically gifted distributions (Frost et al., 1994). The disparities also deviate in accordance with mathematical sub skills. Boys seem to perform better than girls on activities that require application of algebraic rules or algorithms and activities in which the comprehension of mathematical concepts and number relationship is required. Marked differences between the sexes going in favor for boys have been seen at the outstanding ends of the distribution on numeracy tasks. Boys' and girls' achievement is subjected to some study areas such as number and relation and using of mathematical algebraic methods and rules in working out mathematics. From this, we can say that the achievement of boys in core mathematics may vary from country to country.

Generally, some basic facts have been more or less generated in the research of the last two decades on gender differences in mathematics and science throughout different grade levels. Gender differences that favor boys in mathematics tend not to appear until high school–in beginning grades, differences are either non-existent or considers girls as favorites (Goodchild & Grevholm, 2009). Thus in pre-schools and lower primary schools, girls perform or do better than boys do. Various activities performed at pre-school levels are related to concrete materials and at this stage, based on this study, girls perform very well than boys do. At the fourth and eighth grades, girls perform better than boys on activities involving reading graphs, calculation and problem solving involving a lot of rules.

Concerning body of global literature depicts that girls (female students) perform better than boys (male students) (Hydea & Mertzb, 2009). A comprehensive study in the USA by Hydea and Mertzb (2009) shows that girls have attained level of equality with boys in mathematics accomplishment, including at high school, where a gap existed in former years. Hydea and Mertzb (2009) noted that girls are doing better than boys are that girls are even performing tasks that require compound problem solving. The study in the USA therefore suggests to us that the females' performance have progressed to a level, where they are at par with the males. They also stressed the fact that girls are not only good at making simple computations, but they also perform better, when it comes to tasks that require complex problem solving.



Figure 1. Gender difference in performance across grade levels (Goodchild & Grevholm, 2009)

Table 1. Code of grading system

Grade letter	Coded grades
A1	1
B2	2
B3	3
C4	4
C5	5
C6	6
D7	7
E8	8
F9	9

An exploratory study by Goodchild and Grevholm (2009) sampled students across different grade levels and ages, with the sole aim of determining the gender difference in mathematics performance. The mean score varied across all grade levels (grade 4, grade 7, grade 9, and grade 11). The variability in scores for the females decreased whilst that of the males increased across grade levels (**Figure 1**). At the final grade, that is grade 11, it was recognized that the sequence of variability changed as that of boys decreased. Goodchild and Grevholm (2009) explains that at grade 11, mathematics is not compulsory for students at that level as compared to the other lower grade levels, where mathematics is a core subject for all students (with age ranging from eight to 14 years). Further discussion on the outcome revealed that the mean scores for boys and girls were different. Taking into consideration grade 4, boys performed better than girls and for grade 7 the boys still performed better than girls. At grade 9, the girls outperformed the boys at a very small margin but with grade 11, the boys yet again performed better than the girls. In all grade levels it was only at the grade 11 that the difference in performance was significant. A graphical layout is presented (**Figure 1**).

METHOD

This study is a cross-sectional study, which sought to explicitly assess the performance difference among boys and girls from four selected schools. The study investigates core mathematics achievement of boys and girls in four selected single-sex senior high schools in Cape Coast Metropolis, Ghana. For the four selected senior high schools, two of them are boys' schools and the other two are girls' schools. Students' grades from 2009 to 2018 from West African senior secondary certificate examination (WASSCE) in core mathematics was used. The number of students within the year range was 18781. This study excluded 2010 results since there was no WASSCE written in that year. In the school system, letters were used to grade student's final results. The grades range from A1 to F9 but were coded into numerical values, as shown in **Table 1**.

Girls

7,795

Table 2. (Core mat	thematics	achievement	of	boys	&	gir	ls
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Grade	Boys	Girls
A1	2,334	2,723
B2	1,282	988
B3	3,106	1,704
C4	822	379
C5	919	476
C6	1,448	728
D7	712	393
E8	283	271
F9	80	133
Total	10,986	7,795

Table 3. Descriptive statistics on performance

Gender	n	Mean	SD	Standard error mean
Boys	10,986	3.528	2.056	.0196
Girls	7,795	3.103	2.222	.0252

The grades as seen in **Table 1**, are arranged from the highest or excellent grade (A1) to the least grade (F9). This means that a grade A1 with a coded grade of 1 is higher than a grade B2 with coded grade of 2. The mean grades for boys and girls were also analyzed. For calculation and analyses, the independent sample t-test, which is an inferential statistical tool was employed to test the hypothesis.

RESULTS AND DISCUSSION

The core mathematics performance of students in the selected schools has varied in 10-year based results. As shown in **Table 2**, more girls (2,723) attained the highest grade, that is A1, as compared to boys (2,334). However, for the other grades, there were varying instances as the performance tends to vary from across grade levels. For the least grade, that is F9, there were more girls (133) attaining this grade as compared to boys (80). The different number of students across the grade levels does provides a base through which the means of the grades are determined.

From **Table 3**, the mean grades of boys and girls are presented and clearly, we have the mean grade for boys to be 3.5280 as well as a standard deviation (SD) of 2.0560 and a standard error of 0.0196. This means that, the mean grade of the boys stands approximately at C4 with the deviation closely distributed around the mean. Also, the mean recorded for the girls is 3.1030 and an SD of 2.2220 with a standard error of 0.0252, which indicates that the mean grade for the girls approximately lies at B3, where their deviation is widely spread over the mean.

Studies regarding gender in relation to academic performance in mathematics have always resulted in varying viewpoints and findings. Studies carried out in countries of the north have shown that boys performed better than girls in mathematics (Fennema, 2000; Kaiser-Messmer, 1994; Muthukrishna & Kwela, 2010) but this study shows otherwise as girls attain a higher grade than the boys (**Table 3**). Literature also suggests that girls perform better than boys (Hydea & Mertzb, 2009). Hydea and Mertzb (2009) showed that girls have gotten to a level of equality with boys in mathematics performance. This does not exclude high school grades, where a gap existed in previous years. They supported that girls are performing better than boys as girls are additionally able to execute tasks that demand complicated problem solving. Table 4. Independent sample t-test on performance difference

3.100

	-					
Gender	n	Mean	SD	Т	df	Sig.
Boys	10,986	3.530	2.056	13.472	18,779	.000

2.222

An independent sample t-test (**Table 4**) was performed to compare the difference between the attainment levels of boys and girls in the selected schools in the Cape Coast Metropolis. The results show a substantial difference in the grades for the boys (M=3.53; SD=2.056) and girls (mean [M]=3.10; SD=2.222) at p=0.000 (<0.05) at 95% confidence interval, which is lesser than 0.05 significance level. This therefore gives a basis for us to reject the null hypothesis, which states that there is no significant difference in achievement of boys and girls in core mathematics considering the selected schools in Cape Coast Metropolis. This study depicts the existence of a significant difference in core mathematics performance of boys and girls. This coincides with other studies, which also found that there is gender difference in mathematics performance (Muthukrishna, 2010; TIMSS, 2011).

CONCLUSIONS

Following the results of the study, there is a statistically significant difference in the gender achievement of boys and girls in core mathematics. The findings also revealed that girls outperformed boys as they (girls) attained a higher mean grade than the boys. Conclusion can therefore be drawn that girls performed better than boys in core mathematics in single-sex schools. Teachers can do better to ensure quality passes among students. Research can be done to search out for the factors that account for the higher performance of girls than boys in single-sex schools. There might be underlying factors or conceptions that need to be identified and tackled by educational authorities.

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Research Article

Influencing postgraduates' cognition in research methodology via active-interactive PowerPoint-based learning strategy

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ABSTRACT

The rationale of this study was the paradigm shift due to the integration of the educational research methodology course into the curriculum of mathematics postgraduates. However, in most literature reported for postgraduates of education, social, and other science disciplines, who have often enrolled for it, the pedagogics of these curricula have not yet appropriately embedded in the content in a well-structured manner. Because postgraduates poorly conceived research methodology theories, they have been highly challenged in executing their research projects. This study aimed to examine the influence of the active-collaborative PowerPoint-based approach on postgraduates' cognitive knowledge progress in achievement tests and writing and peer presentation skills on open-ended tasks. The mixed methods in a one-group pre-/post-test pre-experimental design were used. Data were collected using the five-point Likert scale questionnaire, achievement test and open-ended questions and analyzed through descriptive statistics, paired samples t-test and thematic analysis techniques. The findings reveal that the active-collaborative learning strategy highly contributed to postgraduates' progress in cognitive performance on the achievement test as there was a statistically significant difference between post-test and pretest scores; t(33)=17.3; p<0.05; $\eta^2=0.9$. Postgraduates' conception, understanding, justification, and discourse towards writing and peer presentation on open-ended tasks were not substantial.

Keywords: active-collaborative learning, cognition, postgraduates, PowerPoint-based learning, research methodology

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INTRODUCTION

The human-beings have come to live on earth with a more developed nervous system that distinguishes them from other animals (John & James, 2006, p. 3). However, in ancient times they experienced the natural, physical and social world through their sense organs. They practiced every-daily life in a very traditional way, essentially never involving any scientific knowledge. Their approaches entirely linked with dogmatic religious beliefs called conventional approaches. That, let alone gods furnish people with a livelihood they could even manipulate the sun, stars, wind, rain and lightning at their whim. Abuse their power and extensive preaching, medicine men or priests influenced ancient people in such a way that they are unable to update themselves with the dynamic world. Consequently, the conservative life-style hindered them the search for new scientific knowledge or truth for many centuries.

As time gone in many centuries, human beings became enlightened and then began to think about conducting research in academia, other professions, and careers to make their life easier (Cohen et al., 2018, p. 5). Still, they entirely relied on observation and experience about orders and trends that occurred in the universe. This time was an indicator for the beginning of scientific research. During this time also, their research endeavors had to agree with the doctrines of religion; otherwise, they were often punished and even put to death to any demonstrated disruption. This era was when the pragmatism perspective flourished for which the subjective reality highly dominates scientific inquiry.

To complement the pragmatism paradigm, the first objective/deductive method, a logical approach to reasoning, was introduced by Aristotle and the Greeks (Cohen et al., 2018, p. 6; John & James, 2006, p. 4). The deductive method had also been under the influence of religious dogma. The deductive method Cohen et al. (2018, p. 6), John and James (2006, p. 4), and Soiferman (2010) refers to that at the outset it is driven by hypothesis/theory in the proposal stage, and then tested in the specific application during thesis stage, whether the collected data would support or not support it. It played a vital role in the development of modern problem-solving.

After long years, Cohen et al. (2018, p. 6) and John and James (2006, p. 4), the first time Francis Bacon proposed the inductive method to free the limitation of the deductive method. An inductive method Cohen et al. (2018, p. 6), John and James (2006, p. 4), and Soiferman (2010) refers

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to the inquiry conducted to generate a theory or theories in the findings, by taking an in-depth understanding of the natural, physical, and social world based on evidence of many specific observations from the beginning to the end of research.

Since the nineteenth century to date, human beings have paid several efforts and sacrifices to transform the conventional into the scientific approach to research, which is a combination of the deductive and inductive methods. During this time Sheikh and Bibi (2009) as the tertiary education has been expanded more than ever before worldwide. the scientific approach has become compulsory for undergraduates and postgraduates engaged in various disciplines. Therefore, this evidencebased information reminds us of an investment of great effort and time is required of all instructors and learners to have an in-depth understanding of the research methodology course. Consequently, the better knowledge of it undergraduates and postgraduates have acquired in the mainstream class, the more successful they would become applying the theoretical, conceptual and technical aspects in their actual research projects.

However, literatures reported the challenges that most educational and social science undergraduates and postgraduates have faced in the instruction due to the use of inappropriate learning strategy. But this learning challenge has been more critical to pure science postgraduates. As Mishore and Abate (2023) explored, pre-service science teachers in teacher education college have confronted with the difficulty of conducting research projects. One of the main reasons is that the learning strategy instructors used has not allowed them to effectively gain the skill and knowledge of the research methodology course, which requires higher-order thinking.

Other educators and researchers have also pointed-out the roots of learning challenges along with possible remedies based on empirical evidence. As Saeed and Al Qunayeer (2021) examined, students' attitudes towards the subject matter and instructors' modes of delivery are some of the main challenges. They also tried to evaluate several active learning methods used by different researchers and the strategies grounded on them as means of pedagogics. In their own right, they implemented various active learning methods to alleviate the learning challenges. They found that postgraduates developed self-confidence, progressed on assignment work, appreciated the instructor's teaching method, and expressed positive views as better learning experiences. They recommended a pre-test-post-test experimental design with tests/grades that measure learners learning outcomes used as data collection instruments. They also suggested that the intent of future study should be to determine the extent to which instructors' use of similar active learning methods in other contexts is effective or not.

In the study of Saeed et al. (2021), exposing postgraduates to several learning practices, which is quite similar to the active learning methods used by Saeed and Al Qunayeer (2021) enhanced their learning challenges. Integrating research proposal writing in their study was also an important learning environment in gaining conceptual, procedural and technical skills. Because research proposal writing allows learners interaction, reflection and feedback and enable them to engage in problem identification; and objective and research question/hypothesis construction. Akhmetov et al. (2016) confirmed that postgraduates could overcome the difficulties of thesis work through advanced preparation in a research methodology course. They succeeded in organizing experimental work procedures by exposing learners to the pedagogical conditions of which the active learning methods ease their

understanding of the various research methods notions. The research recommendation by Saeed and Al Qunayeer (2021) supported these arguments.

According to Daniel et al. (2018), postgraduates (PhD and MSc) had limited knowledge on whether research methodology is a discipline or a less discipline. They also had information gaps in the pedagogy practices. Similarly, Kilburn et al. (2014) observed the underdevelopment of the pedagogical culture compared to other disciplines in the research methodology course. That is one of the predominant challenges in social science research methods instruction in higher education. Daniel et al. (2018) explored much learning and choosing research methodology course challenges as conceptual, procedural and technical problems.

To mention some of them: the scope of the research methodology course was not delimited, and the content was not relevantly detailed. There was no well-developed institution base standardized curriculum as a matter of not viewing it as a discipline. Instructors lack skills in connecting theory with practical instances and developing the right research questions. Because of this, learners have poor knowledge and justification for selecting and using appropriate paradigms (quantitative, qualitative, and mixed) for their research project. They do not have a common understanding of basic terms and concepts in research methodology. They usually associate it with mathematical and statistical knowledge. Conducting a critical literature review to cover the breadth and depth, the problem of aligning research methods and analysis of data, and choosing research methods, like sampling strategy and research methodology, are the other challenges for postgraduates to be good researchers and instructors (Kilburn et al., 2014).

Furthermore, Nind and Katramadou (2022) synthesized literature from studies conducted in 2014-2020 in different countries. Many were from the USA, next from Europe and a few from Asia, like China and Malaysia. One of the learning challenges identified in social science was that the lessons in the research method have not consistently offered to undergraduates and postgraduates. It means most instructors emphasized qualitative research paradigms. Some others concentrated on delivering a quantitative approach. Very few delivered stressing mixed paradigms, research design, and other aspects of research methodology. The pedagogical culture (approach, strategy, tactic, and tasks) in the teaching and learning of research methodology was at a low level of development. Generally, the pedagogies have been underresearched (Kilburn et al., 2014; Lewthwaite & Nind, 2016). They rarely involved active, experiential, and student-centered learning and a combination of them in social science research methods. In the COVID-19 pandemic era, these methods have highly supported online teaching. As Nind and Katramadou (2022) suggested, researchers always need to be encouraged to review research conducted on online learning of research methods using active, experiential, and student-centered learning tactics as a pivot.

Lewthwaite and Nind (2016) conducted a thematic literature review. The review emphasizes social science research methods instruction based on data from responses to interviews, focus groups, dialogic, and panels rather than individual expert teaching experiences. They found that the pedagogic culture and practice are still in the infant stage of development (Kilburn et al., 2014). The absence of standard national and international university curricula has exacerbated these challenges. As instructors could not access this document in the one national education system, their pedagogical content knowledge has not
been sufficient in helping and capturing learners' interest. However, research method instructors have attempted to use active, experiential and reflective forms of learning. It is to address learners' interests and attitudes.

Indifferent from this review, learning by doing has been distinguished as a better learning strategy for natural science research methods courses. But the research on this was limited. Connecting learners to research (visibility), creating a learning environment for learners' hands-on experience in research, and allowing learners to be reflective on their way of tackling research problems have been recommended for researchers and instructors to work on them in the future as remedies for research methodology learning challenges. Based on the principles and illustrative examples produced in Kilburn et al.'s (2014) and Lewthwaite and Nind's (2016) studies, it is suggested that dialogue and debate in an active, experiential and reflective learning environment could be helpful to enhance pedagogics culture and practice.

Research Questions

- 1. Do postgraduates' exhibit progressive research methodology knowledge through an active-collaborative PowerPoint-based learning strategy?
- 2. Do postgraduates are capable of writing on open-ended assignment questions and reflecting in peer presentation?

LITERATURE REVIEW

Active-Collaborative Learning and PowerPoint Presentation

The study of the research methodology course requires postgraduates' high engagement into the learning of nature of science and scientific method. As Phillips et.al. (2022) recommended the use of explicit and reflective instruction could allow them to make deep understanding of the nature of science in their learning and teaching endeavors. These days, the explicit and reflective instruction is essential to promote their creative and innovative power for lifelong learning. To realize this, instructors should have passion seeking and use appropriate pedagogical strategies, which needs to be an active, collaborative and interactive learning has become compulsory in higher education. These strategies should always involve instructional technologies and instructors' prepared learning activities and materials to scaffold active-collaborative learning environments with hands-on experiences.

In this regard, Marciniak (2017) confirmed that the class worksheet and the active learning used were highly helpful for developing learners' mathematical knowledge. In this paper, active learning can be effective if it entertains higher-order thinking and group work. Yimer (2022) verified that transitioning teacher-led discourse by traditional lecture method (TLM) into a blended learning environment as an active learning method could increase learners' roles. Likewise, Gámiz-Sánchez (2017) advised that replacing or complementing TLM with an active-collaborative learning. In Gámiz-Sánchez (2017) mega research, information, communication and technology (ICT) tools have addressed different learning purposes using their many features. They can substantially enhance educational science learners' active learning experiences. As this study verified, active learning, concept maps, and project-based learning can also increase their awareness, creativity, higher-order thinking, positive attitude, communication and competencies.

In Eison's (2010) assessment and Carr et al.'s (2015) validation study, active instructional strategy refers to a learning approach used in various disciplines involving several learning strategies with comprehensive features to maintain and capture learners' interest, attention, and involvement. Eisen (2010) also affirmed that active learning strategy has many advantages over TLM of which even it can be used by blending with to fill what TLM lacks. This same paper also identified and suggested instructors and learners bear in mind those barriers that hinder the application of it in-class and out-class situations. Nicol et al.'s (2018) findings remind them to cautiously use high-technology-based active learning classrooms as it appears various obstacles in the course of implementation.

Instructors and learners can effectively learn by combining active learning with a group project, PowerPoint slides, and online learning, provided the obstacles are lessened (Eison, 2010). Othman et al. (2017) confirmed the argument that diploma learners had shown a positive attitude towards using PowerPoint presentations by performing well in calculus learning. As one of the remedies, Clinton and Kelly (2020) suggested intervention can improve learners' negative attitudes towards group discussion as an active learning technique. Villarroel et al. (2020) study supported this argument as higher education learners responded by strongly agreeing to a five-point Likert scale perception questionnaire towards intervention in experiential learning. In a comprehensive scale measures study by Carr et al. (2015) on online/active learning, the content validity of the response has created an opportunity for higher education learners to be highly engaged.

Bolliger and Armier Jr (2013) examined an empirical study on the satisfaction of postgraduates with the online/active learning environment while generating audio files. From the analysis of data, it inferred that they were highly involved, connected, engaged, socially interactive and communicant with peers. Roberts (2019) studied a research on images as a medium of instruction for energizing active learning. This circumstance has transformed the higher education passive receivers' situation in large-group TLM into participatory learning practices within active methodologies like flipped classrooms can generate valuable and reusable content for learners to review. It would help them remember what they missed and concretize the already captured materials with interest and motivation. Most research evidence has often advocated the merits of active-collaborative learning strategies.

Theoretical Framework: Pre-Experimental and Post-Experimental Tasks

Active learning strategies are intrinsically social. They promote learner-instructor/tutor, learner-learner, learner-parent and learnermaterial interaction. Because of this, most of the theories in this study applied in line with the social constructivism cognitive development learning theory by Vygotsky (1980). According to Vygotsky (1980), in most adult learning cases cognitive knowledge development comes through social interaction with classmates and instructor. Taking Vygotsky's (1980) learning theory into consideration, the following experimental tasks were throughout the study.

Before the pre-test, the researcher prepared two PowerPoint presentations, PPT1 and PPT2. PPT1 contains notes on the research methodology course (Math 4071), which was used as learning material



Figure 1. One-group pre-/post-test pre-experimental design (Johnson & Christensen, 2019, p. 458)

for eight years by updating at the end of every academic semester through 2015-2022. PPT2 consists of basic terms of the same course. At the same time, he developed by adapting of achievement test consisting of 53 multiple-choice, 11 matching and 12 completion items; and 20 open-ended assignment questions for writing and peer presentation. During this same period, 21 five-point Likert scale questions labelled as strongly disagree=1, disagree=2, neutral=3, agree=4, and strongly agree=5 were employed.

