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Transitioning to Problem-Based Learning in Higher Education: Opportunities for Producing 21st- Century Pre-Service Teachers in Sub-Saharan Africa

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Abstract (English)

A descriptive survey research design was adopted for this study. The population of the study was pre-service teachers in degree-awarding institutions located in sub-Saharan African countries drawn using the multi-stage sampling technique, while the sample size was determined using the electronic sample size calculator with a sample size of 403 participants. Data were collected using a questionnaire titled 'Transitioning to Problem-based Learning in Higher Education, which was face and content validated by educational measurement experts. Also, the reliability of the scale was subjected to the test of internal consistency using Cronbach's Alpha coefficient and an overall coefficient of 0.815 was obtained. Data collected for this study were analysed using descriptive and inferential statistics. The findings of the study were affirmative for the transition to PBL, particularly for pre-service teachers in the social sciences and in West and Southern Africa. As such, the integration of PBL could effectively address contextual teaching needs while fostering a student-centered, inquiry-driven approach. Moreover, PBL encourages interdisciplinary engagement, enabling pre-service teachers to develop a holistic understanding of real-world issues. The study concluded that the shift towards PBL in sub-Saharan Africa's higher education institutions holds immense promise for nurturing adaptable and competent 21st-century-ready pre-service teachers.

Keywords: Problem-Based Learning, Higher Education, Pre-Service Teachers, 21st-Century Skills, Sub-Saharan Africa.

Introduction

The world is changing rapidly through technological innovation. These changes require pre-service teachers to be equipped with a new set of core knowledge and skills to solve problems, gather and evaluate evidence, and make sense of the information they receive from varied print and, increasingly, digital media. This is necessary to aid proper student engagement for technology deployment in educational settings. Problem-based learning (PBL) is an approach to education that emphasises active learning using real-world problems as the basis for student learning. It is effective in promoting student engagement, critical thinking, and problem-solving skills (Guo et al., 2020; Karthikeyan, 2021; Malan et al., 2014; Puangpunsi, 2021). PBL has gained significant attention as an effective approach to teaching and learning in higher education and preparing students for the 21st-century workforce. However, the transition to a PBL approach can be challenging for educators and students who are used to traditional methods of instruction. While adopting PBL in West and Southern African countries as arrowhead developing countries is germane to producing the requisite workforce, perception remains a major determinant for transition (Vecchio et al., 2022).

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Literature Review

University education aims to develop skills and prepare students for a workforce where success results not only from what is known but also from what is knowable. Studies show that graduates with practical and relevant skills embedded in their educational experiences will be in high demand in all job sectors (Lowden et al., 2011; Tanenbaum et al., 2016) including teaching careers. Adequate preparation of pre-service teachers for their future work as teachers through PBL is imperative for innovative education. Practising PBL in higher education can foster in students a passion for inquiry and discovery and promote persistence, teamwork, and the application of knowledge to new situations (Hoidn & Kärkkäinen, 2014; Malan et al., 2014; Purichia, 2015). A strong teacher education programme that results in relevant skills and mindsets opens opportunities for lifelong learning and is culturally responsive and problem- and inquiry-based. It engages students in hands-on activities that offer opportunities to interact with workplace professionals (Tanenbaum, 2016; Times Higher Education, 2021). In the context of higher education, the development of problem-solving skills includes a variety of teaching strategies to prepare students for solving new kinds of problems and provide opportunities for theoretical concepts to become more concrete (Karan & Lisa Brown, 2022).

Problem-based learning (PBL) is a student-centred real-world problem strategy that emphasises the application of knowledge to real-world problems. This approach has gained popularity and is regarded as an effective way to prepare students for the challenges of the 21st century (Hendarwati et al., 2021; Niwa et al., 2016). In sub-Saharan African countries, PBL can play a crucial role in producing work-ready graduates who are equipped with the skills and knowledge to address complex problems in their respective fields including teaching. PBL offers numerous opportunities for developing countries. First, PBL allows students to work on real-world problems which helps them to develop problem-solving skills that are essential for success in the 21st century (Karthikeyan, 2021; Sroufe & Ramos, 2015; Luvizu, 2023; Sponsor, 2022; Tsai et al., 2022). By working on real-world problems, students can see the relevance of their learning to daily living and future careers (Fiore et al., 2018). With its origin in medical education, PBL is a teaching method that involves presenting students working in small groups to solve real-world problems using critical thinking and problem-solving skills; at the same time it fosters collaboration, student engagement, self-directed learning, and retention which make learning more relevant and interesting to students, leading to increased engagement and enhanced motivation (Alaagib et al., 2019; Hussin et al., 2018; Karan & Brown, 2022; University of Illinois Board of Trustees, 2022).