On day one class one, the achievement test was administered to preassessing the background knowledge of postgraduates, as well as the five-point Likert scale questionnaire to pre-assess their opinion about the course. They responded to the five-point Likert scale questionnaire individually while the achievement test individually and in a group dialogue-base, where six groups were with five students and one group with four students after each continuous session task. On this same day, a softcopy of PPT1 was offered for them as a reading assignment for one week before the instructor/researcher and postgraduates discussed it. Immediately after the completion of PPT1, they directly engaged in PPT2. Around the end of the semester, six postgraduates presented the five open-ended assignment questions for classroom observation. They also sat for post-test achievement tests and submitted their writing assignment questions.

METHOD

The mixed method in a one-group pre-test-post-test preexperimental design with quantitative and qualitative data utilized in the study shown in **Figure 1**.

Target Population

The target population of the study was the first-year mathematics postgraduates of three batches through 2020 to 2022, who enroll for the research methodology (Math 4071) course in the second academic semester.

Sample and Sampling Technique

Purposive sampling technique was used to select 34 three batches postgraduates, where one of them did not participate during post-test.

Instruments

The researcher prepared a five-point Likert scale questionnaire, open-ended assignment questions for writing and peer presentation, and the adapted achievement test (Mohamed Osman, 2018, p. 16; Sheikh & Bibi, 2009, p. 7) used as the data collection instruments.

Content Validity

As Gay et al. (2012, p. 160) suggested, data collection instruments validated in different contexts could be effective for various research purposes. Accordingly, this study presumed the content of the adapted achievement test with 76 questions in the context of previous research projects. The researcher taught for 28 years. He validated the content of this same test for postgraduates' formative and summative assessment

of the research methodology (Math 4071) course through 2015-2022. Moreover, three subject experts evaluated it in the context of the current study. They supplemented four more multiple-choice items in the post-test in it. They assessed the 20 five-point Likert scale questionnaires about the overall language used, order and items coherence. They also added one more question by evaluating its suitability and agreement with the purpose of the study and syllabus.

Data Collection

Achievement test scores, as quantitative data collected from respondents for measuring the statistical significance of the cognitive performance change through pre-test to post-test (Gay et al., 2012, p. 155). Respondents' opinion ratings on a five-point Likert scale questionnaire had used as qualitative data. It was to assess their background affective characteristics towards the course. Writings on five open-ended assignment questions and peer presentations for classroom observation from six postgraduates explored to take an indepth understanding of the knowledge progress.

DATA ANALYSIS AND RESULTS

Descriptive Analysis

For research participants' undergraduate learning experience towards the research methodology course was paid due consideration. It is to see in the analysis whether or not it had some influence on their cognitive performance in the postgraduate study. 19 (55.9%) postgraduates enrolled for the research methodology course in the undergraduate study. Out of which, 14 (41.2%) postgraduates carried out project work, while five postgraduates (14.7%) conducted research using their basic knowledge and skill. 15 (44.1%) postgraduates did not enroll for the research methodology course in their undergraduate study.

Descriptive statistics results of research participants' opinion rating on a five-point Likert scale questionnaire are depicted in **Table 1**. In **Table 1**, there are 21 constructs grouped into four criteria in the questionnaire. One construct is about the concept of research. One construct is about exposure to the research methodology course in the undergraduate study. 18 constructs are about basic knowledge towards the research methodology course. One construct is anticipating the significance of the research methodology course. Most postgraduates (mean [M]=4.29) responded by agreeing to the concept of research construct. A little bit above one-half of postgraduates (M=3.14) took the research methodology course in their undergraduate study. The agreeing response on their basic knowledge towards this course was moderate (M=2.95). All agreed on the importance of the research methodology course in their future research work.

In the pre-test, postgraduates accomplished the following cognitive knowledge on the achievement test in the research methodology course by way of individual and group performance out of 100.0%. The maximum scores for individual and group performance were the same and equal to 57.50. The minimum score for individual performance was 34.20, while the minimum group performance score was 46.57. The reason for the minimum score progress from individual to group performance was most likely the postgraduates' response through the active-collaborative and interactive discussion in devised instrument. Overall, group cognitive performance scores were better than individual performance scores.

Table 1. Descriptive statistics on postgraduates' affective characteristics (pre-test)		
Affective characteristics constructs	М	SD
Concept of research		
I have an overview about the term 'research'.	4.29	0.76
Exposure to research methodology course		
I have not learnt basics of research in my undergraduate course study.	3.14	1.77
Basic knowledge towards research methodology course		
I can differentiate scientific research activity from that of daily life activity.	2.86	1.35
I cannot identify and state research problem statement.	3.29	1.38
I can construct the objective(s) of a research study.	3.00	1.16
I cannot construct the hypotheses/research question(s) of a research study.	3.14	1.22
I can explain the importance of literature review.	3.29	1.38
I am not familiar with positivist, post-positivist, interpretive, empiricist, & etc., philosophical assumptions.	2.43	0.98
I can mention the basic types of quantitative, qualitative, & mixed research methods.	3.57	1.28
I cannot develop data collection instruments such as questionnaire, observation, & interview.	3.71	1.25
I can describe the term sampling, sampling frame, sample, representative sample, & population.	2.86	1.22
I can explain probability and non-probability sampling techniques, & the types under each of them.	2.86	1.07
I cannot explain the difference or similarity among methods, methodology, & research design.	3.14	1.35
I can classify the basic data analysis techniques for quantitative, qualitative, & mixed paradigms.	2.71	1.38
I can define the term research proposal.	3.00	1.53
I cannot develop research proposal.	3.29	1.38
I have worked with statistical software packages for social sciences (SPSS) for quantitative data analysis.	1.14	0.38
I do not have the skill of research report writing.	2.86	1.57
I can use the proper in-text citations and referencing styles in my research work.	3.14	1.07
I am not familiar to publishing research article in appropriate journal.	2.86	1.57
Weighted mean	2.95	
Anticipating significance of research methodology course (Math 4071)		
Math 4071 course can help me for conducting basic/fundamental research project, expected from me after having completed course works.	5.00	0.00

Note. M: Mean & SD: Standard deviation

Table 2. Paired-samples t-test results & effect size value

Variable	Group	n	М	SD	MD	SD-MD	df	t	р	η^2
Post-test score	0	24	82.58	9.30	20 (0	1.55	22	15.20	000*	0.00
Pre-test score	One	34	51.88	10.14	- 30.69	1.77	33	17.30	.000*	0.90

Note. *p<.05; M: Mean; SD: Standard deviation; MD: Mean difference; & SD-MD: Standard deviation of mean difference

Table 2 displays the paired-sample t-test results with effect size value on achievement test scores through pre-test to post-test on the basis of postgraduates' individual performance.

According to Cohen et al. (2018), the results shown in **Table 2** there was a statistically significant difference between the post-test score (M=82.58, SE=1.59) and pre-test score (M=51.88, SE=1.74); t(33)=17.3, p<0.05, 95% CI [27.09, 34.29]. The effect size value η^2 =0.9 represents a strong effect.

Results Through Thematic Analysis

The five open-ended questions used for writing assignments and peer presentations in classroom observation are the following.

- 1. Brief why different people (researchers) provide different meanings to the concept of 'research/scientific research.'
- 2. Explain about the term 'science' and 'philosophy', and their relationship with the term 'research'.
- 3. Explain why the need to conduct research by researchers in different settings.
- 4. Explain what a researcher needs to do at the outset of any research process.
- 5. Explain why the need to define a research problem and delimiting it.

The thematic analysis on postgraduates' reflections in classroom observation towards these questions were summarized.

Most participants presented all the five open-ended questions with poor reflections and discourses by merely adhering to reading the written material, which is not advisable and convincing. However, student PGR2 nicely reflected overall questions in the peer discussion. Some of the reasons for their unsatisfactory verbal performance were poor language proficiency, difficulty to conceptual understanding, lack of skill to procedural and technical knowledge and problem of justification in dialogues requiring strong logical reasoning.

The thematic analysis on postgraduates' writings were synthesized based on the dominant themes involved in their responses.

Student PGR1 answered question 1 by merely viewing research as the field of study in which researchers are engaged. The availability of resources at the given time led many educators and scholars to construct different meanings of the term research. He simply wrote the definitions developed by educators and scholars.

PGR2 responded to question 1 as researchers could draw different meanings to the concept of research based on the choice of data collection and analysis techniques they can make.

PGR3 and PGR4 responded to question 1 as a researcher's perception of research depends on his or her knowledge of the meaning

of the scientific method. They viewed research and the scientific method are closely related.

PGR5 answered question 1 as the concept of research is wide and occurs everywhere.

PGR6 responded to question 1 as anybody can define the concept of research as own attitude.

Thematic analysis 1

Almost all learners could not conceptually understand question 1. They provided poor justification for their answers. They demonstrated difficulty conceptually understanding the question. PGR1 entirely depended on others definitions instead of he was expected to define research in his own words. PGR2 was not able to identify the basis for educators or researchers in giving different meanings to research. PGR2, PGR3, and PGR4 had lack of explanation on conceptual questions with understanding. PGR3 and PGR4 tried to relate research and scientific method without mentioning that scientific method can be used as tools in the research process from the beginning to end. As compared to other students, answers of PGR5 and PGR6 had no substance in connection to the conceptual, understanding and justification aspects of question 3.

PGR1 explained the terms 'science', 'philosophy' and 'research' and their relationship between them as philosophy refers to a study/domain with many branches. It makes use of reasoning, questioning, and analysis. It explains situations and find answers. It does this using logical argumentation. It originated from the Greek word 'philosophy'. It helps us to understand the nature and relationship between man and existence. It involves subjective and objective questions and generating them. It creates knowledge through thinking applied to many extensive areas of the discipline. It is a system of a researcher's thoughts and follows to which to obtain a new and reliable knowledge about research. It forms the basis of research through the appropriate choice of research strategy, formulating the problem, data collection, processing, and analysis.

Science does the same thing but utilizes empirical data. It comes from the Latin word 'scientia'. It is a defined study concerned with natural phenomena. Only objective questions can be related to it. It takes answers and proves them as objectively right or wrong. It creates knowledge by observing, applying and studying the logic of facts and diligent research through experimentation in the physical or natural world. It has different fields and topics to do research with. Research is the systematic study of scientific materials or evidence to establish facts and reach new conclusions about that science.

PGR2 answered question 2 as philosophy is a way of learning about ourselves and the world. It cannot provide the answer to all questions without research. Science does the same thing. Philosophy is an academic discipline. It studies the fundamental nature of knowledge, reality and existence.

Science refers to intellectual and practical activity encompassing systematic study of structure and behavior of physical and natural world through observation and experiment. Scientific revolution completely shifts that science looks at the world through scientific research. Scientific research orients towards the discovery of relationship that exists among phenomena of the world. It does not progress towards truths. But dogma and old theories influence it. Science studies things by following certain agreed-upon norms and practices, reality and existence (philosophy), and structure and behavior. PGR3 and PGR4 answered question 2 as philosophy is a critical analysis of fundamental assumptions or beliefs. It is a system of values by which one lives and a "love of wisdom". Science includes any systematic or carefully done actions to answer research questions or meet other needs of a developing research domain. It involves the application of the scientific method. It does not accept face-value takenfor-granted knowledge. It uncovers and justifies descriptions and explanations of people, groups, and the world around us.

PGR5 and PGR6 answered question 2 as philosophy is a rational attempt to look at the world as a whole. It is a set of views or beliefs about life and the universe. Science is systematic and interpretive that builds and organizes knowledge through explanation and prediction. The terms science and research are used together often or sometimes interchangeably. The term science, philosophy and research are almost the same. All are the process of thinking.

Thematic analysis 2

PGR1 explicitly and concisely explained the three terms, particularly on philosophy and science. He also demonstrated satisfactory understanding by sufficiently describing the relationship between the three terms. Overall, he could conceptually understand this question. PGR2 had some conceptual understanding. He was not able to sufficiently explain the relationship between the three terms. PGR3, PGR4, PGR5, and PGR6 entirely depended on the reading materials used for their reading. They were unable to write answers in their own words. They could not mention the relationship between the three terms. They missed parts of the instruction in the question. They had partly conceptually understood this question.

PGR1 responded to question 3 as research is conducted in different settings to understand a phenomenon, situation, or behavior under study. It is also to test theories and develop them based on existing ones. It is to answer the 'wh' questions.

PGR2 answered question 3 as it is to describe the physical, social or experimental context. The interpretation may heavily depend on these environments. A laboratory experiment setting is more controlling the environmental variables.

PGR3, PGR4, PGR5, and PGR6 answered question 3 as it is to find a solution, make life easy and explore ideas.

All participants answered question 4 by mentioning most of the steps involved in the research process. These are problem identification, reviewing the literature, setting research questions, objectives and hypotheses, choosing the study design, deciding on the sample design, collecting data, processing and analyzing data, and writing a report.

Thematic analysis 3 & 4

All of them could not conceptually understand question 3. They provided poor justification for their answers. They demonstrated difficulty conceptually understanding the question. As compared to answers to the preceding two questions, they irrelevantly answered question 3 and question 4, with no substance in connection to their conceptual, understanding and justification aspects. All in all, they missed the instruction in the question.

PGR1 responded to question 5 as a research problem is a specific issue, difficulty, contradiction, or knowledge gap that we will aim to address in our research. Practical problems contribute to change. Theoretical problems expand knowledge. Research delimitation means

focusing on concrete terms in our area of interest, specifying their scope, and determining their limits. That is to advance the research problem from an ideal situation to a concrete reality that is easy to handle.

PGR2 answered question 5 as defining a research problem is essential to acquaint the reader with the topic studied. It is to associate the research problem with a particular context and to provide the framework for reporting the results. It also specifies all the aspects necessary to answer the research question. It establishes the target population, time and space for research.

PGR3 and PGR4 answered question 5 as every research plan is unique in itself and has unique research problems. There was an old saying that "a problem well defined is a problem half solved". A research problem means a systematic way of asking and answering research questions. Delimitation of the study is a section, where we exactly show the boundary of our research. It determines what aspects of the topic should be incorporated and where they should be employed.

PGR5 responded to question 5 as research defines a research problem. Specifically, delimiting a research problem is done to address all the aspects that are necessary to answer the research question. Delimitation refers to the boundaries of the research based on the researchers' decision of what to include and exclude. It narrows the study to make it more manageable and relevant to what we are trying to prove.

PGR6 answered to question 5 as the problem investigated must be defined unambiguously to discriminate relevant data from irrelevant ones. A well-defined research problem enables the researcher to be on the right track, whereas an ill-defined problem may create hurdles. Delimiting a problem can also be made on some variables, the study area, on size of the sample considering the time, energy and money, the best method possible, and the best tool for measuring the variable.

Thematic analysis 5

PGR1, PGR2, PGR5, and PGR6 had some knowledge conceptually understand question 5. PGR1 and PGR2 provided poor answers without any justification as to the importance of defining and delimiting research problem. PGR5 and PGR6 supplied better conceptually understand with some justification as to the importance of defining and delimiting research problem. PGR3 and PGR4 had a better knowledge conceptually understand and justification in answering question 5 as compared to their other writings and reflections. Overall, all of them demonstrated difficulty conceptually understanding the question.

DISCUSSION

These days, science and mathematics curriculum developers in worldwide universities have paid great attention to the research methodology course. Despite this, a curriculum for it as a compulsory course has been designed for mathematics undergraduate and postgraduate studies. However, even for education and social postgraduates, the curriculum of this course was not rich in concepts, procedures, techniques and pedagogics. So, it has not been taught in an organized and structured way.

As a matter of this fact, this study intended to influence postgraduates learning challenges of the research methodology course through an active learning strategy. The concepts of research ideas, critical literature review, paradigms, approaches, theories, philosophical perspectives, methodology, data analysis techniques and research report writing were a few for the point of focus. To meaningfully address this, undergraduate background towards research methodology, affective characteristics by the five-point Likert questionnaire and cognitive knowledge through achievement tests and open-ended questions have been examined.

The findings look like the following. A bit above the average number of postgraduates (M=3.14, 55.9%) enrolled on the research methodology course in their undergraduate study. During this time, most of these (41.2%) carried out project work, while a few (14.7%) worked on research using their basic knowledge and skill. 15 (44.1%) postgraduates did not enroll for the research methodology course in their undergraduate study. In the pre-test, the maximum scores for individual and group performance on the achievement test were the same and equal to 57.50. The minimum score for individual performance was 34.20, while the minimum group performance score was 46.57. The reason for the minimum score progress from individual to group performance was most likely the use of the active-collaborative and interactive discussion in the devised instrument. Overall, group cognitive performance scores were better than individual performance scores.

In the post-test, most postgraduates (M=4.29) responded by agreeing to the concept of research construct in the affective questionnaire as they could provide something that explains the term. The agreement response on their basic knowledge towards this course was moderate (M=2.95). All agreed on the importance of the research methodology course in their future research work. In the same session, there was a statistically significant difference between post-test and pretest cognitive knowledge performance scores in the achievement test, t(33)=17.3; p<0.05; $\eta^2=0.9$.

Consequently, the devised learning circumstances, such as examining the backgrounds of postgraduates, allowing them to work individually and discuss in the group on achievement tests during pretest and assessing their writings and observing peer presentation openended questions through the active-collaborative PowerPoint-based approach have contributed to the highest cognitive knowledge performance. This outcome, particularly on concept learning, agrees with Marciniak (2017), Othman et al. (2017), and verified what Akhmetov et al. (2016), Clinton and Kelly (2020), Eison (2010), Gámiz-Sánchez (2017), Kilburn et al. (2014), Lewthwaite and Nind (2016), Saeed & Al Qunayeer (2021), Saeed et al. (2021), and Yimer (2022) suggested. However, postgraduates' conception, understanding, justification and discourse in writing and peer presentation on openended assignment questions were not remarkable. This result partly agrees with Saeed and Al Qunayeer's (2021) findings. It implies that learners, researchers and instructors are required to be more engaged in these learning challenges in the future.

CONCLUSIONS

The research methodology is an essential course for mathematics undergraduates and postgraduates. But it is a challenging course. It involves proposal and thesis projects, which require a lot of writing skills with logical reasoning. Thus, instructors should always be motivated to seek and use appropriate pedagogical strategies to maintain and capture their interest, attention and involvement. One of the learning strategies able to realize profound forms of collaboration and engagement and replace autonomous learning is an activecollaborative learning strategy. The findings of this study are evidence that the active-collaborative PowerPoint-based learning environment greatly benefitted postgraduates. Consequently, instructors should always be encouraged to explore active learning environments with different practices and strategies, potential to positively influence undergraduates' and postgraduates' writing tasks in research methodology courses as well as their research projects.

Recommendations

Based on the findings of this study, the researcher would like to advise instructors and researchers to be able to design interventions. They should also be encouraged to devise new active-collaborative learning strategies integrated with appropriate instructional technology. Overall these could likely serve undergraduates and postgraduates successfully tackle their writing assignments knowledgeably in their future teaching-research projects in research methodology courses. Instructors should be encouraged to discover active learning strategies that can entertain learners' context and their prior knowledge. Postgraduates should always learn basic notions of research methodology in their degree program studies. The Ethiopian education system is currently introducing this curriculum for public universities.

Undergraduates and postgraduates must enroll for the research methodology course as a compulsory course to be innovative and creative in their lifelong learning. Postgraduates should always be industrious while studying the research methodology course, which requires them great effort and time. Blending various learning practices with instructional technology in higher education should be inevitable for effective learning in this modern era. College/university instructors and pre/in-service teacher educators should have the skill of activecollaborative and interactive learning strategies integrated with instructional technology developing well before mainstream classes. Applying active-collaborative and interactive learning strategies integrated with instructional technology can substantially improve learners' conceptual understanding and procedural fluency.

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Building students' conceptual understanding of operations on fractions using manipulatives: A junior high school perspective

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ABSTRACT

Mathematics plays a key role because it is one of the important subjects within the foundation that constitute the core curriculum for basic and secondary education. Mathematics must therefore be taught in a way to engage learners to construct their knowledge, which helps them build conceptual understanding using modern teaching strategies. Fractions are the building blocks for a solid conceptual understanding of algebra and other concepts in mathematics, especially at the basic school. Therefore, teachers must use strategies that make lessons more realistic and practical, such as manipulatives. The purpose of the study was to use manipulatives to build students' conceptual understanding of the operations of fractions. The study design was quasi-experimental, with a pre-/post-test method used for data collection to assess the impact of the intervention design. A sample of 50 junior high school students was selected purposively for the study. The data was analyzed using SPSS v.26. The researchers concluded that using manipulatives in the teaching of fractions improved the students' performance and helped build their conceptual understanding of the operations of fractions.

Keywords: mathematics, fractions, manipulatives, conceptual understanding

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INTRODUCTION

In the majority of nations around the world, mathematics is one of the crucial foundational disciplines that make up the core curriculum for basic and secondary education (OECD, 2017). This is due to the fact that mathematics has been identified as one of the topics that promotes the growth of a person's original, inventive, analytical, and problemsolving abilities (Ministry of Education, National Council for Curriculum and Assessment [MoE, NaCCA], 2019). Math is a "facilitating" subject, according to research. In other words, learning mathematics is a prerequisite for learning other topics and pursuing a wide range of occupations (Maldonado et al., 2018). We can appreciate the value of mathematics by looking at how it is used in technology and in our daily life. Mathematics is the only discipline that acts as a significant unifying force among the numerous branches of research, and without it, knowledge of science frequently stays rudimentary (Moyer, 2001).

According to Berger et al. (2020), mathematicians are interested in number, shape, and space. They also like to categorize things and prove that a given phenomenon must, can, or actually cannot occur. To ground mathematics teachings in reality, contemporary experts advise stressing context-based mathematics instruction (OECD, 2017). To help the students understand how essential mathematics is to their lives, real-world events are introduced into the mathematics classroom (Barnes, 2005). Many researchers both locally and internationally support this strategy since it is consistent with the problem-solving method to teaching mathematics (Bartolini & Martignone, 2020).

Most word problems are context-based, and they frequently involve students in debates, brainstorming, group projects, and other student-centered teaching and learning activities (Andamon & Tan, 2018). While some see math word problems as merely arithmetic exercises, other students find word problems to be the most difficult and intricate. For instance, Mereku (2004) found that Ghanaian students who participated in trends in mathematics and science studies (TIMSS) in 2003 did well on routine issues but badly on non-routine ones. They were able to solve questions that needed computations and basic knowledge recall. This suggests that teachers should make their lessons more practical by using activities and real-world examples to help students develop their conceptual understanding.

Policymakers in Ghana's education sector are still working to guarantee that the country's mathematics instruction complies with international norms. This is the result of the paradigm shift from the conventional method of teaching mathematics to contemporary educational techniques and abilities that strengthen conceptual understanding (Nabie et al., 2013). The government has started a

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number of curriculum reviews and modifications to make sure the nation's educational system stays up with the fast-moving international trends (Abudu & Mensah, 2016; Adu-Gyamfi et al., 2016; Mereku, 2010). Understanding and using mathematical languages, symbols, and notations is one of the main goals of the mathematics curriculum. In order to fulfill the purpose of mathematics education at the elementary level and beyond, it is expected that they will develop communication and collaboration skills (CC), which are key abilities (MoE, NaCCA, 2019). According to Baah-Duodu et al. (2020), mathematics should be taught utilizing engaging, hands-on, and mind-on methods that students will enjoy and take to heart as a way of life. If teachers were able to stick to this schedule, it would guarantee that the students could think, reason, and communicate numerically. As a result, math lessons must involve group projects and conversations in the classroom to get students thinking about and solving real-world problems (Adu et al., 2017).

One of the fundamental abilities that must be cultivated in the mathematics curriculum is the understanding of fractions (Bouck et al., 2017). This is due to the fact that it is crucial for comprehending algebra, geometry, and other mathematical concepts. Comprehension fractions requires a thorough understanding of all the concepts they can be used to represent (Cramer et al., 2010). Any learner must have a conceptual understanding of fractions in order to be able to handle more difficult subjects in the high school curriculum (Niemi, 1996). Learners will probably struggle with procedural competency in these areas if they have trouble comprehending the several meanings of fractions. National Council of Teachers of Mathematics (NCTM) curriculum and evaluation standards encourage using tangible materials and other representations to help kids build their grasp of the fraction idea, according to Bouck et al. (2017). There is sufficient evidence to demonstrate the significance of using images effectively in fraction problems (Cramer & Henry, 2002). Unfortunately, manipulatives are rarely used in textbooks, and when they are, they usually just serve as area models (Hodges et al., 2008). This indicates that pupils frequently lack the opportunity to investigate fractions using a variety of models and the time necessary to link the visuals to the pertinent ideas. The use of physical instruments seems to be crucial for learning because it creates mental models in students' heads that help them understand fractions (Cramer et al., 2010; Lee et al., 2021).

Items known as manipulatives can be touched, moved, rearranged, and in other ways handled by kids. They appeal to numerous senses (Johnson-Smith, 2022). Manipulatives can be physically manipulated as well as digitally, therefore they are not just tangible items that we can handle with our hands (Agyei et al., 2022). The use of manipulatives in classroom education, according to National Council of Supervisors of Mathematics (NCSM), raises student achievement (Berger et al., 2020). Regardless of the level, the declaration contends that educators must deliberately include the use of tangible and digital manipulatives into their lesson plans (Moore, 2014). This was done to make sure that every student could become proficient in mathematics (NCSM, 2013), as referenced in (Moore, 2014). With the help of manipulatives, instructors may provide students the chance to interact, practice, and manipulate objects and resources to solve challenges (Larbi & Mavis, 2016). Because students actively participate in the process of discovery during the learning process, manipulative is constructivist (Bosson-Amedenu, 2017; Larbi & Mavis, 2016). Numerous studies carried out locally support the use of manipulatives as one of the finest methods for teaching mathematics (Alolga & Essel, n. d.; Boakye, 2019). Researchers have found that students who use manipulatives in some mathematics areas, such as algebra and fractions, among others, are more likely to succeed than those who do not have access to manipulatives (Chappell & Strutchens, 2001; Sebesta & Martin, 2004). Therefore, the goal of this research is to develop, through the use of manipulatives, students' conceptual knowledge of operations on fractions.

Statement of the Problem

As was already said, fractions serve as the foundation for a strong mental knowledge of algebra and other mathematical ideas, particularly in the basic school. Unfortunately, most junior high school pupils do not have a strong interest in fractions because they believe that fractional notions are difficult and impossible. According to data collected throughout time, a number of junior high school students in their last year have been denied admission to senior high schools in the majority of districts of Ghana's Ashanti Region because of their poor math scores on basic education certificate exam (BECE). Students' performance on the mathematics portion of BECE was negatively impacted by their lack of knowledge of fractional concepts and operations, according to data collected from classroom activities, homework, and end-of-term exams.

This information supports the claim made by Bingham and Rodriguez (2019) that fractions are among the least understood mathematical topics taught in elementary schools. Therefore, the study aims to develop students' conceptual comprehension of fractional operations through the use of manipulatives.

Objectives of the Study

- 1. To determine if manipulatives could build students' conceptual understanding of operations on fractions.
- 2. To determine the extent to which manipulatives could improve students' performance in fractions.

Research Questions

- 1. What is the impact of manipulatives on students' conceptual understanding of operations on fractions?
- 2. To what extent does the use of manipulatives to teach the concept of fractions help improve students' performance?

LITERATURE REVIEW

History of Manipulatives

Manipulatives as a notion have a long history (Caglayan, 2019; Nikiforidou, 2019). Physical objects have been employed by people from numerous cultures around the world to assist them in resolving common math issues. Middle East and ancient Southwest Asia both developed counting boards. Counting boards were trays made of wood or clay that were dusted with fine sand. In order to take an inventory or total an account, for instance, the user would draw symbols in the sand. The earliest abacus was made by the ancient Romans by altering counting boards (Boakye, 2019). Chinese abacus, which was used centuries later and may have been a modification of Roman abacus, was another. In Americas, similar devices were created. The counting implements used by Mayans and Aztecs included wires or maize kernels strung on strings over a wooden frame. The knotted cords known as "quipu" were the Incas' special method of counting. The first real manipulatives were created in the latter half of the 1800s. These manipulable items were made with teaching mathematical principles in mind and appeal to all of the senses of the human body (Bartolini & Martignone, 2020). Friedrich Froebel, a German educator, established the first kindergarten program in history in 1837. He created many tools to aid his kindergarteners in identifying patterns and appreciating the geometric shapes present in nature.

Maria Montessori, an Italian-born educator, contributed to the development of the notion that manipulatives are crucial to education in the early 1900s. She brought out a variety of resources to aid young children in preschool and primary school in discovering and learning fundamental concepts in arithmetic and other topics. Manipulatives have become crucial in elementary school mathematics instruction since the early 1900s. In reality, NCTM has long advocated the use of manipulatives while instructing students in mathematics across all grade levels (Jimenez & Stanger, 2017; Sulistyaningsih et al., 2017).

The instructor has traditionally served as the classroom's leader. The teacher's responsibilities were working from the front of the room, imparting knowledge on the day's subject, and giving out homework. However, this function is altering in the dynamic field of mathematics. According to Cain-Caston (1996), the instructor is now more of an observer while the pupils are actively engaged in their learning (Bingham & Rodriguez, 2019). Math class has evolved from the tedious pencil and paper task it once was to a pleasant and exciting activity that many kids now look forward to in the majority of classrooms across the nation and in Ghana. Even though the same ideas are being taught, it has changed from being a chore to something enjoyable. What altered the situation? The use of manipulatives and a hands-on learning approach is the solution (Agyei et al., 2022).

Relationship Between Manipulative Use & Educational Theory

By enabling pupils to progress from the concrete stage to abstract reasoning, manipulatives can aid in learning (Heddens, 1986; Ross & Kurtz, 1993). Experts have shown that learning happens in three stages. These are the phases of cognition, association, and autonomy (Dowling et al., 2018). This is in line with Brunner's constructivist theory, which contends that when faced with new concepts, all learners-regardless of age-go through three stages of learning. Enactive (action-based), iconic (image-based), and symbolism are these levels (language-based) According to Clements et al. (2022), students' ability to think mathematically is improved by the usage of manipulatives. Stein and Bovalino (2001) claim that

> "manipulatives can be valuable instruments for encouraging pupils to think and reason in deeper ways. Such manipulatives as pattern blocks, tiles, and cubes can help kids acquire solid, integrated understandings of mathematical concepts by giving them real opportunities to compare and manipulate amounts."

Students must integrate and connect various ideas in a variety of ways in order to develop a deep comprehension of mathematical concepts. This kind of comprehension is referred to as "integratedconcrete" knowledge by Clements (1999), as mentioned in (Clements et al., 2022). Students can connect ideas and integrate their knowledge to develop a thorough comprehension of mathematical concepts by using manipulatives effectively. Teachers play a critical role in assisting students in using manipulatives effectively so that they can easily move through all three phases of learning and achieve a thorough comprehension of mathematical ideas (Larbi & Mavis, 2016; Sulistyaningsih et al., 2017).

Advantages of Using Manipulatives

The use of manipulatives in the classroom has a long history because they make arithmetic ideas understandable to a wide range of students. Low achievers and pupils with learning difficulties can benefit from it (Kontas, 2016; Marsh & Cooke, 1996; Moore, 2014; Ruzic & O'Connell, 2001). Researchers have found that when students use manipulatives and are subsequently given time to reflect on their experiences, their learning in mathematics is improved and their anxiety in math is greatly decreased. Exploring manipulatives, particularly self-directed exploration, creates a stimulating learning environment and encourages students to have a positive outlook on learning (Cain, 2021; Cain-Caston, 1996; Heuser, 2000; Moch, 2002). This means that manipulatives contribute to the enjoyment, realism, and application of mathematics. This is a result of the hands-on, experiential learning activities that students engage in when using physical learning instruments (Baah-Duodu et al., 2020).

Studies have indicated that children who have the opportunity to work with manipulatives in particular mathematics courses, such as algebra and fractions, among others, are more likely to succeed than students who do not (Chappell & Strutchens, 2001; Sebesta & Martin, 2004). Empirical research have demonstrated that consistent use of manipulatives, particularly in the teaching and learning of mathematics, results in the following benefits:

- 1. Communicating mathematical ideas and concepts, discussing mathematical ideas and concepts, and connecting mathematical symbolism to real-world problems.
- 2. Working cooperatively and using divergent thought to come up with a number of solutions to difficulties.
- 3. Making presentations, using a range of mathematical symbols to convey issues and solutions, and taking responsibility for their learning experiences.
- Growing self-assurance in their ability to solve mathematical problems using their own approaches without following the teacher's instructions (source: info@hand2mind.com).

How Manipulative Support Fractions Education and Learning?

By portraying mathematical concepts in various ways, manipulatives aid students in developing a conceptual knowledge of mathematics, claims (Shaw, 2002), which leads to a number of advantages. Manipulatives can offer visual representations of ideas, just as a picture can be worth a thousand words, assisting children in recognizing and comprehending the notion of fractions.

The use of manipulatives improves students' reasoning and communication skills at all grade levels. Utilizing manipulatives helps students retain and use the material in fresh contexts for problemsolving, which increases their comprehension of fractions ideas (Shaw, 2002). Again, Shaw (2002) asserts that one strategy to resolve students' misconceptions about fraction concepts is to teach fractions using manipulatives. Additionally, students actively participate in developing conceptual understanding through the use of manipulatives.

Additionally, the promotion of manipulatives is based on the learning theories of Piaget, Bruner, and Montessori, which state that knowledge is developed and built as pupils' progress from concrete experiences to abstract thought (McNeil & Jarvin, 2007). Bruner's hypothesis is supported by using manipulatives, which has pupils begin learning new information by executing activities on tangible things.

By enabling pupils to transition from tangible experiences to abstract reasoning, manipulatives aid in learning (Heddens, 1986; Reisman, 1982; Ross & Kurtz, 1993). According to educational specialists, this learning occurs in three stages.

METHODOLOGY

A quasi-experimental design was used for the study for practical and ethical reasons. According to Collom (2021) and Shadish et al. (2002), a quasi-experimental design involves a non-random assignment of participants to conditions in a study. The type of quasi-experimental design adopted by the researcher is- a group pretest-posttest design. An intervention design was rolled out after the pre-test.

Population and Sample

The study population was the Ampabame Junior High School students in Atwima Kwanwoma District in the Ashanti Region of Ghana. The school has a numerical strength of 135, comprising 42 forms one student, 50 forms two students, and 43 forms three students. The sample size was 50, comprising the form two school students. The students comprised 30 males and 20 females. This research used the purposive sampling method to get the sample size. Purposively, form two students were selected because they have had more extensive tuition in fractions than the form one students. The form three students could not be used since they were busy preparing for their BECE. According to Etikan and Bala (2017), purposive sampling is a form of non-random sample method whereby the researchers use their judgment in choosing participants for the study.

Study Tool

The primary tools for gathering data were pre- and post-test. The tools were created for convenient data capture, interpretation, analysis, and organizing. The purpose of the pre-test, which consisted of 10 questions, was to identify the relative strengths and weaknesses of the students' understanding of or assimilation of the idea of fractions, particularly the operations on fractions. The survey included questions on adding and subtracting fractions with both common and unusual denominators. Additionally, it included fraction division and multiplication exercises. The purpose of the post-test tool, which comprised 10 test items, was to gauge how much knowledge the students had gained regarding the idea of fractions, particularly the operations on fractions. Thus, the effectiveness of the rollout of the intervention was evaluated using the post-test method. Questions on fractional addition, subtraction, multiplication, and division as well as their use in word problems were included in the test items.

Fraction bars were employed as manipulatives in the teaching and learning of addition, subtraction, multiplication, and division of fractions during the implementation of the intervention. Each group of five pupils had a number of fraction bars, including wholes, halves, thirds, fourths, and so on. The pupils were initially led by the manipulatives to investigate how the component parts fit together to form a whole. For instance, two one-halves placed side by side have the same length when combined. The kids were able to recognize that each portion is equal to one when a whole is divided into two pieces. In addition, four quarters that are placed side by side have the same overall length. The pupils recognized that each part, when divided into four equal pieces, constitutes one-fourth of the whole. Additionally, the pupils were able to recognize that two one-fourths was equivalent to one half. The kids gained an understanding of fractions as pieces of a whole via these activities.

Students were assisted in exploring and appreciating equivalent fractions while utilizing the manipulatives. For instance, when twothirds and four-sixths were instructed to be placed side by side, students noticed that the two different fractions took up the same amount of space. They were able to recognize and comprehend that the two fractions were equal in this way. Students were helped in investigating and comprehending which fractions are greater among various fractions while utilizing the manipulatives. Students were instructed, for instance, to align fraction bars representing the one-fourth and onesixth fractions. They noticed that a quarter was larger than a sixth in terms of size. They were able to recognize that one-fourth is greater than one-sixth when comparing the two fractions.

Fractional Addition and Subtraction

The fraction bars served as a guidance for the students in each group as they added and subtracted fractions. They started by learning how to add and subtract fractions with the same denominator. Adding one-eighth and three-eighths is an illustration. The pupils had the option of choosing one eighth of a fraction bar and three additional eighths of a fraction bar. When they fitted everything together, they found that the fraction bars were all the same, resulting in four pieces of one-eighth. The pupils discovered that one eighth plus three eighths equals four eighths by using the fraction bars. They were also able to recognize that one-eighth minus three-eighths yields the result as minus two-eighths when the operation's sign was altered. The pupils were provided additional examples to practice on.

Students once more investigated utilizing the fraction bars to add fractions with unusual denominators. Using their prior understanding of equivalent fractions, they were led. For instance, multiplying by half and quarter. One-half and two-fourths are the same size when placed side by side, therefore students were prompted by the bars to recognize this relationship. The students understood that the result of one-half plus one-fourth is three-fourths. The students were also able to recognize that one-half less one-fourth equals one-fourth when the operation's sign was changed to minus. More examples were used as practice by the pupils.

Division of Fractions

The students were helped to realize that multiplication, taken literally, refers to how many times a quantity is multiplied. They were instructed to experiment with utilizing the fraction bars to multiply fractions. for instance, four times one-half. The pupils were instructed to choose four one-half fraction bar pieces to represent one-half times four. They were able to calculate that they had four halves in total, which meant that multiplying four by one-half would result in four halves. The same was true when students were asked to multiply onefourth by five. They were able to choose five sections of the fraction bar, which gave them five-fourths when added together.

Fractional Division

The fraction bars were once more used to guide the pupils as they investigated how to split fractions. The pupils were given instructions on how to recognize that division in this sense denotes sharing. For instance, the number of twos in four can be calculated by dividing it by two. To help them understand the idea of fractional division, the students were instructed to use the fraction bars. For instance, divide one-half by four. They understood that the question was asking, "how many one-fourths are in a half?" The pupils' task was to choose a onehalf fraction bar and calculate how many one-fourth fraction bars would fit in the same space when placed side by side. They saw that a one-half bar and two pieces of one-fourth bar had the same length. On this basis, they were taught to recognize that the result of half divided by a fourth is the entire number two. The similar exercise was used with the pupils to arrive to the conclusion that three-fourths divided by oneeighth equals a whole number, which is six. The pupils were encouraged to perform further examples like this.

Data Gathering

The pre-presentation stage was the initial stage. To help communicate the information by inspiring the students to learn and value mathematics in practical tasks, the researcher gathered enough tools, techniques, and tactics. In addition to several materials and resources created to improve the usage of the manipulatives, lesson notes were also provided. The presentation stage served as the second face and was where the actual lessons were taught. In order to develop their knowledge, students were free to explore, browse, and alter teaching tools and other resources. To demystify the notion of fractions and make it more alive, realistic, and interesting, this took a variety of forms, including self-learning, group discussions, role playing, contests, and speed tests.

The post-test was given in the third and final phase to gauge how well the intervention had worked. The test items were created by the researcher, hence content and construct validity were achieved. The test questions were all modified from former West Africa Examinations Council (WAEC) examinations as well as TIMSS and other standardized test questions. The post-exam had 10 theory test questions that were to be answered in 45 minutes. The students' grasp of adding fractions with the same denominator and fractions with unusual denominators was tested with four questions. They were put to the exam on their knowledge of fractional subtraction by way of two questions. Additionally, there were two questions on division of fractions and two more on multiplication of fractions among the test items. After getting the questions, measures were taken to have some other students attempt the items so they could rephrase or delete as necessary. In addition, the problems were reviewed by a senior mathematics teacher from the Ampabame Junior High School. The test's reliability was assessed using the test-retest reliability method. The test yielded a reliability coefficient of r=0.86. Therefore, it is possible to consider the study's test to be reliable.

Each student's performance on both tests was entered into the statistical package for the social sciences (SPSS) version 22.0 software's data view in order to analyze the data gathered. Charts were utilized to answer the study's research questions once the data entered into the software were transformed into frequency counts and percentages. Mann Whitney's independent samples. The U test was also utilized to look into gender differences in test results between the pre- and posttests. Table 1. Frequency distribution for pre- & post-test scores

Marka	Frequency						
	Pre-test scores	Post-test scores					
11-20	4	0					
21-30	9	3					
31-40	10	6					
41-50	15	7					
51-60	12	11					
61-70	0	10					
71-80	0	10					
81-90	0	3					
Total	50	50					

RESULTS

The analysis of the results has been presented in order of the research questions.

Research Question One: What is the Impact of Manipulatives on Students' Conceptual Understanding of Operations on Fractions?

Tests conducted were the main avenue to answer research question one. The scores of the tests were presented as shown in **Table 1**. **Table** 1 presents the raw scores obtained from the pre- and post-test. A close observation reveals that the post-test performance is better than the pre-test results.

In order to give a visual impression of the impact of the use of manipulatives on the students' understanding and performance, a histogram was also used to compare the students' performance for both the control and experimental modes. It is practically clear from **Figure 1** that none of the students scored above 60% in the pre-test, but the post-test had more than half of the students scoring 60% or more.

Furthermore, out of the 50 students who took the pre-test, 13 scored 30% or below, indicating very abysmal performance. A whooping 25, representing half of the students scored between 31% and 50% inclusive, and only 12 of the students could score 50% and above but not more than 60%. As outlined, the students' performance has increased tremendously mainly because of the manipulatives in teaching the operations on fractions. It is worth noting that out of the 50 students, only three scored 30% or below. This is quite an enormous improvement from the pre-test. Also, only six students fall in 31% and 40%, and seven in 41% and 50%. This means that out of the 50 students, 16 of them scored 50% or below, and the rest scored a mark of more than 50%. A close observation of **Figure 1** shows the physical and practical adaptability of the students to interventional design, which has manifested in the outstanding results observed herein.

Table 2 shows the descriptive statistics of the pre- and post-test. It is observed that the post-test had a better mean score of 60.48 with a standard deviation of 15.83 compared to the pre-test mean score of 40.80 with a standard deviation of 12.66. This indicates that the students had a better conceptual understanding of operations on fractions after the intervention roll out and this was as a result of the use of the manipulatives in the teaching and learning activities.