Some strategies for implementing PBL are active learning, inductive learning, backward course design, experiential learning, empathy, retrospectivity, problem-solving and just-in-time teaching deployed by anticipating impasses through a series of exercises that allow the teacher educator to survey and assess the student's abilities and knowledge. Other strategies are constructing puzzles, challenges, or discrete questions that push students to learn how to solve issues and build a framework of knowledge from these inquiries also known as guided enquiry (Iowa State University of Science and Technology, 2022). PBL has been increasingly adopted in higher education institutions of learning as an alternative to traditional lecture-based teaching which is generally teacher-centred (Blom et al., 2017; Guo et al., 2020; Hsu, 2014; Herold, 2019). Also, Da Silva et al. (2018) and Chatterjee and Corral (2017) proposed that the transition to PBL in higher teacher education can be done systematically.

In Africa, PBL has also been adopted in the fields of medicine and engineering (Dahms & Stentoft, 2008; Saloojee & Van Wyk, 2013). Studies have shown that PBL positively influences the academic performance of students in Nigeria. A study in Nigeria by Oderinu et al. (2020) showed that most undergraduate dental students preferred the PBL approach to traditional teaching methods. This study also found that PBL was more effective in promoting critical thinking, self-directed learning, and

problem-solving skills among the students (Oderinu et al., 2020). Furthermore, a study by Araz and Sungur (2007) investigated the effectiveness of PBL on academic performance in genetics in a higher institution in Ankara, Turkey. This study was conducted on a sample of 57 first-year undergraduate students enrolled in a genetics course who were randomly assigned to either a PBL or a lecture-based learning (LBL) group. The results of the study showed that the students in the PBL group had significantly higher academic performance than the students in the LBL group. The PBL group also had a higher average score in the final examination compared to the LBL group. Furthermore, the study found that the PBL group had higher scores on conceptual understanding, problem-solving ability, and critical thinking skills than the LBL group. In a related study, Tugwell (2020) investigated the effect of PBL on electrical and electronic engineering final-year students' (telecommunications and electronics option) academic achievement in digital electronics at Ken Saro-Wiwa Polytechnic, Nigeria. The study showed that the students in the PBL group had significantly higher academic achievement than the students in the traditional lecture-based learning group. However, some studies have reported mixed results regarding the influence of PBL on academic performance in Nigeria. Also, Adigun (2020) investigated the effect of computer-assisted instruction (CAI) and project-based learning on the achievement of deaf secondary school students in biology. The results of the study showed that both CAI and PBL had a positive effect on the achievement of deaf learners in biology with participants exposed to CAI having the highest mean score of 13.74 followed by the PBL group (10.51) and control group (9.15). The study also found that the students who were taught using PBL had a higher level of engagement and motivation compared to those who were taught using CAI or LBL. It is also in the same context that Fatade et al. (2013) investigated the effect of PBL on senior secondary school students' achievement in further mathematics in Nigeria. The study showed that the implementation of PBL had a significant effect on students' achievement in further mathematics and that students who were taught using PBL had higher mean achievement scores compared to students who were taught using traditional methods. In addition, the study found that PBL improved students' problem-solving skills, critical thinking, and motivation to learn further mathematics. Iji et al. (2015) conducted a study on the effect of PBL on senior secondary school students' achievement in trigonometry in the northern educational zone of Cross River State, Nigeria. They found that PBL could be integrated into the pre-service (teachers in training) mathematics education curriculum. A recommendation was that mathematics teacher educators should also be encouraged to include PBL in their pedagogical practices.

There is a growing body of empirical evidence that supports the effectiveness of PBL in higher education. Reviews on related studies by Dolmans et al. (2005) and Hmelo-Silver (2004) revealed that students who participate in PBL show increased motivation and engagement in their learning as well as improved critical thinking skills and the ability to work effectively in teams. In addition, PBL has been found to be effective in promoting deep learning and long-term retention of knowledge (Hmelo-Silver, 2004). A meta-analysis of studies on PBL found that students who participated in PBL showed significant improvements in critical thinking, problem-solving, and teamwork skills as well as increased motivation and engagement in their learning (Dochy et al., 2003). Schmidt et al. (2011) carried out a multi-country review (mostly developed) to examine the process of PBL and progress made in graduate medical education and found significant learning gains in PBL students that extended beyond those students in controlled conditions in which problems were not the focus of attention or students were not encouraged to elaborate on their prior knowledge. Amaya Chávez et al. (2020) investigated the effects of PBL on academic performance and perceptions using a questionnaire designed to capture the three domains of knowledge acquisition, generic skills, and attitudes towards PBL of first-year engineering students in computer sciences in Cuba and Spain. The findings of the study revealed statistically significant differences in aspects such as academic performance. Also, Eneovo and Ogbuanya (2021) investigated the effect of PBL on students' academic achievement in computer

hardware maintenance in universities in Enugu State, Nigeria. The study concluded that PBL can be used as an effective instructional method to enhance the learning outcomes of students studying computer hardware maintenance.