Figure 1. Histogram showing comparison between pre- & post-test scores (Source: Authors)

 Table 2. Outputs of descriptive statistics mean, standard deviation, &

 standard error of mean

		Gender	Pre-test	Post-test
	Valid	50	50	50
n	Missing	0	0	0
Mean		1.40	40.80	60.48
Standard er	ror of mean	.070	1.791	2.239
Median		1.00	40.50	60.00
Mode		1	40 ^a	60
Standard de	viation	.495	12.664	15.832

Note. ^aMultiple modes exist & the smallest value is shown

Table 3. Paired samples statistics

	Mean	n	Standard deviation
Pre-test score	40.80	50	12.664
Post-test score	60.48	50	15.832

Table 4. Paired samples test

	Paired differences							Signif	ficance	
	Moon difforence	Standard doviation	Standard arran	95% confidence interval of difference		t	df	One sided	Two sided	
	Weall unierence	Stanuaru ueviation	Stanuaru error	Lower	Upper			One-sided	I wo-sideu	
Pre-/post-test	19.680	8.672	1.226	17.215	22.145	16.04	49	<.001	<.001	

 Table 5. Mann-Whitney U test for gender differences for pre- & post-test

Variable	Pre-test	Post-test
Total n	50	50
Mann-Whitney U	324.000	356.500
Wilcoxon W	534.000	566.500
Mean rank (male, n=30)	24.70	23.62
Mean rank (female, n=20)	26.70	28.33
Test statistic	324.000	356.500
Standard error	50.426	50.292
Standardized test statistic	.476	1.123
Asymptotic Sig. (2-sided test)	.634	.261

Research Question Two: To What Extent Does Use of Manipulatives to Teach Concept of Operations on Fractions Improve Students' Performance?

To find the answer to the research question two, steps were taken to determine the extent of improvement in students' performance after the intervention and check if there was any statistical significance. As a result, the following hypothesis was tested.

- 1. Ho. There is no statistically significant improvement in students' performance after using the manipulatives.
- 2. **H**_a. There is a statistically significant improvement in students' performance after using the manipulatives.

Table 3 provides a statistical perspective to bring out clearly, the improvement in the students' performance. **Table 3** shows that the mean performance of the students after the intervention is better than their performance in the control mode. A mean score of 60.48 with a standard deviation of 15.83 in the post-test is far better than the mean and standard deviation of 40.80 and 12.66, respectively, in the pre-test. Therefore, it is prudent to reject the null hypothesis and conclude that there was a statistically significant improvement in the post-test scores of the student.

From Table 4, it can be deduced that there was a significant difference between the means of the test conducted before the

intervention and the one that was intervened after the training. Since the p-value or the significant value is less than 0.05, it indicates a statistically significant improvement in the students' performance. We, therefore, reject the null hypothesis and conclude that there was a statistically significant improvement in the mean score of the post-test.

Independent-samples Mann-Whitney U test was used to test the distribution of the scores of the pre- and post-test across the male and female students. This was used to examine if there was a significant difference between the male and female students' scores in the pre-test as well as the post-test as indicated in **Table 5** there was no statistically significant difference between the scores obtained by male and female students in the pre-test (male: mean rank=24.70, n=30; female: mean rank=26.70, n=20; U=324.00, Z=0.476, p=0.634>0.05). Similarly, the difference between the male and female students' scores in the post-test was not statistically significant (male: mean rank=23.62, n=30; female: mean rank=28.33, n=20; U=356.50, Z=1.123, p=0.261>0.05).

From **Table 6**, we reject the null hypothesis and conclude that there was no statistically significant difference between the scores of the males and their female counterparts in the pre-test. Much the same way we reject the null hypothesis and conclude that no significant difference was found between the scores the male students obtained in the posttest and that of the female students.

DISCUSSION

Research question one was to find out the impact of the use of the manipulatives in teaching the concept of operations on fractions. As analyzed, the results from the post-test have proven that the manipulatives positively impact students' conceptual understanding. This goes a long way to confirm the recommendations made by modern researchers (Adendorff et al., 2018; Andamon & Tan, 2018; Bartolini & Martignone, 2020; Sulistyaningsih et al., 2017). Therefore, effective use of manipulatives enhances students' conceptual understanding and must therefore be encouraged. This is because students get the

Table 6. Hypothesis test summary

_	Null hypothesis	Test	Sig.	Decision
1	Distribution of pre-test is same across categories of gender.	Independent-samples Mann-Whitney U test	.634	Retain null hypothesis
2	Distribution of post-test is same across categories of gender.	Independent-samples Mann-Whitney U test	.261	Retain null hypothesis

Note. Asymptotic significances are displayed & the significance level is .050

opportunity to interact with materials and with their peers to find solutions to problems by themselves. They tend to understand the concepts better, retain the knowledge acquired, and apply it to new situations.

In respect of the research question two, which sort to find out the extent to which the use of the manipulatives can enhance students' performance, the analyses have proven beyond doubt that the effect size was good enough; this makes it clear enough to conclude that the statistical significance in the students' performance was appreciable. We can, therefore, prudently conclude that using the manipulatives in teaching the concept of operation on fractions is indeed grounded, as observed by various researchers (Adendorff et al., 2018; Cramer & Henry, 2002; Shaw, 2002).

The comparison of students' pre- and post-test scores with respect to gender showed that both the male and female students in the class were at the same level in terms of their conceptual understanding of operations on fractions. Neither category of students could outperform the other. This revelation confirms scores of work done by some researchers who had similar results (Ajai & Imoko, 2015; Alkhateeb, 2001; Armah et al., 2020)

Implications

Ghana's educational system seeks to ensure students' academic growth and a conceptual understanding of concepts especially in the fields of mathematics and science. This can be achieved by way of using a multidisciplinary approach in teaching in order to meet the needs of diverse students. Teaching methods that make use of concrete teaching aids such as manipulatives should be employed when teaching abstract concepts to help in students' conceptualisation. The is re-echoed by NCTM (2000), which encourages the use of manipulatives in teaching abstract concepts across grade levels. In light of this the mathematics curriculum has to be reviewed to incorporate activities that make concepts realistic than abstract in the teaching and learning activities. Furthermore, the goal of teachers should be to make use of these concrete, hands-on manipulatives during teaching and learning of mathematics to facilitate students' academic growth and ultimately achieve better student performance.

CONCLUSIONS

As per the study findings, the researcher wishes to conclude that heads of junior high schools encourage manipulatives in teaching mathematics, especially fractions. By so doing, the mathematics lessons become so realistic and practical. Teachers should also try to have a conceptual understanding of every topic before they attempt teaching it. This will help them to relate the lesson to real-life activities.

Learners, on the hand, will appreciate the subject very well if they know the impact and implication of mathematics in their daily activities. As a result, the school authorities must ensure that teaching and learning materials are available for teachers to enhance smooth interaction. **Author contributions:** All authors were involved in concept, design, collection of data, interpretation, writing, and critically revising the article. All authors approved the final version of the article.

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Ethics declaration: Authors declared that as part of their teaching roles they teach the learners who were used as the subjects of the study at the Basic Education. Ethics committee approval was not required by the school since it is a common practice for teachers to modify their instructional methods to know which learning strategies are more effective and can better help achieve good learning outcomes. Authors further declared that the issues of voluntary participation, privacy and confidentiality were explained to participants, and that their informed consents were obtained before participation.

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Effect of Inhibitory Modelling Technique in modification of bullying behavior among secondary school boarding students

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ABSTRACT

This study investigated the effect of inhibitory modelling technique (IMT) in modification of bullying behavior among senior secondary school boarding students in Zaria, Kaduna State, Nigeria. The pre-/post-test quasi experimental control group design was adopted. The entire senior secondary two boarding students in Zaria constituted the population for the study. The sample for the study was 282 (172 males and 110 females) students drawn from three boarding secondary schools. Two intact classes in each of the three schools were used. The treatment package for the experimental group was IMT. To establish the relative effect of the treatment in modifying bullying behavior, both experimental and control group were pre- and post-tested using research instrument titled involvement and attitude bullying rating scale. The instrument was validated and have the reliability coefficient of 0.87. Four hypotheses were formulated and were tested using t-test at the α =0.05 level of significance. The study revealed that IMT emerged superior to traditional school counselling technique for modifying attitude to, and involvement in bullying among secondary school boarding students. IMT was also found to be effective for modifying both male and female participants' attitude to, and involvement in bullying. It was recommended among other that school counsellors should adopt IMT as an anti-bullying intervention for counselling secondary school students against bullying as well as for prevention or modification of bullying behavior in boarding schools.

Keywords: boarding secondary school, bullying, anti-bullying, intervention, inhibitory modelling technique, counselling

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INTRODUCTION

Bullying, in all of its forms, has been recognized as one of the most highly prevalent antisocial behaviors in the world (Williams et al., 2023). It is a widespread public problem with significant behavioral and mental health consequences (Fei et al., 2022; Williams et al., 2023). It can be seen in the family, private and the public sectors such as military, the political arena, social services, educational settings among others. Ekwelundu (2022) stated that bullying could happen to children or adults at home, public facilities, buses, parks, neighborhoods, schools, the Internet, or through phone communication such as texting and photo manipulation on social media sites like Facebook. Hence, there is school bullying, workplace bullying, family bullying, cyber-bullying etc. Therefore, bullying is a maladaptive behavior that can occur anywhere (Ekwelundu, 2022). More so, people's participation in bullying is diverse, this is because it takes numerous practices or ways of causing pain to the victims. Olweus and Limber (2010) asserted that a lot of bullying happens without any apparent provocation on the part of the person being bullied, thus could be regarded as a form of abuse. However, the context in which bullying occurs, as well as the relationship of the parties involved, distinguishes it from other forms of abuse such as child abuse and domestic violence (Olweus & Limber, 2010). Bravo-Cedeño and Avila-Rosales (2022) regarded bullying as an extreme form of school violence. On the forms of bullying, Pfeiffer and Pinquart (2014) expressed that

> Physical bullying or aggression is characterized by observable behaviors including being hit, physical threats, and blackmail. In contrast, relational forms of bullying include more subtle and of aggression such as spreading untrue rumors, and social exclusion. Furthermore, new possibilities of relational bullying arise in new media by using the internet or social networks (cyberbullying) (Pfeiffer & Pinquart, 2014, p. 581-582).

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According to Aluede (2011), there appears to be disagreement on how the term bullying should be defined. Nonetheless, Fatah et al. (2022) defined bullying as an intentionally aggressive behavior, repeated for a long time, and involves an imbalance of power. Ponce et al. (2021) defined bullying as a person's constant exposure to aggressions, either physically or emotionally. Ponce et al. (2021) identified indirect forms bullying to include "teasing, name-calling, threats, ridicule, aggravation, taunting, hazing, social exclusion, or rumors or gossips" (p. 3). Bullying can therefore be described as a deliberate hurtful and often violent or devious behavior or acts committed by one or more individuals against the other, typically carried out repetitively over a particular range of time.

Bullying occurs in a variety of settings, particularly organized communities such as schools (secondary, boarding schools and tertiary institutions) (Ekwelundu, 2022). It has become an increasingly serious problem in today's schools. Ossa et al. (2021) maintained that bullying remains a social issue that affects millions of students of all ages worldwide. Thus, it is widespread among school students (Lu et al., 2022; Nguyen et al., 2022; Olweus & Limber, 2010; Ossa et al., 2021; Sihidi & Amirudin, 2022; Williams et al., 2023). Therefore, school bullying has sparked widespread national and international concern in recent years due to its multifaceted negative impacts on students and the general society. It is prevalent among secondary school students due to many influences. Some of these influencing factors are the students' age and youthful exuberant that occurs during adolescent period, which is characterized as full of anxiety, disposition, identity crises, passionate urge to gain recognition among peers or be accepted as a member of a group. However, according to Kilicaslan et al. (2022), the prevalence of bullying is dependent on many factors, such as the type of bullying, geographical location, and how bullying is defined.

Schools are classified as physically conducive if they can create a peaceful or peaceful atmosphere, however, there are several circumstances that cause a school to no longer be peaceful for its students (Saprilia, 2022). Ideally, according to Ponce et al. (2021), the school environment should be a safe place for each student, where they can go to learn without any fear. The authors further expressed that students' school experiences are critical to their successful transition into adulthood. This is due to the fact that this is where they develop social skills, explore and refine their strengths, try to deal with vulnerabilities and also build citizenship and character. Unfortunately, several secondary school students are exposed to unfriendly environments as a result of the breakdown of families, public disorder in society (Otta, 2007). Also, accessibility and affordability of internet technology among others hinders the chances or enabling atmosphere for school age children to acquire social skills essential for effective social interactions with their peers (Wilson et al., 2003). School children uses the facilities to significantly get exposed to aggressive behaviors and ills attitudes to others at home, school, and in society.

Ekwelundu (2022) indicated that school bullying occurs in places, where children and adolescents are less visible and supervised by teachers and staff, such as toilets, hallways, playgrounds, classrooms, changing rooms, and corridors. Composition of the peer group that is made up of children or adolescents from different backgrounds could be the main contributing factor to school bullying. This is because illbehaved or bad eggs are likely to be found in the group, whose influence frequently leads to criminal tendencies such as bullying, petty stealing etc. Ponce et al. (2021) defined school bullying as the victimization and intimidation of students by their peers in the school environment. It occurs when students are repeatedly intimidated or victimized by powerful peers over a long period of time (Ponce et al., 2021). Chu et al. (2019) sees school bullying as an intentional aggressive behavior involving perpetrators and victims in school settings, and it primarily consists of physical and verbal attacks, as well as social exclusion.

Chen et al. (2023) reported that multiple research studies have shown that bullying occurs at a rate of 16.00%-36.00% among middle school students. Song et al. (2019) reported that 57.29% of junior high school students in China had suffered from at least one type of school bullying in the past year. A study conducted in Nigeria by Raji et al. (2019) revealed that 51.10%, 22.70%, 8.40%, and 35.80% in-school adolescents had experienced physical, verbal, relational, and damageto-property victimization, respectively. Overall, 65.60% had experienced at least one type of bullying victimization. More so, research findings revealed, students at boarding schools experienced more bullying than those at day schools (Nugrohoand & Ainyfardhana, 2018; Pfeiffer & Pinquart, 2014). Boarding school system provide students with a semi-permanent institution for education, housing, and food. On this note, Pfeiffer and Pinguart (2014) highlighted that attending a boarding school means being separated from parents, former friends, and familiar surroundings, thereby limiting the impact of parenting practices aimed at preventing or reducing negative behaviors. This circumstance provide more opportunities for bullying.

Therefore, it is not surprising that bullying incidents are more common at boarding schools than at day schools. Students share more time for interaction with peers at boarding school and do not have the opportunity to leave the groups in the way day students do, hence providing opportunities for victimization (Brien, 2016; Francia & Edling, 2016; Nugrohoand & Ainyfardhana, 2018; Pfeiffer & Pinquart, 2014). In the same vein, Raji et al. (2019) revealed that students in boarding schools were practically five times more probable to be victims of bullying compared to those attending day schools. This could explain the finding of Pfeiffer and Pinquart (2014) that lower levels of life satisfaction is more evident among bullied boarding students than bullied day students. Francia and Edling (2016) regarded bullying at boarding school as "boarding school syndrome", which refers to the types of violence experience by students such as: bullying, violence and annoyances. It is worthy to note that many of the issues that arise during childhood or adolescence are likely to persist into adulthood.

Bullying is understood to be a stage in life of every adolescent, especially those attending boarding schools, which they must undergo. Olweus and Limber (2010) stated that several decades of studies confirm that children and adolescents who are bullied are likely to be severely impacted in a variety of ways. For instance, bullying among secondary school students has been connected to an "increased risk of poor academic performance, low self-esteem, anxiety, depression, and even self-harm behaviors" (Chen et al., 2023, p. 2). More so, Olweus and Limber (2010) reported some of the implications of bullying to include social isolation, psychosomatic problems, severe mental health problems such as psychotic symptoms and suicidal ideation. Bullying is also known to interrupts the peace and tranquility required for schools to function normally. It obstructs children's normal processes of development and impedes their stress-free transition through adolescence, making them less productive in the society. Bullies may hit, kick, or coarse people to handover money, or they may tease them repeatedly. The victim of bullying finds it hard to stop the bullying and is always feel concerned or terrified for its repeated reoccurrence. Bullying is responsible for the majority of violent behavior and indiscipline in secondary schools. Lessons are habitually disrupted, lives are jeopardized, and school administrators devote significant time and resources in addressing bullying-related issues.

Matsani (2022) revealed that both male and female students have similar attitude and involvement in bullying and are exposed to similar levels of victimization. But Ponce et al. (2021) reported that female are typically more relational than male with females reporting more positive attitudes than males. Many students irrespective of gender are coerced into joining cults as shields or covers from being bullied. The bullies are more likely ends up joining cult or groups leading to the formation of a fearsome cult that will wreck any opposition. There are also instances, where bullying results to death. For example, the dead of a student at Dowen College (a boarding school in Nigeria) on November 30, 2021. Before this unfortunate incident, there was another case of the death of 14-year-old Karen-Happuch, a student of Premier Academy, Abuja, Nigeria. This instances further affirmed how dangerous school bullying could be. Furthermore, an anecdotal records have shown that bullying exits in many boarding secondary schools in Nigeria and has continue to grow and sparks controversy. Boarding school managers have been reportedly made some efforts to cover up cases of bullying in their schools while parents have been expressing their discontentment over the cruel action being meted on some children in such schools. Brien (2016) reported that attitudes to bullying do not always reflect behavior. The student's attitudes and involvement in bullying behavior is diverse in the sense that bullying takes various forms or patterns and causes varying degrees of physical, psychological, and emotional pain to the victims (Ekwelundu, 2022). Salmivalli et al. (2005) stated that there is a discrepancy between students' attitudes and their actual behavior in bullying situations. They also suspected that this may be an important factor contributing to the persistence of the bullying (Salmivalli et al., 2005). Thus, Salmivalli et al. (2005) posed that changing attitudes might be a good starting point, but an even more critical question in intervention work may be how to convert the antibullying attitudes into actual behavior in bullying situations. The entire situation appears to be terrible and clearly stances serious intimidations to the achievement of the secondary educational goals outlined by Federal Republic of Nigeria (2013) in national policy on education, which unequivocally mentioned that secondary education is intended to "raise a generation of people who can think for themselves, respect the views and feelings of others, respect the dignity of labor, appreciate the values outlined in our broad national goals, and live as good citizens" (p. 18). Again, several international investigations have highlighted the difficulties in combating violence at boarding schools due to their unique characteristics (Francia & Edling, 2016).

In recent years, the number of studies on bullying has increased with the frequent media coverage of aggression among students in schools, and it has become one of the important research topics that researchers focus on (Matsani, 2022). Creating a safe environment and instilling confidence in students encourages them to feel comfortable and to speak up if they are being harassed; for this reason, anti-bullying campaigns are suggested. (Bravo-Cedeño & Avila-Rosales, 2022). Allen (2010) argued that school anti-bullying interventions may produce modest positive outcomes. In a review of 26 anti-bullying interventions that were designed to reduce bullying and victimization, Vreeman and Carroll (2007 cited in Allen, 2010) reported a mixed success. Some resulted in reductions, while others did not. Badejo and Ubangha (2002) emphasized that it is possible to successfully help out bullies and their victims with intervention based on the ideologies of cognitive restructuring and assertiveness training. A research by Ikeagu (2006) revealed that providing encouragement to students as well as assisting them in mastering important skills to tackle bullying and understanding concepts related to bullying are highly recommended for teachers than using reprimands such as beating, rebuking, suspension, expulsion etc. Omoteso (2010) listed five antibullying strategies or skills that students applied in coping with bullying as thus: bullying the person back (18.30%), reporting to school authority/counsellor (81.10%), absconding from school for long time (6.30%), avoiding person (52.40%) and telling their parents (64.70%).

It appears that adequate anti-bullying initiatives and procedures have yet to be developed in order to effect positive behavioral and attitudinal changes toward bullying behavior among school students. However, while several studies on anti-bullying programs (preventive and intervention) on changing attitudes, intentions, involvement in bullying have been conducted in many other countries, such studies in Nigerian secondary schools were limited, and the few that were conducted were mostly in the southern part of the country (e.g., Aluede, 2011; Badejo & Ubangha, 2002; Egbochukwu, 2007; Jegede et al., 2008; Nwankwo & Unachukwu, 2006; Obe, 2009; Omoteso, 2010; Sullivan et al., 2005). Again, majority of these studies were carried out in mainstream secondary schools using survey, with recommendations based on reviewed literature instead of experimental findings. This suggested the need to broaden the research to other parts of Nigeria using boarding schools. The present study was designed against this background to contribute to existing studies on bullying interventions by experimentally exploring the relative effectiveness of inhibitory modelling technique (IMT) in modification of bullying behavior among senior secondary school boarding students in Zaria, Kaduna State, Nigeria. To achieve this, following objectives were formed:

- (a) To determine the effect of IMT in modifying attitudes of senior secondary school boarding students towards bullying.
- (b) To determine the effect of IMT in modifying involvement of senior secondary school boarding students in bullying behaviors.
- (c) To determine the effect of IMT in modifying attitudes of male and female boarding students towards bullying.
- (d) To determine the effect of IMT in modifying involvement of male and female boarding students in bullying behaviors.

Based on the above objectives, it was hypothesized that

- (a) There is no significant difference in the attitudes towards bullying between participants who were exposed to IMT and those were not.
- (b) There is no significant difference in the involvement in bullying behaviors between participants who were exposed to IMT and those were not.
- (c) There is no significant difference in the attitudes towards bullying between male and female participants who were exposed to IMT.
- (d) There is no significant difference in the involvement in bullying behaviors between male and female participants who were exposed to IMT.

METHODS

Design

This study adapted pre-/post-test quasi-experimental research design. The study used two groups: experimental and control. Experimental group received experimental treatment, which is counselling using IMT, while control group received conventional/ traditional school counselling for the period of six weeks.

Study Area

The study was carried out in Zaria Local Government Area, Kaduna State. Zaria lies in the Northern Guinea Savanna Zone of Nigeria, between latitude 11°15'N and 11°3'N of the equator and longitude 7°30'E and 7°45'E of the Greenwich meridian (Isma'il et al., 2016).

Population

The population for this study is the entire senior secondary two (SS 2) students in boarding schools in the Zaria, Kaduna State. There are four boarding secondary schools with population of 1,142 students in the study area.

Sample and Sampling Techniques

Before selecting the sample, pre-test was administered to the four boarding schools to ensure that the samples chosen are significantly not different in their bullying attitude and behavior. Three boarding schools namely, Alhudahuda College, Government Secondary School (WTC), and Barewa College were found not significantly different and therefore used. Two intact SS 2 classes in each of the three schools were randomly sampled, which gave rise to the sample size of 282 (172 males and 110 females) participants.

Data Collection Tool

The instrument used for data collection was involvement and attitude to bullying rating scale (IABRS) adapted from Ettu (2011). The IABRS was sub-divided into sections A to E. Section A to D consist of items relating to involvement in bullying while section E was on attitude to bullying. IABRS was subjected to validation by three qualified experts with PhD who specialized in the field of guidance and counseling. The reliability for the instrument was found to be 0.87.

Treatment Procedure

The experimental groups were given a treatment using a package IMT adapted from Ettu (2011). The overall objective of the package is to give participants the opportunity to hear or see some of the unpleasant experiences of students and ex-cultists who have bullied in the past in order to serve as deterrents to the participants. The inhibitory models were the ex-bullies, inmates with past bullying experience, and ex-cultist(s). IMT was administered to the experimental group in six sessions. Each session are carefully planned to get the best attention of the participants and also give room for interaction. The sessions are briefly highlighted below.

Session one

Briefing for awareness of the intervention at school with principal, staff and students in attendance. Explanation on bullying as deviant, anti-social and self-defeating behavior. Identification of bullying behaviors and their consequences in the schools by the participants.

Session two

Presentation of the models, former boarding school student(s) (exbullies or ex-cultists) to share their experiences to elicit the inhibitory modelling effect on the participants. Interactive time with the model(s), reflective discussions on the consequences of bullying on the model(s).

Session three

Review of previous day's activities, presentation of the second model(s), former boarding school student(s) (ex-bullies or ex-cultists) to share their experiences to elicit the inhibitory modelling effect. Interactive time with the second model(s), reflective discussions on the consequences of bullying on the model(s).

Session four

Excursion to Nigerian Correctional Center in Zaria to listen to the teenage detainees with particular reference to the reactive bullying history (permission and their consent were sought). However, this session may be skipped if the permission to warrant the excursion proved difficult.

Session five

Reflective discussions on the consequences of bullying on the teenage detainees (inhibitory model(s)).

Session six

Video show portraying lasting consequences of bullies who are school dropouts or expelled from school. General discussions, questions and answers on attitudes to, involvement in, and consequences of bullying.

The control group did not receive any treatment. However, they continue to be under the conventional/traditional school counselling were school counsellors (if there is any) and/or schoolteachers serves as mediators.

Data Collection

Both experimental and control groups were pre- and post-tested using IABRS.

Data Analysis

Null hypotheses were tested using t-test statistic at 0.05 level of significance.

RESULTS

Ho1. There is no significant difference in the attitudes towards bullying between participants who were exposed to IMT (experimental group) and those were not (control group).

Table 1 shows that t-value computed is 8.02 and p-value of 0.00 is observed at df of 280. Since critical p-value of 0.00 is less than alpha value of 0.05, there is a significant difference in attitude to bullying behavior of subjects in experimental and control group. A significant difference indicates rejection of the null hypothesis. The significant difference is in favor of experimental group because their mean scores reveal a reduction of their attitudes towards bullying behaviors.

HO2. There is no significant difference in the involvement in bullying behaviors between participants who were exposed to IMT (experimental group) and those were not (control group).

Table 1. t-	test analysis	of attit	ude to bullying	g behavior scores of partie	cipants				
Variables	n		Mean	Standard deviation	df	t-value	t-critical	p-value	Decision
Experiment	al 138	8	16.20	6.37	290	0.02	2.26	0.00	Si-miGaant
Control	144	4	30.70	0.95	280	8.02	2.20	0.00	Significant
Table 2. t-	-test analysis	of invo	olvement in bu	llying behavior scores of	participants				
Variables	n		Mean	Standard deviation	df	t-value	t-critical	p-value	Decision
Experimen	al 138	8	26.50	3.99	280	12.36	1 99	0.00	Significant
Control	144	4	38.98	6.47	280	12.30	1.70	0.00	Significant
Table 3. t-	-test analysis	of attit	ude to bullyin	g between male & female	students wh	o were exposed	to IMT	p voluo	Decision
variables	11		Iviean	Standard deviation	ui	t-value	t-critical	p-varue	Decision
имт Ма	de 172	2	38.72	8.15	280	3 25	2.0	0.21	Not significant
Fem	ale 110	0	39.54	7.51	200	5.25	2.0	0.21	ivot significant

Table 4. t-test analysis of involvement in bullying between male & female students who were exposed to IMT

		-				-			
Variables		n	Mean	Standard deviation	df	t-value	t-critical	p-value	Decision
INT	Male	172	28.42	3.83	200	2.1.(2.0	0.00	N
INI I	Female	110	26.60	4.29	280	2.16	2.0	0.08	Not significant

Table 2 reveals that the t-value computed is 12.36 and the p-value of 0.00 is observed at df of 280. Since the critical p-value of 0.00 is less than the alpha value of 0.05, there is a significant difference in the involvement to bullying behavior of the experimental and control groups. Thus, the null hypothesis is rejected. The significant difference is in favor of experimental group as their mean scores shows a significant reduction in their involvement in bullying.

HO3. There is no significant difference in attitudes towards bullying between male and female participants who were exposed to IMT.

From the result in **Table 3**, it is observed that in the experimental group, the t-value of 3.25 is obtained and the p-value observed is 0.21 at the df of 280. The p-value of 0.21 is greater than the alpha value of 0.05. This shows that there is no significant difference between the male and female students' attitudes towards bullying after intervention. A no significant difference infers retaining of null hypothesis.

HO₄. There is no significant difference in the involvement in bullying behaviors between male and female participants who were exposed to IMT.

Table 4 shows that the t-value of 2.16 is obtained and the p-value observed is 0.08 at the df of 280. The p-value of 0.21 is greater than the alpha value of 0.05. This shows that there is no significant difference between male and females in the experimental group after the intervention. Therefore, the null hypothesis is retained.

DISCUSSION OF FINDINGS

From the findings in **Table 1** and **Table 2**, the study revealed that experimental group recorded a drastic reduction in their mean scores than control group, which shows that there is a significant difference between the students in the experimental and those in control group in their attitude towards bullying and involvement in bullying. A significant difference implies rejection of null hypothesis. Therefore, null hypothesis that states that there is no significant difference in the attitude to bullying behavior between participants who were exposed to IMT and those were not rejected. The significant difference indicates that IMT is significantly effective in changing participants' attitudes towards, and involvement in bullying behavior than the traditional counselling strategies been adopted in boarding schools in Zaria.

The study yielded positive results on concern raised by Ettu (2011), Raji et al. (2019), and Saldiraner and Gizir (2021). Raji et al. (2019) showed that bullying victimization is extremely common among school students and that intervention should be provided to protect all students from victimization. Saldiraner and Gizir's (2021) study revealed that to tackle bullying, counselors should identify better intervention technique. Findings of this study support Corey's (2008) assertion that behavior of a person (model) plays a vital role or serves as a stimulus for similar attitudes and behavior on part of onlookers. Similarly, Ettu (2011) found that out of four interventions, IMT appeared to be the most effective technique for modifying involvement of the participants in bullying behavior than other two interventions compared with. Also, Haralambos and Holborn (2008) and Taylor (2006) reported that students frequently learn social attitudes and behaviors by simply observing others, also known as models. A lot of students picked up bullying attitudes and behaviors from seniors who served as non-inhibitory models for bullying others, and they tend to try and emulate them. This was made easier because the seniors' bullying behavior was not punished, but rather praised by their peers, and the bullies were respected by both their peers and the juniors.

This study is also in line with Wang et al.'s (2022) finding that established a need for research on interventions to reduce or diminish bullying in both primary and secondary schools. Findings show that when students were presented with inhibitory models (ex-bullies) in the treatment package, the model seemed to have shifted from admiring and showing respect the bullies to feelings of sympathy and displeasure and misgivings. The use of ex-bullies was very appealing because the students could easily recognize with them. This could have impacted the observed change in attitude and behavior toward bullying among participants. It is not thus exactly a surprise that IMT emerged effective technique than the traditional school counselling. IMT was comparable to "cognitive restructuring technique" used by Badejo and Ubangha (2002) to assist bullies and victims in gaining understanding into their challenges and applying knowledge to resolving related problems.

The findings of this study also confirmed the study of Carbone and Cocodia (2019), Ikeagu (2006), and Jegede et al. (2008). Jegede et al. (2008) used peace education as intervention involving 40 senior secondary school II students. In all of the identified existing deviant behavior in schools, the study found that the control group had a higher presence of deviant behavior than the treatment group. They found Bullying occurred at a rate of 60.87% in the control group versus 39.13% in the treatment group. Hence, peace education, which is more or less similar to IMT was found to be a very effective technique for changing deviant behavior among secondary school students. Ikeagu's (2006) revealed that effective behavior adjustment techniques such as selfcontrol, inhibitory and their combination should be used to address cases of bullying and discouraged the use of punishment in handling bullies. Carbone and Cocodia (2019) research shows that bullying interventions through inhibitory to be more effective than individual counselling with victims and perpetrators of bullying.

From the findings in Table 3 and Table 4, the study revealed no significant difference in the post-test scores in attitudes towards bullying and involvement in bullying due to gender. Both male and female participants appeared to have gotten right attitudes and appropriate involvement perspectives to bullying. This finding gain further support from the work of Aluede's (2011) and Greeff and Grobler's (2008) and on gender attitude towards and involvement in bullying among school students. Greeff and Grobler's (2008) study no significant difference was found between the proportion of boys and girls who have experienced intervention from some form of bullying. Aluede (2011) established that physical and psychological bullying in Nigerian schools is almost evenly distributed between male and female students, and the use of inhibitory intervention stabilized the attitude and involvement in bullying of both gender. However, the finding of this study contradicts the study conducted by Salmivalli and Voeten (2004). Salmivalli and Voeten (2004) reported that anti-bullying attitudes of girls is stronger on average than that of boys, and boys had a higher within-classroom variance than girls even after intervention.

CONCLUSIONS

Based on the results from this research, the experimental group recorded a significant reduction in their mean scores than control group after anti-bullying intervention using IMT. It is concluded that IMT emerged as an effective technique for modifying the attitudes towards, and involvement of secondary school boarding students in bullying behavior, as well as across the gender than the conventional/traditional counselling intervention in boarding schools.

Recommendations

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

- 1. IMT should be adopted by school counsellors as an intervention package for counselling students who are heavily involved in bullying.
- School counsellors should strive in complementing the existing anti-bullying counseling interventions through awareness campaigns on the implications of bullying on the victims, bullies, bystanders, school, and the society in general.
- 3. Students who are heavily involved in bullying and/or are considered potential criminals should be made to understand

that bullying is a bad wind that brings nothing good. This can be accomplished through IMT sessions such as official visits or inviting a willing model or using videotapes among others.

4. There is need for research to compare the effectives of IMT with other techniques other than traditional counseling to find out the most effective in curbing bullying behavior among secondary school students.

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Research Article

Examining pre-service teachers' attitudes towards mathematics teaching and learning

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ABSTRACT

The study examined pre-service teachers' perceptions of learning mathematics. The study involved a total of 482 teacher-trainees from chosen colleges of education in Ghana. The study's methodology was quantitative. With the help of a structured survey questionnaire, the main data was gathered. The questionnaire was broken down into four sections (or constructs), including the students' self-sufficiency in learning mathematics, their perception of how learning mathematics has affected them, their concerns about learning mathematics, and their evaluations of Mathematics teaching. The constructs' respective Cronbach's alpha reliability analysis values are 0.96, 0.90, 0.96, and 0.93, respectively. The majority of the students demonstrated a high level of independence in their mathematics learning, according to the results of the teacher trainees' self-sufficiency assessments. The results also showed that 74.3% can solve math problems even when they struggle with a mathematics course; 53.6% have less trouble learning mathematics; 65.7% find solving mathematics problems to be very satisfying; and 60.2% have a lot of selfconfidence in learning mathematics. Then, 63.7% of the students said they also really enjoyed mathematics. A total of 82.4% of students agreed that learning mathematics has a variety of positive effects on one's life. However, the mean value of about 2.8% confirmed that the majority of students disagreed with the claim that "the tutors incorporate information and communication technologies (ICTs) into the teaching of mathematics." The study suggests mathematics tutors at the colleges make efforts to incorporate ICTs in lessons, and management at the colleges also provide enough ICT resources and equipment to facilitate ICT integration.

Keywords: pre-service teachers, teacher trainees', self-sufficiency, self-efficacy colleges of education

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INTRODUCTION

One of the most effective means of enhancing success in life is education. Ghanaian schools cover a wide range of subjects. Some of which are regarded as essential and control how quickly students advance from one level to the next. Mathematics is one of these subjects. As a logical body of knowledge, mathematics can be used as a map to arrive at conclusions in a methodical way. It is a way of thinking that includes both working and how people organize their daily lives.

Several disciplines in higher education, including engineering, economics, agriculture, pharmaceuticals, and health sciences, among others, require an in-depth knowledge of mathematics (Gradwohl & Eichler, 2018). Mathematics plays crucial roles in a variety of fields in human endeavor. Thus, achievement in mathematics is seen as a key to economic success around the world, and studying mathematics improves precision, continuity, and mental discipline. Carey et al. (2017) affirmed that acquiring mathematics skills is important for successful and responsible problem solving and decision making in everyday life.

Many higher education fields, including engineering, economics, agriculture, pharmaceuticals, and health sciences, among others, require a solid grasp of mathematics (Gradwohl & Eichler, 2018). Mathematics is a very important part of many human endeavors. Thus, mastery of mathematics is regarded as a requirement for economic success on a global scale, and learning the subject improves one's accuracy, consistency, and ability to concentrate. According to Carey et al. (2017), understanding mathematics is essential for making ethical decisions and solving problems in daily life. Smith (2004) asserts that mathematics provides a useful and pervasive mental toolkit for consideration, generalization, and blending for its purported purpose. Smith (2004) purported that "acquiring at least fundamental mathematics skills, which are commonly referred to as "numeracy," is essential to individual citizens' life prospects and accomplishments" (p. 13). In a similar vein, Cuthbert and Standish (2017) argued that mathematics is a pervasive, socially constructed operation, meaning

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that every known human society has created a mathematical lens on the world and utilized that lens to aid in its fostering. Cockcroft (1986, p. 1) wrote in his submissions that "it would be very difficult, perhaps impossible, to live a normal life in very many parts of the world in the twentieth century without making use of mathematics of some kind".

Due to its special nature, learning mathematics is obviously very important on a global scale. Smith (2004) affirmed that mathematics is unique in both good and bad ways. Due to its fundamental existence as a common abstract language, its foundation in the sciences, technology, and engineering, and its significance in a variety of contexts, including the workplace and for individual citizens in projecting its positive nature, it has an intrinsically different status from most other disciplines. On the downside, mathematics in particular is viewed as being challenging and boring and presents disproportionate challenges to achieving educational goals, both in terms of workload and the possibility of achieving high grades.

Theoretical Framework

Self-efficacy motivation model is the basis of this study. As a component of the social cognitive theory, Bandura (1986) first introduced the idea of self-efficacy (Kulcsár, 2020). Self-efficacy, according to Bandura (1986, 1997), is the belief that an individual can perform at a given level and exercise control over circumstances that have an impact on their lives. A comparable definition of self-efficacy according to García and de Caso (2006), includes self-assurance in one's capacity to complete a task and the conviction that one is endowed with the necessary skills. Suraya et al. (2009) claim that self-efficacy development is a continuous process. This is consistent with Bandura's (1989) claim that people's self-efficacy increases and develops as they learn new things, have new experiences, and have new insights throughout their lives.

In relation to mathematics learning, Negara et al. (2021) suggested that, in addition to cognitive factors, the affective factor plays a significant role in the learning of mathematics. One of the emotional components that can affect how students learn is self-efficacy (Skaalvik et al., 2015; Wang et al., 2017). According to Negara et al. (2021), student's actions, efforts, perseverance, flexibility in handling differences, and goal achievement are all indicators of how well they are doing in their inquiry, which has an effect on their self-efficacy. The ability to achieve the desired or determined level of performance, which will affect subsequent actions, is also mentioned as being a student's perception of self-efficacy.

Garfield and Ben-Zvi (2009) highlighted that in order to be able to do mathematics, it is important to have self-efficacy as well as knowledge of the subject. Thus, the motivation level demonstrated in the efforts made and the amount of time committed to finishing and producing certain results are determined by self-efficacy. Pintrich (1999) contends that the development of motivation, which promotes learner self-regulation and academic success, is significantly influenced by students' perceptions and attitudes toward their own mathematical self-efficacy.

Students' Attitude towards Mathematics Learning

A person's attitude towards mathematics can be described as "a liking or disliking of mathematics, a tendency to engage in or avoid mathematical activities, a belief that one is good at or bad at mathematics, and a belief that mathematics is useful or useless" (Kibrislioglu, 2015, p. 65). Numerous studies have looked into how

students' attitudes affect their mathematical learning behaviors. Positive attitudes towards any subject are frequently found to increase students' interest in and motivation for learning. Braten and Stromso (2006) were of the view that, students' attitudes towards learning have an impact on how actively they engage in learning activities. Research has it that a student's attitude affects how they perform in mathematics. It establishes the level of commitment, enthusiasm, and personal effort necessary for performance (Smith, 2004). Students' attitudes towards particular subjects have an impact on how well they perform in those subjects, either negatively or positively. As said by Tahar et al. (2010), one's attitude towards mathematics can be characterized by their positive or negative emotional response to it. It is thereby necessary for mathematics educators to take into consideration the attitude of students towards the subject as they teach them.

Students' Perceptions about Mathematics Learning

Teh and Fraser (1995) assert that considering students' perceptions is crucial when assessing the effectiveness of their education. Aguilar et al. (2012) and Rensaa (2006) assert that one's perceptions about learning mathematics are formed through previous interactions with the subject in accordance with its cognitive and affective components. The cognitive aspect refers to what a person thinks or believes about mathematics, whereas the affective aspect refers to the person's feelings or emotions regarding learning of the subject (Mensah et al., 2013). Similar to this, Di Martino and Zan (2011) asserted that the cognitive and affective components are intricately linked and interdependent, and that these components have an impact on how learners feel about learning the subject. The primary objective of this study is to examine college students' (pre-service teachers [PSTs]/teacher-trainees) perceptions of learning mathematics based on the aforementioned conceptual and literature explanations.

Objectives of the Study

Examining college students' (PSTs'/teacher-trainees') perceptions of learning mathematics is the main goal of this study. The study specifically investigates PSTs' perceptions on

- 1. Self-sufficiency of mathematics learning,
- 2. Impact of mathematics learning,
- 3. Concerns about mathematics learning, and,
- 4. Assessing of mathematics teaching.

METHODOLOGY

Research Design

Research design is described as a blueprint or a road map for data collection, measurement, and analysis (Kothari, 2004). This study seeks to examine PSTs' perceptions of mathematics learning. The study used a quantitative descriptive survey design approach. According to Kabungaidze et al. (2013), quantitative research design allows researcher to answer questions about relationships between measured variables in order to understand, predict, and monitor specific phenomena. The teacher-trainees of the public colleges of education in Ghana were the focal groups of this study. Five colleges of education were purposively selected as the study areas. Both level 100 and 200 (1st and 2nd year) students from the colleges formed targeted population. Purposive sampling technique was used to select 100 students from each of five study areas giving sample size of 500 students.

Table 1. Scale reliability statistics

Items	Mean	Cronbach's alpha
Self-sufficiency in learning mathematics	2.43	0.962
Impacts of mathematics	1.79	0.898
Attitude towards mathematics learning	3.39	0.958
Assessments based on mathematics teaching	2.11	0.927

Table 2. Frequencies on students' self-sufficiency in learning mathematics

Itoms	:	SA	Α		N		D		SD	
Items	n	%	n	%	n	%	n	%	n	%
Even when I battle with mathematics I know I can solve problem.	204	42.3	154	32.0	68	14.1	30	6.2	26	5.4
I have less trouble learning mathematics than other subjects.	117	24.3	141	29.3	67	13.9	106	22.0	51	10.6
I get a great deal of satisfaction out of solving mathematics problems.	179	37.1	138	28.6	65	13.5	62	12.9	38	7.9
It makes me nervous to even think about having to solve mathematics problems.	102	21.2	124	25.7	77	16.0	104	21.6	75	15.6
I have a lot of self-confidence when it comes to mathematics learning.	146	30.3	144	29.9	75	15.6	63	13.1	54	11.2
I am able to solve mathematics problems without much difficulty.	92	19.1	140	29.0	90	18.7	101	21.0	59	12.2
I expect to do fairly well in any mathematics class I partake.	199	41.3	168	34.9	64	13.3	31	6.4	20	4.1
I am comfortable expressing my ideas on how to look for solutions to difficult problems in math.	124	25.7	172	35.7	75	15.6	72	14.9	39	8.1
I am comfortable answering questions in mathematics class.	121	25.1	146	30.3	97	20.1	68	14.1	50	10.4
I really like mathematics.	152	31.5	155	32.2	78	16.2	43	8.9	54	11.2



Figure 1. Mean responses on students' self-sufficiency in learning mathematics (Source: Field work in 2022)

Instrument Used

The primary data was collected using a structured survey questionnaire that extracted information about the teacher-trainees' perceptions of mathematics learning. Questions were measured using a 5-point Likert-type response format: (1=strongly agree [SA], 2=agree [A], 3=neutral [N], 4=disagree [D], and 5=strongly disagree [SD]). The questionnaire was divided into four sections: section 1 had 10 items to determine their self-sufficiency in the learning of mathematics. Section 2 contained seven items intended to examine the students' perceptions of the impact of mathematics learning. Section 3 included ten items that gathered information on students' attitudes towards mathematics learning, and section 4 presented items to examine students' assessments based on mathematics teaching.