Similarly, a qualitative study premised on the interpretivist approach by Okolie et al. (2021) on improving graduate outcomes through the implementation of PBL in Technical and Vocational Education and Training (TVET) systems of Nigerian higher education showed a positive impact on graduate quality learning outcomes. The study found that graduates from TVET programmes that implemented PBL had higher levels of critical thinking, problem-solving, and communication skills compared to graduates from programmes that did not implement PBL. Similarly, Al-Abdullatif and Gameil (2021) investigated the effect of digital technology integration on university undergraduates' academic performance through PBL in an e-learning environment. The results of the study showed that the use of digital technology integrated with PBL had a positive effect on students' academic performance. This finding is apt for the Generation Z category of learners (those born between 1996 and 2010) who have a deep affinity for technological advancement which largely fosters their receptiveness (Puangpunsi, 2021). The study found that students who were taught using digital technology integrated with PBL had significantly higher scores with a total positive effect on the final exam than those who were taught using traditional lecture-based instruction. PBL has also been shown to promote higher levels of collaboration and communication among learners as they work together to solve complex problems using both direct and indirect measures. The direct measures included assessment grades and surveys completed by the students related to the courses and faculty feedback on courses taken later while the indirect measures included feedback from employers at the end of internships to measure the outcomes (Raza & Hasib, 2022). In addition, PBL is effective across a range of subject areas, including science, technology, engineering, and mathematics fields as well as social sciences and humanities. Some studies have also found that PBL can be an effective approach for diverse learners, including those with different learning styles and abilities (Mulyanto et al., 2018; Orji & Ogbuanya, 2022) while increasingly creating opportunities for producing work-ready graduates for the 21st century (Mulonda et al., 2022).

Despite the advantages of PBL, it also has some drawbacks. The implementation of PBL in developing countries may present unique challenges such as facility, resource and structural constraints, large class sizes with implications for concrete practice opportunities, information overload, time and human capital constraints, lack of technology, and limited learning due to poor implementation (Getuno et al., 2022; Kiviranta, n.d.). As such, Hursen (2021) noted that the implementation of PBL may require significant investment in infrastructure and pre-service teacher education. As such, the adoption of PBL for pre-service teacher education in sub-Saharan African countries may face some challenges, particularly in resource-constrained settings and requires more human/material resources and time than traditional teaching methods. In addition, PBL can be challenging for students who are not used to taking responsibility for their learning or who struggle with ambiguity and open-ended problems. It can also be difficult to assess the learning that takes place through PBL activities, as traditional assessment methods may not be well-suited to this approach. To address these challenges, researchers and educators have developed a range of best practices for PBL. For example, it is recommended to design high-quality, relevant problems that are aligned with learning objectives and that allow for multiple solutions (Oladipo et al., 2020). Another challenge with the transition to PBL in higher education in sub-Saharan African countries is the lack of trained PBL facilitators who can guide students/participants through the process and provide feedback on their work. It is important to provide students with support and guidance as they work through PBL activities, including regular feedback and opportunities for reflection for effectiveness. Also, some challenges may be encountered when creating and implementing effective PBL activities as they require significant planning and time. Students should be assessed through various measures, such as formative, self, peer, and adaptive assessments while employing the use of higher-order items (Oladele et al., 2022; Raza & Hasib, 2022).

The reviewed literature shows that PBL is a radical departure from traditional pedagogy. However, adapting this approach can be demanding and may be met with resistance by relevant stakeholders who are accustomed to the traditional approach (AlBuali & Khan, 2018). This resistance can either be fuelled or doused by students' perceptions of the transition to PBL in higher education, with previous studies, mostly conducted in Asia, showing that students are a major stakeholder in the success of this transition (Al-Drees et al., 2015; Ahmad et al., 2021; Deng et al., 2019; Jaganathan et al., 2020; Kim & Kim, 2019; Puangpunsri, 2021; Sang et al., 2016; Vecchio et al., 2022). This review identified a gap in the literature which this study sought to bridge by interrogating the perceptions of students on the implementation of PBL. This study also aimed at identifying strategies that could facilitate the transition to PBL and address impending challenges within the African higher education sphere.

University graduate employability in the 21st century has become a necessity in the Fourth Industrial Revolution (4IR) characterised by fast-changing roles (Oladele et al., 2022). Therefore, today's graduates are expected to have knowledge and skills that respond to the trends and challenges that are altering the nature of work in both the formal and informal sectors (MasterCard, 2023). Youth unemployment has become a big challenge to governments across the world particularly in sub-Saharan African countries. The unemployment rate in Nigeria in 2022 was estimated to reach 33% with the situation among graduates not any better as 36.26% of recent graduates were unemployed (Nwogu, 2015; Sasu, 2023). This has been further strained by under-employment (22.8%), youth unemployment (42.5%) and youth under-employment (21.0%) (National Bureau of Statistics, 2023). Similarly, the youth unemployment rate in South Africa is reported to be 64.18%; the youth unemployment rate thereby reached its highest value during 2020–2021 (O'Neill, 2023). A related national report revealed that only 2.5 million of over 10 million young people aged 15–24 years were in the labour force (Statistics South Africa, 2023).

The challenge of general unemployment, youth unemployment and under-employment cuts across most sub-Saharan African countries (Akinyele et al., 2022; Fox et al., 2016; The World Bank Group, 2023). The reason may not be far-fetched as the findings of a study revealed that a significant proportion of Nigerian fresh graduates were deficient in 21st-century skills, and this has contributed significantly to their underemployment and unemployment over the years (Akinbode & Oyelude, 2020; MasterCard, 2023). Furthermore, a study conducted by the British Council in 2014 estimated Nigeria's graduate unemployment at 23.1% while in Kenya, it takes an average of five years for a graduate to find a job – business leaders frequently complain of a lack of skilled talent to carry out available jobs considering that employers are now looking for graduates who can think for themselves and integrate into fast-paced work environments, are digitally literate, self-directed and can adapt and learning (Oladele et al., 2022; Papier, 2021; Trudeau & Omu, 2017). As a solution to this challenge, it is recommended that more thought should be put into how to teach students different ways of thinking for complex problem solving, communication, analytical thinking, problem-solving, and creativity as some of the soft skills that employers across the world need today, and the ability to blend soft and hard skills (Khan, 2014; MasterCard, 2023; Puangpunsri, 2021). While research has clearly shown that PBL is effective for developing self-directed learning skills, sustainability issues which ride on students' beliefs in the approach remain germane (Malan et al., 2014). The traditional teacher-education approaches have often been criticised for their limited ability to equip educators with the dynamic skills and competencies demanded by modern classrooms. PBL, on the other hand, which emphasises active learning, critical thinking, collaboration, and problem-solving, aligns well with the multifaceted challenges faced by teachers in sub-Saharan Africa and is perceived as a worthy transitional approach to learning. It is against this backdrop that the study aimed to examine the perceptions of students of PBL implementation and strategies while identifying the associated opportunities and challenges for transition in developing countries. These aims were translated into the following research questions which guided the study:

1. What are the perceptions of pre-service teachers on the implementation of PBL in sub-Saharan African higher education institutions?
2. What strategies could facilitate the transition to PBL in sub-Saharan African higher education institutions?
3. What are the challenges of transitioning to PBL in sub-Saharan African higher education institutions?

Hypothesis: There is no significant difference in pre-service teachers' perceptions of the transition to PBL in sub-Saharan African higher education institutions based on the demographic variables of gender, age, discipline, level of study and region.

Methodology

Research Design

This study adopted a quantitative research design that used the survey research method and a questionnaire instrument to collect data from university teacher educators from West, Central/East North and Southern African geographical areas (also referred to as sub-Saharan African countries).

Sample and Data Collection

The population of the study consisted of university undergraduates, honours, and postgraduate students while the target population was pre-service teachers at the three levels of study. Although no exact population was estimated due to the inaccessibility of the data, the researchers employed the multi-stage sampling technique involving purposive and random sampling to include institutions that had a record of implementing PBL. By employing these sampling techniques, pre-service teachers across higher institutions in sub-Saharan African countries were targeted for this study. The sample size was determined using the electronic sample size calculator which computes the minimum number of necessary samples to meet the desired statistical constraints of Confidence Level, Margin of Error, Population Proportion and Population Size (which can be left blank in cases with unlimited population size). Using this approach, a sample size of 385 participants was obtained. The data were collected using a researcher-designed and structured questionnaire titled "Transitioning to Problem-based Learning in Higher Education (TOPLHE)". The questionnaire was face and content validated by the educational measurement experts among the authors. The questionnaire had a pre-scale section designed to collect the demographic information of respondents (gender, age, discipline, level of study and region) and three sub-scales labelled as sections. Section A was designed to explore the perceptions of the implementation of PBL with 16 items, Section B was on strategies that could facilitate the transition to PBL with 10 items, while Section C was designed to examine the challenges of transitioning to PBL with 11 items. The questionnaire was structured on a 4-point Likert response option of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) with assigned weights of 4, 3, 2 and 1 respectively. The reliability of the questionnaire was determined using Cronbach's Alpha coefficient. The sub-scales had values of 0.894, 0.785 and 0.764 with no significant improvement as shown by Cronbach's Alpha if items deleted values. Therefore, all the items in each of the sub-scales were retained. An overall coefficient of 0.815 was obtained with a reliability benchmark of 0.65. As such, the obtained coefficients showed that the questionnaire was reliable for data collection.