The questionnaire was piloted with 30 teacher-trainees who were not involved in the main survey. Cronbach's alpha reliability analysis was conducted on the constructs separately. The alpha values produced on the constructs of self-sufficiency in learning mathematics, impact of mathematics learning, attitude toward mathematics learning, and assessments based on mathematics teaching are 0.962, 0.898, 0.958, and 0.927, respectively. The alpha values obtained showed strong internal consistency of items. Miller (2006) asserts that a reliable test produces coherent outcomes when it is being tested. In all, 500 questionnaires were distributed, and 482 (96.4%) were retrieved (**Table 1**).

Data Analysis

All copies of questionnaires were checked for precision and completeness and inputted into computer for coding. Microsoft Excel application tool and the Jamovi statistical data analysis package were used to analyze the statistical data. The descriptive statistics were displayed using charts, absolute numbers, and fundamental percentages.

FINDINGS

According to objectives, the study's findings are divided into four major categories. The frequencies of respondents on the created items are represented using frequency distribution tables. Figures are used to illustrate the mean scores of the responses to the items. Items are with the following values: 1=SA, 2=A, 3=N, 4=D, and 5=SD.

Objective 1

Objective 1 is to examine teacher-trainees' self-sufficiency in learning mathematics. Table 2 and Figure 1 present findings on the students' responses to their self-sufficiency in learning mathematics. From Table 2, more than 50.0% of the respondents either strongly agreed or agreed: they can solve mathematics problems even when they battle with a mathematics course; have less trouble learning mathematics; get a great deal of satisfaction out of solving mathematics problems; and, have a lot of self-confidence when it comes to mathematics learning. These responses had 74.3, 53.6, 65.7, and 60.2 percentages, respectively. The rest include I expect to do fairly well in any mathematics class in which I partake (76.2%); I am comfortable expressing my own ideas on how to look for solutions to difficult problems in mathematics (61.4%); I am comfortable answering questions in mathematics class (55.4%); and I really like mathematics (63.7%). Also, 53.1%, and 51.1% disagreed or strongly disagreed on the statements: "I feel nervous to even think about having to solve mathematics problems, and I am able to solve mathematics problems without much difficulty."

Table 3. Frequencies on impacts of mathematics learning

Items –		SA		Α		Ν		D		SD	
		%	n	%	n	%	n	%	n	%	
Mathematics helps develop mind and teaches a person to think.	310	64.3	139	28.8	20	4.1	6	1.2	7	1.5	
Mathematics is very worthwhile and a necessary subject.	233	48.3	176	36.5	45	9.3	15	3.1	13	2.7	
Mathematics is important in everyday life.		63.1	138	28.6	22	4.6	8	1.7	10	2.1	
Mathematics is one of the most important subjects for everyone to study.		51.7	136	28.2	44	9.1	23	4.8	30	6.2	
I can think of many ways that I use mathematics outside school.	198	41.1	171	35.5	66	13.7	28	5.8	19	3.9	
I believe studying mathematics helps me with problem solving in other areas.		36.5	161	33.4	86	17.8	29	6.0	30	6.2	
A strong mathematics background could help me in my professional life.	243	50.4	146	30.3	44	9.1	24	5.0	25	5.2	

MEAN

mean

2.12 1.96 1.86 1.75 1.84 1.47 1.51 Mathematics helps Mathematics is very Mathematics is Mathematics is one I can think of many I believe studying A strong Maths develop the mind and worthwhile and a important in of the most ways that I use Maths Maths helps me with background could teaches a person to necessary subject everyday life important subjects outside school. problem solving in help me in my think for everyone to study other areas professional life

Figure 2. Mean responses on impacts of mathematics learning (Source: Field work in 2022)

Ta	ble	e 4. S	Students	attitude	toward	s mat	hematics	learning
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Itomo		SA		Α		N		D		SD	
		%	n	%	n	%	n	%	n	%	
I want to develop my mathematical skills, but I fear mathematics.	123	25.5	109	22.6	48	10.0	108	22.4	94	19.5	
I feel a sense of insecurity when attempting to solve mathematics problems.	89	18.5	105	21.8	67	13.9	129	26.8	92	19.1	
I do not have a mathematical mind.	60	12.4	60	12.4	58	12.0	153	31.7	151	31.3	
Mathematics is one of my most dreaded subjects.			76	15.8	56	11.6	125	25.9	138	28.6	
I am unable to think clearly when working with mathematics.		15.1	70	14.5	64	13.3	150	31.1	125	25.9	
Studying mathematics makes me feel nervous.	67	13.9	69	14.3	62	12.9	148	30.7	136	28.2	
Mathematics makes me feel uncomfortable.	68	14.1	66	13.7	55	11.4	143	29.7	150	31.1	
I am always under a terrible strain in mathematics class.		12.4	66	13.7	56	11.6	147	30.5	153	31.7	
When I hear the word mathematics, I have a feeling of dislike.	63	13.1	63	13.1	48	10.0	136	28.2	172	35.7	
I am always confused in mathematics class.	58	12.0	59	12.2	73	15.1	133	27.6	159	33.0	

The radar chart in **Figure 1** graphically supports the results in **Table 2**. **Figure 1** shows the mean responses largely lying in the ranges between the least value of 1.97 and the highest value of 2.85. Majority of the items 1, 3, 5, 7, 8, and 10, respectively have mean responses of less than 2.5, and the items 2, 4, 6, and 9 have mean responses of 2.65, 2.85, 2.78, and 2.54, respectively.

Objective 2

Objective 2is students' perception on the impact of mathematics learning. From **Table 3**, totals of 93.1%, 84.8%, 91.7%, 79.9%, 76.6%, 69.9%, and 80.7%, strongly agreed or agreed, respectively on mathematics helps develop the mind and teaches a person to think; mathematics is a very worthwhile and necessary subject; mathematics

is important in everyday life; mathematics is one of the most important subjects for everyone to study; mathematics can be used in many ways outside school; mathematics helps solve problems in other disciplines; and a strong mathematics background could help in professional life. The mean responses to the items mentioned are supported by the radar chart as presented in **Figure 2**. Mean values are 1.47, 1.75, 1.51, 1.86, 1.96, 2.12, and 1.84, respectively. This indicates that students largely agreed that mathematics positively impacts one's life in so many ways.

Objective 3

Objective 3 is assessing teacher-trainees' attitude towards mathematics learning. From the **Table 4**, 63.0%, 54.5%, 57.0%, 58.9%, 60.8%, 62.2%, 63.9%, and 60.6% respectively disagreed on statements: "I



Figure 3. Students' attitude towards mathematics learning (Source: Field work in 2022)

do not have a mathematical mind"; "mathematics is one of my most dreaded subjects"; "I am unable to think clearly when working with mathematics"; "studying mathematics makes me feel nervous"; "mathematics makes me feel uncomfortable"; "I am always under a terrible strain in mathematics class"; "when I hear the word mathematics, I have a feeling of dislike"; and "I am always confused in mathematics class." Also, 41.9% and 45.9% of respondents, respectively, disagreed on the statements, "I want to develop my mathematical skills, but I fear mathematics" and "I feel a sense of insecurity when attempting to solve mathematics problems." The mean responses of items, as indicated in **Figure 3**, show a range from 2.9 to 3.6, indicating high disagreement on the items assessed.

Objective 4

Objective 4 is assess teacher-trainees' perceptions of mathematics teaching. Table 5 illustrates students' responses to the items based on their perceptions of the teaching of mathematics. With the exception of the 6th item (the tutor incorporates information and communication technologies [ICTs] into mathematics teaching), which had a score of 44.8% (less than 50%), all the remaining seven items had values ranging from 62.9% to 88.0%. Figure 4 also shows the mean responses to items. The items are tutor is knowledgeable in mathematics, tutor always gives exercises during class, tutor discusses the exercises or quizzes after marking, tutor uses varieties of techniques in delivering, tutor's methods of teaching mathematics cater for diverse needs, students are allowed to integrate technologies to solve mathematical problems, and tutor's method of teaching encourages an interactive mathematics classroom, received mean responses within the range of 1.64 to 2.38, indicating students' agreement on the variables tested. The variable "tutors incorporate ICTs into mathematics teaching" however, presents a mean response of 2.78, showing low agreement on teachers' incorporation of technologies in teaching mathematics.

DISCUSSION

This study examined the college of education students' perceptions of mathematics learning as a whole. All-inclusive, the study examined the students': self-sufficiency in learning mathematics, perceptions of the impact of mathematics learning; attitudes towards mathematics learning; and assessments of mathematics teaching.

The results of the assessments of the teacher-trainees' selfsufficiency in learning mathematics, showed respectively the mean scores of 2.0, 2.3, 2.4, 2.0, 2.4, and 2.4, on the items: even when I battle with mathematics I know I can solve the problem; I get a great deal of satisfaction out of solving mathematics problems; I have a lot of selfconfidence when it comes to mathematics learning; I expect to do fairly well in any mathematics class in which I participate; I am comfortable expressing my own ideas on how to look for solutions to difficult problems in mathematics; and I really like mathematics. The item, "it makes me nervous to even think about having to solve mathematics problems," showed a mean score of 2.9; this sign posted much disagreement with the statement. The results on the items showed most of the students exerted much autonomy in learning mathematics. On the other hand, the items: "I have less trouble learning mathematics than other subjects", "I am able to solve mathematics problems without much difficulty" and "I am comfortable answering questions in mathematics class" respectively recorded the mean values of 2.7, 2.8, and 2.5. In addition, this shows that the majority of the students disagreed with the statements, indicating low self-containment on the items. In relation to this study, the study of Aisyah et al. (2020) showed that students' self-confidence in learning and mathematics learning achievement were both in the fair range.

In terms of assessing the students' perceived impacts of mathematics learning, the results showed all responses on items: mathematics helps develop the mind and teaches a person to think; mathematics is very worthwhile and a necessary subject; mathematics is important in everyday life; mathematics is one of the most important subjects for everyone to study; mathematics can be used in many ways outside school; mathematics helps in solving problems in other disciplines; and a strong mathematics background could help in professional life, showed respectively low mean values of 1.5, 1.8, 1.5, 1.9, 2.0, 2.1, and 1.8. The results showed students' high agreement that learning mathematics really positively impacts one's life in varying ways. In contrast, Chaudhry et al. (2019) reported that students do not believe that mathematics is useful in their everyday lives. The results on assessing the teacher-trainees' attitudes towards mathematics learning showed high mean values of 2.9, 3.1, 3.6, 3.0, 3.4, 3.5, 3.5, 3.6, 3.6, and 3.6, respectively on the items: I want to develop my mathematical skills, but I fear mathematics; I feel a sense of insecurity when attempting to solve mathematics problems; I do not have a mathematical mind; mathematics is one of my most dreaded subjects; I am unable to think clearly when working with mathematics; studying mathematics makes me feel nervous; mathematics makes me feel uncomfortable; I am always under a terrible strain in mathematics class; when I hear the word mathematics I have a feeling of dislike; and, I am always confused in mathematics class.

The analysis of the responses explained that the majority of the students do not have as much nervousness towards mathematics learning as the items tested portrayed. Instead, the students showed they have confidence in learning the course. This finding is in line with the findings of Akhter and Akhter (2018) and Kanafiah and Jumadi (2013), which suggested that students find mathematics to be a fascinating subject and are enthusiastic about learning it. In a similar vein, the studies of Setapa et al. (2016) and Zulkarnain et al. (2011) affirmed that students' attitudes towards mathematics are positive. This study's result is however contradictory to the study results of Chaudhry et al. (2019) and Setapa et al. (2016), which showed that students exhibited a negative attitude towards learning.

Table 5. Students' perceptions on mathematics teaching

Itomo	SA		A			Ν		D		SD	
		%	n	%	n	%	n	%	n	%	
Tutor is knowledgeable in mathematics.	270	56.0	154	32.0	29	6.0	19	3.9	10	2.1	
Tutor always gives exercises during class.	173	35.9	174	36.1	75	15.6	34	7.1	26	5.4	
Tutor discusses the exercises or quizzes after marking.		32.8	155	32.2	101	21.0	39	8.1	29	6.0	
Tutor uses varieties of techniques in delivering.		53.1	145	30.1	40	8.3	25	5.2	16	3.3	
Tutor's methods of teaching mathematics caters for diverse needs.		39.0	172	35.7	60	12.4	38	7.9	24	5.0	
Tutor incorporates ICTs into mathematics teaching.		18.0	129	26.8	122	25.3	91	18.9	53	11.0	
Students are allowed to integrate technologies to solve mathematical problems.		27.4	171	35.5	85	17.6	50	10.4	44	9.1	
Tutor's method of teaching encourages interactive mathematics classroom.	212	44.0	150	31.1	61	12.7	30	6.2	29	6.0	



Figure 4. Mean responses on perception of mathematics teaching (Source: Field work in 2022)

The results of the trainees' perceptions on assessing the teaching of mathematics revealed the following items: the tutor is knowledgeable in mathematics; the tutor always gives exercises during class; the tutor discusses the exercises or quizzes after marking; the tutor uses a variety of techniques in delivering; the tutor's methods of teaching mathematics cater for diverse needs; students are allowed to integrate technologies to solve mathematical problems; and the tutor's method of teaching encourages an interactive mathematics classroom. The mean values are: 1.6, 2.1, 2.2, 1.8, 2.0, 2.4, and 2.0, respectively. This showed the students' high rate of assessment of mathematics teaching. The item: "tutor incorporates ICTs into mathematics teaching" obtained a high mean value of 2.8, indicating students' low assessment of tutors' incorporations of ICTs in teaching the course. The study by Ahmad and Aziz (2009), disclosed that students believe that their teachers' teaching methods have a direct and positive impact on their learning experiences. In relation to the integration of ICTs in teaching, Agyei and Voogt (2011) conveyed that as a result of teachers' low ICT competencies and access levels, the ICT integration has obtained low levels in their teaching activities.

CONCLUSIONS

This study investigated PSTs' perception of learning mathematics. self-sufficiency in learning mathematics, the effects of learning mathematics, attitudes toward learning mathematics, and evaluations of mathematics teaching were all examined. The results of this study demonstrated that most teacher trainees had developed strong resourcefulness sufficient for learning mathematics. The outcomes also demonstrated how strongly students supported the value of learning mathematics. Finally, the findings regarding the various approaches to teaching mathematics showed that all of the activities were supported by the students, with the exception of the factor involving the incorporation of ICTs by the tutors. The mean value of about 2.8 confirmed that the majority of students disagreed with the claim that "the tutors incorporate ICTs into the teaching of mathematics," hence, signifying mathematics tutors ICTs incorporation in teaching the course is low in the colleges.

Recommendations

This study suggests that mathematics tutors at the colleges try to use more ICTs when delivering lessons. This will give the students the chance to experiment and create their own models that can aid in their comprehension of mathematical ideas. Technology makes it simpler for students to share their research and take part in discussions about a range of subjects, according to Becta ICT Research (2003). Even without teacher supervision, technology helps students interact with one another. To improve mathematics teaching and learning, the management of the colleges of education should provide enough ICT resources and equipment, including network and internet accessibilities in the colleges.

Study Limitations

Despite the fact that the study's sample size was adequate to permit generalization of our findings, it is crucial to keep in mind that it was only carried out in one of Ghana's 10 regions. As a result, this outcome might not accurately reflect Ghana's overall situation. Future research may use samples from various geographical areas across nation. **Author contributions:** All authors were involved in concept, design, collection of data, interpretation, writing, and critically revising the article. All authors approve final version of the article.

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Ethics declaration: The authors declared that the research presented in this article has been conducted in accordance with the highest ethical standards and guidelines. All procedures involving human subjects have been conducted in compliance with the applicable laws and regulations. Participants were provided with clear and comprehensive information regarding the purpose, procedures, potential risks, and benefits of the study, and their voluntary participation was ensured. The confidentiality and anonymity of participants have been strictly maintained. Data collection and analysis were conducted with integrity and in a transparent manner. All data were collected in accordance with established research protocols, and steps were taken to ensure accuracy and reliability. The data were analysed objectively, and appropriate statistical methods were applied. The authors further declared that they have complied with the publication ethics guidelines of the journal. The article does not contain any fraudulent or unethical data manipulation, and all sources and references have been appropriately cited. Any errors or inaccuracies discovered after publication will be promptly communicated to the journal and corrected. The authors declared that there are no conflicts of interest that could have influenced the design, conduct, or reporting of this research. The work presented in this article is original, and proper credit has been given to all sources used.

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Data availability: Data generated or analyzed during this study are available from the authors on request.

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Pandemic pedagogy conceptualizations of university students during emergency remote education

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ABSTRACT

During the spike of the global health crisis, literature has conceived pandemic pedagogy in a broad sense of meaning based on pedagogical assumptions. Few studies explore the conceptualizations of students regarding pandemic pedagogy. Based on state university students' reflections and insights during emergency remote learning, this study examined pandemic pedagogy through the content analysis of 37 learning modules. The student teachers conceptualize pandemic pedagogy as encompassing six approaches to mitigate learning during emergency remote education in the context of the Philippines. Pandemic pedagogy of care, active learning pedagogy, game-based learning, and contextualized online pedagogy. Through a better understanding of how students choose to learn, teachers can improve online course plans to sustain students' engagement in emergency online or remote learning.

Keywords: COVID-19, pandemic pedagogy, reflections, ERT, online learning, approaches

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INTRODUCTION

As the world grappled with the pandemic, numerous educational institutions in different countries (Basilaia & Kvavadze, 2020 in Georgia; Khalil et al., 2020 in Saudi Arabia; Murphy et al., 2020 in the United States; Toquero, 2020a in Philippines; Zhu & Liu, 2020 in China, etc.) unleashed a metaphorical sense of overnight arrangements of transition to online and remote instruction. This sudden shift caused the impetus of academic experimentation to support the educational needs of their students during such critical periods (Bozkurt & Sharma, 2020; Crawford et al., 2020; Means et al., 2020; Toquero, 2020b; Zimmerman, 2020). Emergency remote education is the concept of learning through any means possible and is a temporary solution during a global health emergency (Bozkurt et al., 2020; Hodges et al., 2020).

Some studies have attempted to conceptualize emergency remote teaching pedagogy. For example, researchers focused on the conceptualizations of the students' relative to their metaphorical attitudes towards learning and instruction during emergency remote teaching using an elicited metaphorical analysis (Saglamel & Erbay Cetinkaya, 2022). Their findings show that the students have unfavorable dispositions towards ERT. Another study revealed from the survey among instructors that there is a need for pedagogical support and to redesign curriculum around existing technologies (Sheppard, 2021). There is a rising debate between online learning and emergency remote teaching. Barbour et al. (2020) acknowledged that "this labeling of the teaching methods used when students are not attending school as online learning is highly problematic" (p. 1). As a result, the current study is an attempt to investigate students' conceptualizations of pedagogical strategies in the context of emergency remote or online learning. The students' conceptualizations of pandemic pedagogy are "associated with the processes and behaviors students decide to activate in a specific context, which potentially leads to the achievement of learning goals" (Tarchi et al., 2022, p. 1).

However, during the experimentation of course learning, where students are forced to digitalize, they confronted the harsh realities of emergency remote teaching. Recent studies have discussed many challenges that hinder students' emergency distance learning during the COVID-19 pandemic (Ferri et al., 2020; Grewenig et al., 2020; Gustiani, 2020). The experimentation of course learning forced the students to digitalize, and technology use during the pandemic created anxiety, stress, and isolation among students that hindered them from having the opportunity to interact with their peers (Daniel, 2020; Gillett-Swan, 2017). Cybersecurity, cyberbullying, online violence, exploitation, and other psychological issues caused by anxieties and uncertainties associated with online learning during the COVID-19 pandemic are present when the odd shift to online learning happens (Daniel, 2020; Yan, 2020). Other psychological issues caused by anxieties and

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uncertainties associated with emergency online learning during the COVID-19 pandemic could persist beyond the pandemic.

Aside from the rapid changes of the full implementation of K-12 in 2016, students in the Philippines specifically experience the mayhem of the experimental online curriculum. Employing a pedagogy that has no lens on how students perceive relevance may add to the students' burden considering their complex circumstance during home learning in the context of the pandemic. Capturing students' cognition during this period, on the other hand, could pave the way for improving the instructional design of online courses and developing sustainable teaching frameworks (Saglamel & Erbay Cetinkaya, 2022). Such understanding could lead to sustain engagement of students in the online environments. Hence, this article explored the conceptualizations of the students regarding pandemic pedagogy.

METHODS AND DESIGN

Research Design

This study applied a qualitative content analysis to scrutinize the conceptualizations of the students regarding pandemic pedagogy. Every analysis needs a context in which to investigate the texts that are available (Vaismoradi et al., 2013). This design is appropriate for this study since it deals with exploring the students' perceptions, opinions, conceptualizations, and experiences during their emergency online learning or emergency remote teaching. The aim of content analysis is to conceptually explain the phenomenon (Elo & Kyngäs, 2008). Data can be understood through the use of texts, images, and expressions rather than representations of physical events (Krippendorff, 2004). Anchored from students' insights and experiences during pandemic, content analysis is supplemented with document review to make sense of the written reflections in the learning modules.

Context and Unit of Analysis

University students served as unit of analysis in the study. They were freshmen students taking up bachelor of elementary education major in general education at a state university in the Philippines. They were chosen as participants in the study since they had not encountered face-to-face education in university settings prior to the pandemic. Hence, they can provide in-depth perspectives relative to how they have experienced dealing with classes done online through synchronous and asynchronous means and how they deal with their online classmates and teachers whom they have never met face-to-face. The students signed an ethical consent form according to their voluntary participation in this study. For the first semester of the academic year 2020-2021, there were 137 students enrolled in child and adolescent learners and learning principles (CPE 100). To choose the unit of observation for this study, inclusion and exclusion criteria were set based on the learning modules. Part of the inclusion criteria was to include those students whose answers in the modules were complete statements with clear details. Students' modules were excluded when they gave incomplete details or when their answers were incomplete. On the first screening, 40 students were included. After careful examination on the second screening, only 37 students were able to attain the inclusion criteria. Hence, there were 37 modules that were included for the data analysis. The students' names remain anonymous, and codenames are used for this study, such as S1, S2, S3, etc. The students who were part of this study were chosen regardless of their academic performance, class standing, or cultural or social affiliations. All of the students were given equal chances of selection based on inclusion and exclusion criteria.

Analysis Strategy

This study applied a qualitative lens to analyze the conceptualizations of the students regarding pandemic pedagogy. Content analysis and document review were applied to make sense of the written reflections in the learning modules. Student teachers under bachelor of elementary education at a state university in the Philippines served as units of observation. CPE 100 softcopy modules were used for this research. Based on the information from selection and screening, 37 modules attained the inclusion criteria needed for this study.

RESULTS

This study delved into the students' perceptions, experiences, and learning beliefs relative to pandemic pedagogy during their exodus to home education and post-pandemic. The conceptualizations of the students about pandemic pedagogy show five dominant pedagogical approaches (**Figure 1**). They regard these pandemic pedagogical approaches as critical for completing the learning experiences of their academic journey.

Modify Curriculum for Personalized Learning Considering Individual Differences

The students reinforced the concept of personalized learning to emphasize the teachers' consideration of the individual differences of their students. Students need the teachers to "focus on what the student can do rather than what he or she cannot do and build on his or her strengths" (S1). They argue for a "highly personalized education that aims for the individual goals of each student" (S25), "focusing on what the students are capable of and their interests" (S7). Consequently, teachers need to "allow multiple interpretations and expressions of learning (multiple intelligences)," allowing them to "present their learning in a creative way" (S31), so that they can help students "understand new concepts or ideas" (S10). This personalized learning is possible when teachers record relevant information about their students to discover their strengths and weaknesses. During this pandemic, students' personal situations should be looked into since "student lives really matter." "So, it is very important to know our students" (S7), including their learning situations in their respective homes. Such profiling can also allow the teachers to provide tasks according to their students' level of capacity for learning through emergency remote education.

Demonstrate Human Centered Pedagogy and Pedagogy of Care

Due to an unstructured curriculum and the sudden shift to emergency online learning or remote learning environments, Filipino students experience the mayhem of an experimental curriculum. Consequently, Filipino students may experience the bombardment of numerous modules and online requirements amidst the complexities of having to study at home. Hence, students call for the teachers to "give more patience and understanding to the students" (S30). The students also want their teachers to "know and understand [their] students' situation in their current mode of learning by acknowledging their concerns" (S23) and "understand situations to avoid making it complicated as much as possible" (S6). Student 26 pointed out that


Figure 1. Conceptualizations of university students regarding pandemic pedagogy (Source: Authors)

teachers should "provide a feeling of comfort and safety, or what we call a security blanket, from family, peers, and other people that might be of great help in one's academic journey, especially that there is an ongoing global health crisis." Likewise, teachers should be "open for consideration in every situation that might hinder students from complying with the academic requirements because of some sort of problem, such as internet and signal issues, distractions at home, computer literacy, or struggling to cope with online-based learning" (S24). Student 13 also calls for teachers to give the students choices and options related to their learning so that they can better cope with the overwhelming activities given to them because of the unceasing distribution of modules.

Reinforce Active Learning Pedagogy During Synchronous and Asynchronous Classes

Creating interaction and sparking engagement are two of the prevailing challenges for teachers in online environments (Dembereldorj, 2021; Wut & Xu, 2021). The students continue to clamor for the teachers to activate student engagement in the classes done online. The students emphasized that the teachers need to "engage students to actively participate in all activities in the online classes; give credit for their efforts" (S33). "Students learn best by doing, and active teaching encourages active learning." "In this new normal, teachers and parents should treat each student as an active participant in the learning process, providing them with skills such as how to study, how to memorize, and how to express themselves effectively" (S27). Integrating active learning pedagogy involves the process of involving pupils in activities that require them to gather knowledge, think, and solve problems while maintaining their mental and frequently physical activity in their learning (Michael, 2006). Students who actively participate in their learning have better chances of retaining what they learn, indicating effective learning during the pandemic.

Integrate Game-Based Pedagogy to Activate Motivation Among Students

During homeschool education of the students, they may experience many challenges related to technical, psychological, familial, and social aspects. Consequently, students may experience boredom and a lack of interest in learning. In that case, the students conceptualized that the pandemic pedagogy needs to incorporate a game-based perspective to activate the students' motivation to learn. Student 16 asserted that motivational games motivate students to learn more about new things. "The tool to be used is social media." Another technique to motivate the students to learn is to "create cognitive dissonance by assigning students to do 30 days of exercise plan, play chess, and other board games online" (S28). "Using strategies like organizing games and team activities will help them remember how it all went." And "activity itself is a demonstration to help them understand how things work or what they are made of" (S9). Integrating game-based pedagogy in emergency remote teaching can motivate students to complete their off-line class requirements and engage with their peers during synchronous classes.

Apply Contextualized Online Learning Strategies in Meeting Students' Educational Needs

The students in this study emphasized the importance of having virtual conferences with their teachers for consistent learning guidance. "Because of the pandemic, face-to-face learning is not possible, but a Google meet from time to time will [help us] learn" (S11). Regular virtual meetings or online class sessions between the teachers and students are vital to assess and regulate the students' learning, as student 17 pointed out. Because the teachers utilize various software or online platforms in the college of education (such as Facebook, Google Classroom, Google Meet, Messenger, Moodle, Telegram, Zoom, etc.), Student 26 argued for a single platform for the students to use:

"One software platform for all the subjects in learning materials, in terms of the distribution of learning materials and taking summative and final examinations, to avoid missed materials or tests because sometimes it may cause confusion due to different platforms used by the instructors."

Moreover, the students clamored for online social interactions. They want their teachers to acknowledge them during "synchronous and asynchronous sessions and have open conversations" (S18). Teachers should also "build exercises that help students illustrate their own point of view and gain knowledge from one another" (S5). The students conceptualized that incorporating pandemic pedagogy means that "a teacher may employ appropriate strategies and techniques that are possible to engage students with the material and how to push them to grow academically" (S37), despite the educational challenges that they encounter during the pandemic. The students in this study are prone to stress and anxiety because of the numerous modules and inherent problems of learning at home, so they stressed having interactions during their synchronous learning sessions. With reference to online conversations among teachers and students, one student stated that teachers should allow them to "produce activities that encourage students to peer up and co-create reviews." Have students swap drafts of their own essays and then come up with questions and comments for each other. "Educators may provide adequate digital lessons and activities and may conduct online meetings enabling the student to actively participate and raise their concerns" (S29).

Conceptualize Authentic Learning Experiences in a Flexible Online Curriculum

The students want a pandemic pedagogy that enhances their "learning experiences through pedagogical innovations" (S8) without neglecting their need for authentic learning experiences. They pointed out that teachers should "encourage the students to share their individual experiences and help them correlate such experiences for their coursework" (S21). Even when they are learning at home, they yearn for meaningful learning. Student 27 mentioned that "students want and need to learn even if they are at their own house, as they need food, clothing, shelter, and to be healthy and safe." As long as they have a connection or gadget, they will reach out for the module distribution. "An educator's primary job is to fill that primary need for learning by creating engaging and relevant learning experiences every day." The yearning for authentic learning means providing the students with the opportunity to show what they have learned through "video presentations, poetry, and reflexive papers" (S28), "scenarios or samples, where students address social reforms" (S23), or by allowing them to "formulate their own questions (inquiries)" (S31). As student 11 remarked, "I can obtain information, knowledge, and more skill by connecting every lesson to my real life." These will help more people understand confusing lessons. Thus, a pandemic pedagogy should incorporate the value of authentic learning experiences for students post-pandemic.

Further, the students also conceptualized a pandemic pedagogy that actualizes the learning of the students through evaluation, feedback, and assessment strategies. Students 13 and 25, for example, call for evaluation of the students through products, assessments, and projects. Student 26 also asserted that teachers should "monitor and track students' achievement or failures and performance, [and] give feedback and not judgments." The students want their teachers to measure and

evaluate their prior knowledge through online discussions, quizzes, or pretests (S31) using "accurate rubrics and guidelines" (S13). Undoubtedly, the students conceptualize a pandemic pedagogy in which the teachers can also organize, implement, and evaluate student learning so that they can "inspire the students to push themselves to the next level even after we've experienced this new normal" (S27). A pandemic pedagogy should incorporate the value of authentic learning experiences.

DISCUSSION

Emergency remote education is the idea that whatever means are possible for learning to occur, this is a temporary solution during the global health emergency (Bozkurt et al., 2020; Hodges et al., 2020). As students learn through emergency remote education, teachers may provide unstructured materials and lessons. The students reinforced the concept of personalized learning to emphasize the teachers' consideration of the individual differences of their students. Students argue for a highly personalized education that aims to meet the individual goals, capabilities, and interests of each student. They reinforced the concept of personalized learning for teachers to uphold the principle of individual differences. They conceptualize that pandemic pedagogy looks at the students' interests and skills in learning while providing tasks according to their capacity. This personalized learning is possible when teachers record relevant information about their students to discover their strengths and weaknesses. The students' personal situations, including their learning situations at home, are important for profiling. Through emergency remote education, profiling can allow the teachers to provide tasks according to their students' level of capacity for learning. Allowing multiple interpretations and expressions of learning can help students create their own pathways for learning (Zhao & Watterston, 2021) within a flexible curriculum.

Filipino students experience the bombardment of numerous modules and online requirements amidst the complexities of studying at home. Students encounter many challenges learning at home, and the unceasing distribution of modules might be a contributing factor. When teachers show them understanding and care, they are more resilient in the face of adversity at home. During this pandemic, the empathy and care of the teachers can help students deal better with the situation and cope with their online-based learning. Giving students the power of choices and options could help them cope with the overwhelming activities assigned to them. It is crucial for teachers to regularly encourage students to flexibly exchange viewpoints in their classes (Wut & Xu, 2021). Students emphasized that the teachers needed to engage students to actively participate in all activities in the online classes and give credit for their efforts. Students who actively participate in their learning have better chances of retaining what they learn, although this is a longstanding challenge among online educators (Wu & Teets, 2021). Treating each student as an active participant in the learning process can make the learning process more meaningful for their experience in this new normal. Students learn by doing, and active teaching encourages active learning.

On the other hand, students experience boredom and a lack of interest in learning. They asserted the use of motivational games during learning. Another technique to motivate the students to learn is to create cognitive dissonance by assigning students to engage in mental exercise plans, play chess, and other online board games. Gamification is a creative, entertaining, and effective method of delivering curriculum materials (Nieto-Escamez & Roldán-Tapia, 2021). Pandemic pedagogy for students means incorporating a game-based perspective to activate their motivation to learn. Integrating gamebased pedagogy in emergency remote teaching may motivate the students (Toquero et al., 2021) to do their offline class requirements and engage with their peers during their synchronous classes.

Moreover, the findings emphasized the value of social interaction and engagement between the teachers and students during emergency remote classes. This interaction can help the students deal with the isolation and quarantine to rid them of worries, stress, and anxieties (Wut & Xu, 2021). Such interaction and engagement might also pave the way for better learning through online modality. Likewise, a pandemic pedagogy enhances students' learning experiences through pedagogical innovations while not neglecting their need for authentic learning experiences at home. Hence, students conceptualized a pandemic pedagogy that actualizes learning through evaluation, feedback, and assessment strategies.

Incorporating pandemic pedagogy also means employing appropriate strategies and techniques that allow teachers to engage students with the material despite the educational challenges due to the pandemic. Disruptions present opportunities, and it is up to teachers to take advantage of them to develop challenging, fair, and compassionate learning opportunities that students will welcome (Schwartzman, 2020).

CONCLUSIONS

This article highlights the students' conceptualizations of pandemic pedagogy based on their context. The six approaches students conceptualize for pandemic pedagogy are personalized learning, human-centered pedagogy, pedagogy of care, active learning pedagogy, game-based learning, and contextualized online pedagogy. Educators could maximize these approaches to enhance pedagogical environments and learning experiences for their students. Because of the study's qualitative aspect, which lacks generalization and scientific sampling, this research does not claim to produce immense findings. The study was limited to 37 participants, and the researchers only applied a document review and qualitative content analysis to the students' conceptualizations and descriptions. A focus group discussion and online interview may yield optimal results as students are free to verbally relate their conceptualizations and experiences. Nonetheless, this article offers social and academic implications to improve the students' experience during their emergency remote academic journey. Teachers could cultivate social exchanges and prioritize student participation in different online forums, where students are free to share their viewpoints and thoughts about societal issues, cultural trends, and educational experiences. Strengthening feedback mechanism that is personalized based on student's needs and context will give them better chances of success in their scholarly endeavors. Through a better understanding and conceptualization of pandemic pedagogy and how students choose to learn in a crisis, teachers improve their academic deliverables to maximize students' motivation and engagement in emergency online or remote learning.

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Ethics declaration: The authors declared that an institutional ethics committee approval was not required for the study. The study did not incur psychological or physical harm to adult students. The study was performed in classroom situations with no human testing or laboratory testing. Participation was entirely voluntary. The authors further declared that they have upheld the basic institutional practice which is to follow procedures of offices for the approval to conduct, obtained signed consent forms from persons involved in the study, and secured research rights and anonymity of the participants.

Declaration of interest: The authors declare no competing interest.

Data availability: Data generated or analyzed during this study are available from the authors on request.

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Research Article

Gender difference in undergraduates' micro-teaching performance using Telegram and WhatsApp platforms in collaborative learning settings

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ABSTRACT

Gender difference has continued to influence achievement and retention of students due to inconsistencies in performance, which troubles researchers. This therefore calls for different approaches to ameliorate this problem by deploying the use of Telegram and WhatsApp in collaborative learning settings in order to bride those gender gaps since technology serves as a leveler. This study examined gender difference on achievement and retention of students in microteaching using Telegram and WhatsApp platforms in collaborative learning settings. A sample of 282 students enrolled on Telegram and WhatsApp from two universities in Gombe State, Nigeria, was purposively selected for the study, where the two sampled groups were assigned into two experimental groups. The instrument used in this study is the micro-teaching achievement test validated by experts in the field of educational technology and curriculum studies, where a split-half method of reliability was used to obtain a figure of 0.91 using Pearson product moment correlation. Descriptive statistics of mean and standard deviation was used to answer the research questions while inferential statistics involving an independent sample t-test was used to test the null hypotheses at 0.05 level of significance. Findings revealed that there is no significant difference in the mean achievement scores of male and female students taught using Telegram platform (t=2.571, p>0.05); there is no significant difference in the mean achievement scores of male and female students taught using WhatsApp platform (t=3.671, p>0.05); there is no significant difference in the mean retention scores of male and female students taught using Telegram platform (t=5.274, p>0.05). However, there is a significant difference in the mean retention scores of male and female students taught using WhatsApp platform in favor of the female students (t=4.071,p<0.05). It is hereby recommended that lecturers should deploy the use of Telegram and WhatsApp platforms in collaborative learning settings during micro-teaching in order to bridge the individual differences occasioned by gender since technology has the potential to serve as a leveler and also be able to bridge gender differences.

Keywords: achievement, collaborative learning, gender, micro-teaching, retention, social media, Telegram, WhatsApp

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INTRODUCTION

Micro-teaching is a minor, replicated and controlled form of teaching aimed at perfecting the skills of student-teachers who are trained in the teacher-education program. Students, in this case, are closely scrutinized and observed by their tutors who, in most cases, video them for some few minutes and they are being shown their lapses in order to make amendments in areas of weakness. Micro-teaching is an important aspect of teacher-education program because quality teachers are very vital when it comes to the implementation of any curriculum into practice (Ajileye, 2013). One of the major aims of Micro-teaching or training program as noted by Garba (2018) is to change teachers' conduct according to the specific objectives. It is a process of subjecting human behavior to 5Rs of video tape recording, reviewing, responding, refining and re-joining. It is a well-ordered training that makes it possible to concentrate on teaching behavior in the student-teacher training. Though the Nigerian policy on education recognizes the incorporation of technology at all levels, most lecturers do not often deploy the use of technology to cover for large classroom sizes, lack of micro-teaching laboratory and to accommodate individual differences occasioned by gender. One of the ways of ameliorating this problem is the incorporation of technology in teaching and learning.

Technology has brought about substantial improvement in several sectors of human endeavors and due to this developmental trend, so

many unparalleled changes in education institutions have been persistently uncovered to reinforce teaching and learning (Khoo et al., 2020). In light of this development, different methods of teaching and learning have emerged, which are making invaluable progress in the education sector worldwide. Technology is being positioned to make learning interesting, flexible, learner-centered, simple and interactive. Thus, in order to simplify learning and make it student-centered in the realms of 21st century pedagogy, it becomes important to incorporate technology into teaching and learning (Falode & Mohammed, 2023; Mohammed & Ogar, 2023). Given the flexibilities brought about by technological progression, educators now appropriately design virtual learning environments, and the problem of distance and time has been eliminated (Exposito et al., 2020). Foster et al. (2022) posited that the integration of technology could be a promising approach to arouse regular and active instructional process while meeting students' need of making learning flexible in terms of time and place. Technology can be used to microteaching through the incorporation of Telegram and WhatsApp.

Telegram is one of the most common user friendly social media platforms that allows users to create groups of up to 200,000 members and channels for transmission to infinite audiences. Telegram has the capacity of sending files of up to two gigabyte in size. Telegram has become one of the major tools for education especially in the aspect of social media learning. The rapid development and enormous advancement in computer technologies have been affecting all aspects of life for more than three decades. Moreover, studies found a positive association between the use of internet and social media and academic performance of the students. Students using internet frequently, scored higher grades (Hakim, 2019; Mohammed & Kuta, 2021). Integrating Telegram channels into existing learning practices can provide an interactive, flexible learning, where students can learn new things and perfect some skills especially in micro-teaching. Denysiuk et al. (2018) labelled instruction on Telegram to be a learner-centered method, where learners have unlimited access to information. By learning on Telegram, the interactions with peers and teachers can be maximized and this promotes better learning compared to a traditional classroom situation. Another platform used in making learning flexible and to accommodate large classroom sizes is the WhatsApp platform.

WhatsApp is a free application, which works on various platforms like iPhone and android systems, and it is largely used to send multimedia contents like photos, videos, audio, and other instant messages in the form of text. WhatsApp can therefore be used for teaching and learning through the creation of online groups aimed at fostering communication with students, creating dialogue and encourage students to exchange ideas and information among themselves (Sonia & Rawekar, 2017). Cetinkaya (2017) observed that WhatsApp is now an effective way of increasing the success of teaching and learning because it makes students to develop a positive attitude towards their various courses. Given its abilities to accommodate groups and communities, WhatsApp can be effectively used for instructional purposes, which can facilitate interaction between tutors and colleagues. The active interaction and engagement of students on Telegram and WhatsApp also has the potential to foster collaborative learning.

Collaborative learning is defined by Dilenbourg (1999) as a situation in which two or more people learn or attempt to learn something together. This can occur in the form of groups or as

individuals. When students work together in a structural, collaborative group, they tend to discuss and gain valuable experience in cognitive development as compared to those students who work alone. Assigning students in groups has become a key factor to enhance social and teamwork skills. Thus, strong teamwork skill can be developed and incorporated during collaborative learning (Khoo et al., 2020). Julius (2018) identified some principles of collaborative learning to include: the learner is the central focus of any instruction; interaction and participation are of primary importance when it comes to collaboration; working in groups is an important mode of learning; structured approaches to developing solutions to real-world problems should be incorporated in learning. Srinivas (2014) revealed that collaborative learning is based on the idea that learning is a naturally social act in which the participants talk among themselves. It therefore means that learners need a social environment, where they will interact, communicate, share and construct knowledge with peers for effective learning to take place. Under the collaborative learning environment, students are challenged to participate because they listen to different perspectives and are required to articulate and defend their ideas. Collaborative learning, which is embedded from primary schools to tertiary institutions is among the most explored learning method in the 21st century (Mahbib et al., 2017). In spite of the excellent collaborative features provided by Telegram and WhatsApp to enhance learning, gender difference still continues to influence the performance of students.