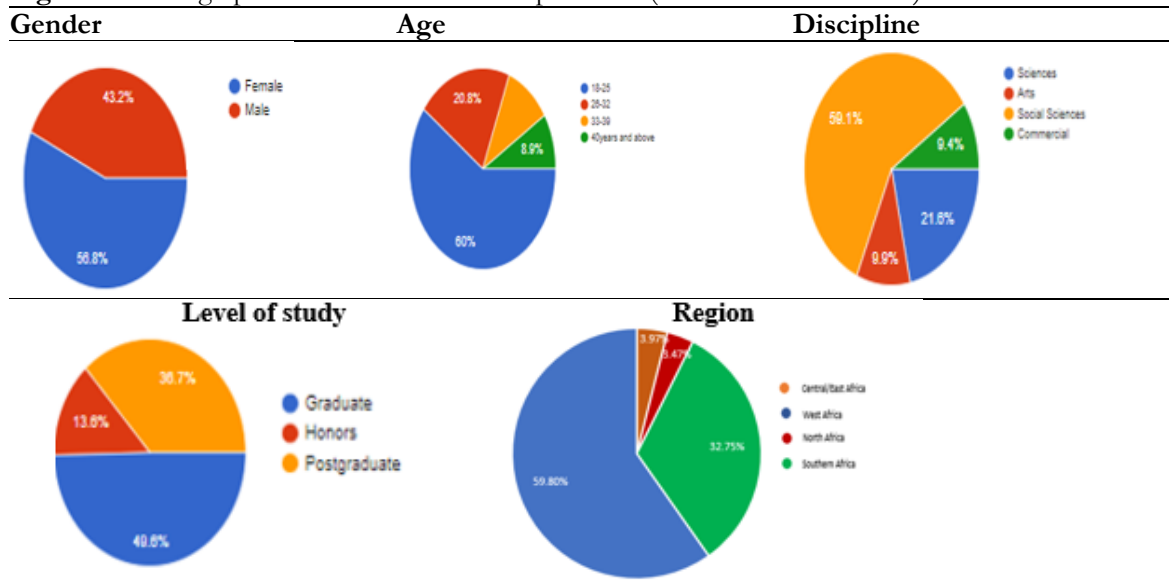
Analysing of Data

Data collected for this study were analysed using descriptive statistics shown in pie charts to present the demographic statistics of the study respondents and frequency and percentages for answering the research questions while the raised hypothesis was tested using chi-square statistics all deployed using SPSS 29.0.

Findings/Result

The demographic characteristics of the respondents were analysed using bar charts as shown in Figure 1.

Figure 1: Demographic Characteristics of Respondents (Source: Research Data).



As shown in Figure 1, the study had both male (43.2%) and female (56.8%) participants. This result shows that there were more female than male participants. Concerning the participants' age distribution, 60% of the study participants were aged 18 to 25 years, 20.8% were aged 26 to 32 years, 10.3% were aged 33 to 39 years and 8.9% were 40 years and above. This result revealed that most of the study participants were in the least age range classified as Gen Z who have a deep affinity for technology. Considering the disciplines of the study participants, 59.1% of respondents were from the social sciences, 21.6% were science-oriented, 9.4% were in the commercial field and 9.9% were in the arts. This result showed that the majority of those who participated in the study were pre-service teachers from the field of social sciences. Concerning the level of study, 49.8% of the respondents were undergraduate pre-service teachers, 38.7% were postgraduate pre-service teachers and 13.6% were pre-service teachers completing the honours programme. This result showed that the majority of those who participated in this study were university undergraduates. Considering the sub-Saharan African coverage of the study, data on the regional participation showed that 59.80% of the participants were from West Africa, 3.97% were from Central/East Africa, 3.47% were from North Africa and 32.75% were from Southern Africa. This result revealed that participants from West and Southern Africa dominated the study.

Research Question One: What is the perception of pre-service teachers on the implementation of PBL in sub-Saharan African higher education institutions?

To answer research question one, participants' responses to a 4-point Likert scale on pre-service teachers' perceptions of the transition to PBL in sub-Saharan African higher education institutions with the response format and weighting of SA: 4; A: 3; D: 3 and SD: 1 were subjected to descriptive statistical analysis of frequency and percentages on item basis as shown in Table 1.

Table 1: Pre-Service Teachers Perception of Transition to PBL in Sub-Saharan African Higher Ed. Institutions.

Perception of Transition to PBL	SA	A	D	SD
	Freq.(%)	Freq.(%)	Freq.(%)	Freq.(%)
I need critical thinking for meaningful studying	240(59.6)	159(39.5)	3(0.7)	1(0.2)
Ability for teamwork and effective collaboration is required for graduate relevance	207(51.4)	168(41.7)	26(6.5)	2(0.5)
Applying learning to real-world problems is my desire	234(58.1)	151(37.5)	16(4.0)	2(0.5)
Engaging with multiple course materials aids my learning	202(50.1)	185(45.9)	13(3.2)	3(0.7)
Problem-solving skills will aid my graduate relevancy	238(59.1)	158(39.2)	5(1.2)	2(0.5)
Applying theoretical knowledge to practical situations will make me relevant	242(60)	150(37.2)	8(2.0)	3(0.7)
Communication skills will aid my graduate relevancy	276(68.5)	119(29.5)	7(1.7)	1(0.2)
Learning for application is more interesting for me	207(51.4)	171(42.4)	24(6)	1(0.2)
Learning for application is more engaging for me	192(47.6)	183(45.4)	25(6.2)	3(0.7)
Learning for application helps me to retain and recall information on time	238(59.1)	149(37.0)	15(3.7)	1(0.7)
Learning for application aids understanding complexities of real-world problems	216(53.6)	172(42.7)	11(2.7)	4(1.0)
Tasks that aid creativity in thinking aids exploring new ideas	240(59.6)	146(36.2)	15(3.7)	2(0.5)
I take responsibility for my learning and be more self-directed	203(50.4)	188(46.7)	11(2.7)	1(0.2)
I like opportunities to receive constructive feedback on my work	227(56.7)	170(42.2)	5(1.2)	1(0.2)
Learning strategies that aids deeper understanding of course concepts are desirable	271(67.2)	128(31.8)	3(0.7)	1(0.2)
Learning strategies that aids adaptability to different situations/contexts are desirable	262(65.0)	130(32.3)	10(2.5)	1(0.2)

Table 1 shows the descriptive analysis of respondents' perceptions of the transition to PBL in sub-Saharan African higher education institutions. Above 90% of the respondents strongly agreed and agreed (have a positive perception) to all 15 items on the transition to PBL. Thus, perceptions of pre-service teachers on the transition to PBL in sub-Saharan African higher education institutions were positive since above 90% of the respondents answered in the affirmative.

Research Question Two: What strategies could facilitate the transition to PBL in sub-Saharan African higher education institutions?

Table 2: Strategies that Could Facilitate Transition to PBL in Sub-Saharan African Higher Education Institutions.

Strategies	SA	A	D	SD
	Freq.(%)	Freq.(%)	Freq.(%)	Freq.(%)
Training of preservice teachers in the principles and practices of PBL	298(73.9)	101(25.1)	4(1.0)	-
Timely commencement of the lecture	224(55.6)	173(42.9)	6(1.5)	-
Progressive introduction to PBL in one or two subjects and gradually expand to other subjects	192(47.6)	200(49.6)	11(2.7)	-
PBL needs to be adapted to the local context, including cultural and social norms, language, and resources	215(53.3)	174(43.2)	12(3.0)	2(0.5)
All stakeholders, including students, teachers, parents, and community members should be involved in the design and implementation of PBL	230(57.1)	150(37.2)	22(5.5)	1(0.2)
Collaboration with other schools and organizations to provide opportunities for sharing resources, expertise, and best practices	237(58.8)	156(38.7)	9(2.2)	1(0.2)
Constant monitoring of the implementation of PBL to identify strengths & weaknesses	247(61.3)	144(35.7%)	10(2.5)	2(0.5)
Constant monitoring of the implementation of PBL to adjust where necessary	244(60.5)	144(35.7)	15(3.7)	-
Room for feedback	270(67.0)	128(31.2)	5(1.2)	-
Support for accomplishing class tasks	227(56.3)	168(41.7)	8(2.0)	-
Effective group management for optimal participation	240(59.6)	153(38.0)	7(1.7)	3(0.7)