Gender is a characteristic that separates male and female in the classroom. These characteristics distinguish social duties, everyday tasks, attitude and values between males and females (Gambari et al., 2017). Investigation shows that men are more likely to use social media to link with people while women use it to seek information (Haferkamp et al., 2012). Haq and Chand (2012) studied social media practice and its impact on performance of university students based on a gender comparison and the study discovered that social media use badly affect the performance of male students compared to female students. Many studies have shown that gender is a huge factor that influences academic achievement and retention of students during social media learning even though some of these studies are not consistent in terms of general conclusion and are mostly not carried out in collaborative learning settings. For example, Ofoka (2019) found no significant difference in the achievement and retention of male and female students exposed to instruction using WhatsApp, Facebook and Blog. Studies by Naderi and Akrami (2018) found no significant gender difference in achievement of students exposed to instruction on Telegram. Jimoh et al. (2018); Kareem et al. (2018) and Dambo and Kayii (2018) found no significant difference in the achievement of male and female students exposed to mobile blended learning. Ilobeneke et al. (2018a); Bawa and Ibrahim (2016) and Omar (2021) reported no significant gender difference in achievement when exposed to WhatsApp. Bataineh et al. (2018) discovered a significant difference in favor of female when WhatsApp was used to teach English in Iran while Safitri (2021) discovered a significant difference in favor of male students when exposed to WhatsApp. On the other hand, Owodunmi and Ogundola (2013) discovered a significant gender difference in the retention of students in favor of female. Studies by Achor et al. (2013) and Gambari et al. (2014) revealed no significant difference in the retention of male and female students. Studies by Ajai and Imoke (2015) and Eze et al. (2016) discovered no significant difference in students' retention scores. Ceylan and Elitok Kesici (2017) also discovered a significant difference

Table 1. Research design layout

Groups	Pre-test	Treatment	Post-test	Retention
Experimental group I	Pre-test for experimental group I	Telegram learning platform	Post-test for experimental group I	O ₃
Experimental group II	Pre-test for experimental group II	WhatsApp learning platform	Post-test for experimental group II	O ₃

Note. O3: Retention for experimental group I & II

in achievement and retention of male and female students exposed to blended learning while Bupo (2019) discovered no significant difference in achievement and retention of male and female students exposed to blended learning. In view of the foregoing, more studies are therefore required to fill these gaps due to the inconsistencies found in the results.

In the light of these inconsistencies noticed in the aforementioned studies reviewed, studies on the effect of gender have continued to yield no general conclusions with each gender outperforming the other in achievement and retention. These gaps have proven to be a huge source of concern to most education stakeholders. It therefore becomes important to try different approaches to ameliorate the difference. To ameliorate this problem, technology has come up with different approaches like leveraging on the collaborative features provided by Telegram and WhatsApp platforms to fill various research gaps and challenges encountered during teacher-education programs especially in microteaching, but most lecturers do not incorporate technology in the course of teaching microteaching in order to cater for individual differences occasioned by gender. This has continued to affect the performance of students for years. This study is therefore an attempt to see whether the collaborative features provided by Telegram and WhatsApp platforms can be used to cater for individual difference occasioned by gender since social media is considered to be a leveler in today's realities.

Purpose of the Study

The purpose of the study is to examine the gender difference on academic achievement and retention of undergraduates exposed to microteaching using Telegram and WhatsApp platforms in collaborative learning settings. Specifically, the study seeks to:

- Examine the influence of gender on the achievement of undergraduate students taught micro-teaching using Telegram-enhanced instruction in collaborative learning settings.
- Find out the influence of gender on the achievement of undergraduate students taught micro-teaching using WhatsApp-enhanced instruction in collaborative learning settings.
- Examine the influence of gender on the retention of undergraduate students taught micro-teaching using Telegram-enhanced instruction in collaborative learning settings.
- Find out the influence of gender on the retention of undergraduate students taught micro-teaching using WhatsApp-enhanced instruction in collaborative learning settings.

Research Questions

The following research questions were answered in this study.

1. What is the difference in the mean achievement scores of male and female undergraduate students taught micro-teaching

using Telegram-enhanced instruction in collaborative learning settings?

- 2. What is the difference in the mean achievement scores of male and female undergraduate students taught micro-teaching using WhatsApp-enhanced instruction in collaborative learning settings?
- 3. What is the difference in the mean retention scores of male and female undergraduate students taught micro-teaching using Telegram-enhanced instruction in collaborative learning settings?
- 4. What is the difference in the mean retention scores of male and female undergraduate students taught micro-teaching using WhatsApp-enhanced instruction in collaborative learning settings?

Research Hypotheses

- HO₁. There is no significant difference in the mean achievement scores of male and female undergraduate students taught micro-teaching using Telegram-enhanced instruction in collaborative learning settings.
- HO₂. There is no significant difference in the mean achievement scores of male and female undergraduate students taught micro-teaching using WhatsApp-enhanced instruction in collaborative learning settings.
- HO₃. There is no significant difference in the mean retention scores of male and female undergraduate students taught micro-teaching using Telegram-enhanced instruction in collaborative learning settings.
- 4. **HO4.** There is no significant difference in the mean retention scores of male and female undergraduate students taught micro-teaching using WhatsApp-enhanced instruction in collaborative learning settings.

METHODOLOGY

Research Design

The study adopted a quasi-experimental study involving pre-/posttest control group design (**Table 1**). This design does not give room for randomization, therefore intact classes were used.

Participants

A sample of 282 faculty of education students enrolled on Telegram and WhatsApp platforms from Federal University Kashere and Gombe State University, Nigeria, respectively was selected using a purposive sampling technique to be used for the study. The schools were purposively sampled because they were the only two universities in Gombe State offering micro-teaching as a course. Faculty of education was selected because micro-teaching is taught as a course in the faculty. The two sampled groups were assigned into experimental group I and experimental group II using a simple random sampling technique.

Table 2. Mean & standard deviation of pre-	& post-test scores of	male & fema	le students exposed to	Telegram	learning platform
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Group		P	re-test	l	Moon difforence	
	п -	Mean	Standard deviation	Mean	Standard deviation	Mean unierence
Male	61	36.87	3.48	73.89	8.11	37.02
Female	56	34.56	4.61	71.29	9.44	36.73

Table 3. Mean & standard deviation of pre- & post-test scores of male & female students exposed to WhatsApp learning platform

Group	-	I	Pre-test]	Maan difference	
	п –	Mean	Standard deviation	Mean	Standard deviation	Mean difference
Male	86	28.49	5.02	67.08	10.65	38.59
Female	79	30.39	3.95	70.76	8.04	40.37

Instrument

The research instrument used in this study is the micro-teaching achievement test (MTAT), which comprised of 30-item multiple choice questions designed based on Bloom's taxonomy table of specifications that cuts across the cognitive domain of educational objectives. The table of specification was used as a guide in order to show the spread of the questions across all the objectives. The achievement test had two sections: A and B. Section A solicited information about the students' personal data, while section B comprised of 30 objective questions drawn from the departmental handbook with options A-D, containing one correct answer and three distracters. The multiple-choice questions were administered as a pre-test, post-test, and retention test to experimental group I and experimental group II. MTAT was validated by experts in the field of educational technology and curriculum studies whereby split-half method of reliability was used to obtain a value of 0.91 using Pearson product moment correlation.

Data Collection and Analysis

The students were added into Telegram and WhatsApp virtual platforms for active engagement during the first week of the experiment. A pre-test was administered in order to determine the entry level of the students in the second week. The online interaction took place in the third, fourth and fifth weeks whereby various microteaching contents in the form of online texts and instant messages were dropped by the researcher at least twice a week. In order to create an online collaborative learning environment, the students were grouped into various sub-groups based on their teaching subjects, where they worked together in groups. The researcher also dropped assignments that required the students to work in groups and to discuss online in order to provide solutions. By the sixth week, a post test was administered. Another test was administered after two weeks in order to determine the level of retention. The data collected were analyzed using descriptive statistics involving mean and standard deviation while inferential statistics involving an independent sample t-test was used to test the null hypothesis using SPSS package version.

RESULTS

Research Questions Analysis

Research question 1. What is the difference in the mean achievement scores of male and female undergraduate students taught micro-teaching using Telegram-enhanced instruction in collaborative learning settings?

Table 2 shows the pre- and post-test scores of male and female students in experimental group I (Telegram). From **Table 2**, male students had a mean score of 36.87 and a standard deviation of 3.48 in the pre-test; and a mean of 73.89 and a standard deviation of 8.11 in the

post-test. The mean difference between the pre- and post-test scores of male students in experimental group I was 37.02. Also, from **Table 2**, female students had a mean of 34.56 and a standard deviation of 4.61 in the pre-test; and a mean of 71.29 and a standard deviation of 9.44 in the post-test. The mean difference in the pre- and post-test scores of female students in the experimental group I was 36.73. It can therefore be concluded that the male students had a slightly higher achievement than their female counterpart.

Research question 2. What is the difference in the mean achievement scores of male and female undergraduate students taught micro-teaching using WhatsApp-enhanced instruction in collaborative learning settings?

Table 3 shows the pre- and post-test scores of male and female students in experimental group II (WhatsApp). From **Table 3**, male students had a mean score of 28.49 and a standard deviation of 5.02 in the pre-test and a mean of 67.08 and a standard deviation of 10.65 in the post-test. The mean difference between the pre- and post-test scores of male students in experimental group II was 38.59. Also, from **Table 3**, female students had a mean of 30.39 and a standard deviation of 3.95 in the pre-test and a mean of 70.76 and a standard deviation of 8.04 in the post-test. The mean difference in the pre- and post-test scores of female students in the experimental group II was 40.37. It can therefore be concluded that the female students had a slightly higher achievement than their male counterpart.

Research question 3. What is the difference in the mean retention scores of male and female undergraduate students taught micro-teaching using Telegram-enhanced instruction in collaborative learning settings?

Table 4 shows the post-test and retention scores of male and female students in experimental group I (Telegram). From **Table 4**, male students had a mean score of 73.89 and a standard deviation of 8.11 in the post-test and a mean of 72.34 and a standard deviation of 2.94 in the retention test. The mean difference in the post-test and retention scores of male students in experimental group I was 1.55. Also, from **Table 4**, female students had a mean of 71.29 and a standard deviation of 9.44 in the post-test and a mean of 70.76 and a standard deviation of 5.88 in the retention test. The mean difference in the post-test and retention scores of female students in the experimental group I was 0.62. It can therefore be concluded that the male students had a slightly higher retention.

Research question 4. What is the difference in the mean retention scores of male and female undergraduate students taught micro-teaching using WhatsApp-enhanced instruction in collaborative learning settings?

Table 5 shows the post-test and retention scores of male and female students in experimental group II (WhatsApp). From **Table 5**, male students had a mean score of 67.08 and a standard deviation of 10.65 in the post-test and a mean of 65.75 and a standard deviation of 10.08 in

Fable 4. Mean & standard deviation of	post-test & retention scores o	f male & female stu	dents exposed to [[] Telegram	learning platform
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Group	-	Р	re-test]	Moon difforence	
	ш -	Mean	Standard deviation	Mean	Standard deviation	Mean unierence
Male	61	73.89	8.11	72.34	2.94	1.55
Female	56	71.29	9.44	70.67	5.88	0.62

Table 5. Mean & standard deviation of post-test & retention scores of male & female students exposed to WhatsApp learning platform

Group	-]	Pre-test]	Maan difforman aa	
	п —	Mean	Standard deviation	Mean	Standard deviation	Mean difference
Male	86	67.08	10.65	65.75	10.08	1.33
Female	79	70.76	8.04	68.84	8.79	1.92

Table 6. Independent sample t-test result of mean achievement scores of male & female students taught micro-teaching using Telegram

Group	n	Mean	Standard deviation	df	t-value	p-value	Decision
Male	61	73.89	8.11	115	2.571	207	A 1
Female	56	71.29	9 44	115	2.5/1	.297	Accepted

Note. Not significant at 0.05 (p>0.05)

Table 7. Independent sample t-test result of mean achievement scores of male & female students taught micro-teaching using WhatsApp

Group	n	Mean	Standard deviation	df	t-value	p-value	Decision
Male	86	67.08	10.65	1(2	2 (71	105	A
Female	79	70.76	8.04	163 3.671 .		.195	Accepted

Note. Not significant at 0.05 (p>0.05)

the retention test. The mean difference in the post-test and retention scores of male students in experimental group II was 1.33.

Also, from **Table 5**, female students had a mean of 70.76 and a standard deviation of 8.04 in the post-test and a mean of 68.84 and a standard deviation of 8.79 in the retention test. The mean difference in the post-test and retention scores of female students in the experimental group II was 1.92. It can therefore be concluded that the female students had a slightly higher retention.

Testing of Hypotheses

HO₁. There is no significant difference in the mean achievement scores of male and female undergraduate students taught micro-teaching using Telegram-enhanced instruction in collaborative learning settings.

In order to test hypothesis three, independent sample t-test was used to analyze the scores of the two groups as presented in **Table 6**.

Table 6 shows the independent sample t-test of the mean achievement of male and female students exposed to Telegram platform. From **Table 6**, it can be observed that the male students had a mean of 73.89 and standard deviation of 8.11. Female students had a mean of 71.29 and a standard deviation of 9.44. Also, t=2.571, df=115 and p-value=.297. Therefore, since p>0.05, the null hypothesis is hereby accepted. This means that there is no significant difference in the mean achievement scores of male and female students taught using Telegram platform.

HO₂. There is no significant difference in the mean achievement scores of male and female undergraduate students taught micro-teaching using WhatsApp-enhanced instruction in collaborative learning settings.

In order to test hypothesis four, independent sample t-test was used to analyze the scores of the two groups as presented on **Table** 7.

Table 7 shows the independent sample t-test result of the mean achievement scores of male and female students taught micro-teaching using WhatsApp learning platform. From **Table** 7, male students had a mean of 67.08 and a standard deviation of 170.65 while the female students had a mean of 70.76 and a standard deviation of 8.04. Also, it

can be observed that t=3.671, df=163 and p-value=.195. Since p>0.05, therefore the null hypothesis is hereby accepted. This means that there is no significant difference in the mean achievement scores of male and female students taught using WhatsApp platform.

HO3: There is no significant difference in the mean retention scores of male and female undergraduate students taught micro-teaching using Telegram-enhanced instruction in collaborative learning settings.

In order to test hypothesis five, independent sample t-test was used to analyze the scores of the two groups as presented in **Table 8**.

Table 8 shows the independent sample t-test result of the mean retention scores of male and female students taught micro-teaching using Telegram learning platform. From **Table 8**, male students had a mean of 72.34 and a standard deviation of 2.94 while the female students had a mean of 70.67 and a standard deviation of 5.88. It can also be observed that t=5.274 and p-value=.386. Since p>0.05, therefore the null hypothesis is hereby accepted. This means that there is no significant difference in the mean retention scores of male and female students taught using Telegram platform.

HO4: There is no significant difference in the mean retention scores of male and female undergraduate students taught micro-teaching using WhatsApp-enhanced instruction in collaborative learning settings.

In order to test hypothesis six, independent sample t-test was used to analyze the scores of the two groups as presented in **Table 9**.

Table 9 shows the independent sample t-test result of the mean retention scores of male and female students taught micro-teaching using WhatsApp learning platform. From **Table 9**, it can be observed that male students had a mean of 65.75 and a standard deviation of 10.08 while female students had a mean of 68.84 and a standard deviation of 8.79. It can also be observed that t=4.071, df=163 and p-value=.000. Since p<0.05, therefore the null hypothesis is hereby rejected. This means that there is a significant difference in the mean retention scores of male and female students taught using WhatsApp platform in favor of the female students.

Table 8. Ir	ndepend	lent samp	e t-test resul	t of m	ean retention	scores o	f ma'	le &	fema	le stud	lents taug	ht micro	-teachi	ng usir	ıg T	elegram
1 4010 0. 11	nucpente	iente sump	ie e cese resul		cull recention	1 000100 0	I IIIu	10 00	I CIII a	ie ocue	ientes tuug	ine miter o	ceaem	ing uom	-6-	elegram

Group	n	Mean	Standard deviation	df	t-value	p-value	Decision
Male	61	72.34	2.94	115	5 274	207	A 1
Female	56	70.67	5.88	115	5.2/4	.380	Accepted
Note. No	t significan	t at 0.05 (p>0.05)					

Table 9. Independent sample t-test result of mean retention scores	of male & female students taugh	t micro-teaching using	WhatsApp
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Group	n	Mean	Standard deviation	df	t-value	p-value	Decision
Male	86	65.75	10.08	163	4.071	.000	Rejected
Female	79	68.84	8.79				

Note. Not significant at 0.05 (p>0.05)

DISCUSSION OF RESULTS

The result of hypothesis one was accepted, and this mean there was no significant difference in the mean scores of both male and female students on the Telegram platform. This result was due to the lack of prompt and frequent interaction as displayed by the students on the Telegram platform, which eventually influenced their final scores in the achievement test. Since interaction was generally low, it therefore resulted into both male and female performing at the same level. This shows the platform is gender friendly. This finding is in line with Naderi and Akrami (2018) whose study reported that there was no significant difference in the mean achievement of male and female students taught reading comprehension using Telegram platform. It is also in agreement with Dambo and Kayii whose study revealed no significant difference in the performance of male and female students exposed to blended learning strategy. Furthermore, the finding is in congruence with Jimoh et al. (2018) who reported no significant difference in the mean achievement of male and female students exposed to three modes of mobile instructional packages. Additionally, the finding equally aligns with that of Kareem et al. (2018) whose result revealed no significant difference in the mean achievement of male and female fine arts students taught sculpture using Facebook platform. Finally, this finding goes in concordant with Ofoka (2019) whose study revealed no significant difference in the performance of male and female students exposed to Facebook instruction.

The result of hypothesis two was tested and it was subsequently accepted. This therefore means that there was no significant difference in the mean scores of both male and female students exposed to instruction on the WhatsApp platform. This was due to the fact that since the students on the WhatsApp platform generally performed better by displaying high engagement and interaction, male and female students performed at the same levels in the achievement test because they both demonstrated some high levels of interaction, discussion and prompt response to questions. This finding agrees with Bawa and Ibrahim (2016) whose study revealed no significant difference in the achievement of undergraduate students exposed to instruction using blended WhatsApp instruction. It also tallies with Jafari and Chalak (2016) who reported no significant difference in the performance of male and female students taught vocabulary using WhatsApp platform. Furthermore, the finding also goes in tandem with Ofoka (2019) whose study revealed that there is no significant difference in the achievement of male and female agricultural science students exposed to instruction using WhatsApp, Blog and Facebook platforms. Additionally, the finding concurs with Ilobeneke et al. (2018a) whose study found no significant difference in the mean achievement of male and female educational technology students exposed to instruction using WhatsApp and Facebook platform. However, the finding contradicts that of Omar (2021) whose study revealed the existence of a significant difference in the performance of male and female students taught writing and speaking skills using WhatsApp platform. Finally, it also goes in parallel with Safitri (2021) whose study found a significant difference in the performance of male and female staff in favour of the male when exposed to vocabulary test using WhatsApp platform.

The result of hypothesis three was tested and it was accepted. This therefore means that there was no significant difference in the mean retention scores of both male and female students exposed to instruction using Telegram platform. This result was possible because interaction and engagement by students was generally low on the Telegram platform, which therefore led to both male and female students performing at the same rate in the retention test because the difference in their retention scores was not significant. This finding agrees with that of Achor et al. (2013) whose study discovered no significant difference in the mean retention scores of male and female students exposed to instruction using a computer-based instructional strategy. More so, this finding is also in congruence with Gambari et al. (2014) whose study revealed that there is no significant difference in the mean retention scores of male and female students exposed to instruction using computer animation and geometry model instruction. Additionally, this finding agrees with that of Ofoka (2019) whose study found no significant difference in the mean retention scores of male and female students exposed to instruction using Facebook and blog instruction. However, this finding disagrees with Owodunmi and Ogundola (2013) whose study revealed that there is a significant difference in the mean retention scores of male and female students exposed to electronic instruction using reflective inquiry method in favor of the female.

The result of hypothesis four was tested, and it was rejected. This therefore means that there was a significant difference in the mean retention scores of both male and female students exposed to instruction using Telegram platform in favor of the female. This finding is in congruence with Ceylan and Elitok Kesici (2017) whose study found a significant difference in the mean retention scores of male and female students exposed to instruction using a blended learning strategy. However, this finding is not in agreement with Ajai and Amoke (2015) whose study revealed that male and female students did not differ in their retention scores when exposed to instruction using a problem-based learning approach. Going further, it is also not in tandem with Ofoka (2019) whose study revealed that there is no significant difference in the mean retention scores of male and female students exposed to instruction using WhatsApp platform. Moreover, this finding does not equally agree with Eze et al. (2016) whose study found no significant difference in the mean retention scores of male and female students taught financial accounting using problem-based teaching method. Finally, the finding does not also fall in line with Bupo (2019) whose study found no significant difference in the mean retention scores of male and female accounting students exposed to instruction using MOODLE-based blended learning approach.

CONCLUSIONS

The findings on deployment of Telegram and WhatsApp platforms in collaborative learning settings in the teaching of microteaching to tackle individual differences occasioned by gender has proven to be effective and this means the two platforms when used in collaborative learning settings have what it takes to tackle individual differences resulting from gender. From most of the findings, both male and female students performed equally, and this further lays credence to the fact that social media have the potential to close gender gaps by bridging the individual differences that exist as a result gender.

Recommendations

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

- 1. Lecturers should deploy the use of social media tools like Telegram and WhatsApp in collaborative learning settings to bride the individual differences occasioned by gender.
- Lecturers should adopt the use of social media tools like Telegram and WhatsApp in collaborative learning during classroom instruction because they are engaging, interesting, and flexible.

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Data availability: Data generated or analyzed during this study are available from the authors on request.

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