It is shown in Table 2 that identified strategies that could facilitate the transition to PBL in sub-

Saharan African countries were training of teachers in the principles and practices of PBL; timely commencement of the lecture; progressive introduction to PBL in one or two subjects and gradually expand to other subjects; PBL to be adapted to the local context, including cultural and social norms, language, and resources; stakeholders’ involvement in the design and implementation of PBL; collaboration with other schools and organizations to provide opportunities for sharing resources, expertise, and best practices; constant monitoring of the implementation of PBL to identify strengths and weaknesses; constant monitoring of the implementation of PBL to make adjustments where necessary, creating room for immediate feedback; and giving support for accomplishing class tasks and effective group management for optimal participation. This submission is because above 90% of the respondents (pre-service teachers) strongly agreed and agreed that all the strategies could facilitate the transition to PBL in sub-Saharan African countries.

Research Question Three: What are the challenges of transitioning to PBL in sub-Saharan African higher education institutions?

Table 3: Challenges of Transitioning to PBL in Developing Countries.

Challenges	SA	A	D	SD
	Freq.(%)	Freq.(%)	Freq.(%)	Freq.(%)
Engaging in self-directed learning	137(34)	211(52.4)	52(12.9)	3(0.7)
Developing self-driven problem-solving skills	134(33.3)	219(54.3)	46(11.4)	4(1.0)
Collaborative peering on assigned academic tasks	175(43.4)	159(39.5)	60(14.9)	9(2.2)
Independent schoolwork engagements	135(33.5)	154(38.2)	106(26.1)	9(2.2)
Availability of appropriate resources for problem-solving	118(29.3)	246(61.0)	36(8.9)	3(0.7)
Access to information for problem-solving	135(33.5)	230(57.1)	36(8.9)	2(0.5)
Adjusting to a self- directed learning environment	97(24.1)	154(38.2)	130(32.3)	22(5.5)
Uncertainty and ambiguity of assigned tasks while learning	78(19.4)	224(55.6)	88(21.8)	13(3.2)
Failure in employing assessments as learning strategies	140(34.7)	183(45.4)	63(15.6)	17(4.2)
Developing self-motivation skill for learning	207(51.4)	164(40.7)	29(7.2)	3(0.7)

It is shown in Table 3 that the challenges of transitioning to PBL in developing countries were lack of self-motivation to learn; access to information for problem-solving; collaborative peering on assigned academic tasks; developing self-driven problem-solving skills; adjusting to self-directed learning; failure in employing assessments as learning strategies; uncertainty and ambiguity of assigned tasks while learning; independent schoolwork engagements and adjusting to a self-directed learning environment. This finding were indicated by the majority (above 70%) of the respondents.

Hypothesis: There is no significant difference in pre-service teachers’ perceptions of the transition to PBL in sub-Saharan African higher education institutions based on the demographic variables of gender, age, discipline, level of study and region.

Table 4: Chi Square Showing Difference in Pre-Service Teachers' Perception on Transition to PBL in Sub-Saharan African Higher Education Institutions Based on Demographics.

Variable	Level of Perception	Male	Female	Total	df	Chi Square value	P-value	Decision	
Gender	Strongly Disagree	0	1	1	3	1.53	0.68	<i>Accepted</i>	
	Disagree	0	1	1					
	Agree	61	80	141					
	Strongly Agree	113	147	260					
	<i>Total</i>	<i>174</i>	<i>229</i>	<i>403</i>					
Age	Level of Perception	18-25 years	26-32 years	33-39 years	40 years & above	Total	df	Chi Square value	P-value
	Strongly Disagree	0	1	0	0	1	9	13.51	0.14
	Disagree	1	0	0	0	1			
	Agree	95	30	8	8	141			
	Strongly Agree	146	53	33	28	260			
<i>Total</i>	<i>242</i>	<i>84</i>	<i>41</i>	<i>36</i>	<i>403</i>				
Discipline	Level of Perception	Social Sci.	Science	Arts	Comm-ercial	Total	df	Chi Square value	P-value
	Strongly Disagree	0	0	0	1	1	9	24.51	0.00
	Disagree	0	0	0	1	1			
	Agree	90	28	16	7	141			
	Strongly Agree	148	59	24	29	260			
<i>Total</i>	<i>238</i>	<i>87</i>	<i>40</i>	<i>38</i>	<i>403</i>				
Level of Study	Level of Perception	Post grads.	Graduates	Honors		Total	df	Chi Square value	P-value
	Strongly Disagree	1	0	0		1	6	3.62	0.73
	Disagree	0	1	0		1			
	Agree	50	74	17		141			
	Strongly Agree	97	125	38		260			
<i>Total</i>	<i>148</i>	<i>200</i>	<i>55</i>		<i>403</i>				
Region	Level of Perception	West Africa	East/Cent-ral Africa	North Africa	South-ern Africa	Total	df	Chi Square value	P-value
	Strongly Disagree	0	0	0	1	1	9	40.32	0.000
	Disagree	0	1	0	0	1			
	Agree	89	9	7	36	141			
	Strongly Agree	152	4	9	95	260			
<i>Total</i>	<i>241</i>	<i>14</i>	<i>16</i>	<i>132</i>	<i>403</i>				

On gender, Table 3 revealed a chi-square value of 1.53 with a p-value of 0.68 which is greater than the significant value of 0.05 ($0.68 > 0.05$); the null hypothesis that stated that there is no significant difference in pre-service teachers' perceptions of the transition to PBL in sub-Saharan African higher education institutions based on gender is therefore accepted. Hence, male and female pre-service teachers are not significantly different in their perceptions of the transition to PBL in sub-Saharan African higher education institutions. On age, Table 3 revealed a chi-square value of 13.51 with a p-value of 0.14 which is greater than the significant value of 0.05 ($0.14 > 0.05$); the null hypothesis two which stated that there is no significant difference in pre-service teachers' perceptions of the transition to PBL in sub-Saharan African higher education institutions based on age is therefore accepted. Hence, irrespective of age, pre-service teachers are not significantly different in their perceptions of the transition to PBL in sub-Saharan African higher education institutions. On discipline, Table 3 showed a p-value of 0.00 which is less than the significant value of 0.05 ($0.00 < 0.05$); the null hypothesis stated that there is no significant difference

in pre-service teachers' perceptions of the transition to PBL in sub-Saharan African higher education institutions based on discipline is therefore rejected. Hence, there is a significant difference in pre-service teachers' perceptions of the transition to PBL in sub-Saharan African higher education institutions based on discipline. Out of 403 pre-service teachers sampled, 238 (59.1%) with social sciences discipline significantly had positive perceptions (Agree and Strongly Agree = 90+148) of the transition to PBL in sub-Saharan African higher education institutions. On the level of study, Table 3 revealed a chi-square value of 3.62 with a p-value of 0.73 which is greater than the significant value of 0.05 ($0.73 > 0.05$); the null hypothesis five which stated that there is no significant difference in pre-service teachers' perceptions of the transition to PBL in sub-Saharan African higher education institutions based on study level is therefore accepted. Hence, there is no significant difference in pre-service teachers' perceptions of the transition to PBL in sub-Saharan African higher education institutions based on study level. On region, Table 3 showed a p-value of 0.00 which is less than the significant value of 0.05 ($0.00 < 0.05$); the null hypothesis stated that there is no significant difference in pre-service teachers' perceptions of the transition to PBL in sub-Saharan African higher education institutions based on region is therefore rejected. Hence, there is a significant difference in pre-service teachers' perceptions of the transition to PBL in sub-Saharan African higher education institutions based on region. Out of 403 pre-service teachers sampled, 241 (59.1%) from West Africa significantly had positive perceptions (Agree and Strongly Agree = 89+152) of the transition to PBL in sub-Saharan African higher education institutions.

Discussion

The findings of this study revealed that the perceptions of students on the implementation of PBL in developing countries are positive. This finding is a clear indication that PBL would be a welcome development which university teacher trainees in Africa would be receptive to. This finding is also not without implication for the study participants who were mostly between the ages of 18 and 25 (teacher trainees) and categorised in the Gen Z category of technology users who are digital natives and characterised by a high propensity to change which is integral to PBL (Dahms & Stentoft, 2008). This finding aligns with the findings of Puangpunsri (2021), who reported a positive perception of PBL in the promotion of 21st-century skills and encouraged a positive attitude towards learning. Also, a study by Jaganathan et al. (2020) revealed a positive attitudinal disposition of learners towards PBL with most of the participants strongly agreeing to the potential of PBL in improving communication skills; promoting student interaction; helping the students to identify their strengths and weaknesses; improving staff-student interaction; students' group skills; and improving students' confidence in decision-making. Similarly, a study by Al Drees (2015) revealed that students viewed the PBL deployed in a system-based hybrid curriculum as beneficial to their learning processes in terms of high self-directed and collaborative learning, improved decision-making skills and development of problem-solving skills; it also helped them to identify their strengths and weaknesses during the learning process. Furthermore, the positive perceptions of the transition to PBL were further strengthened by higher performance than those who were taught using traditional lecture-based instructional strategies reported by various previous studies (Adigun, 2020; Araz & Sungur, 2007; Al-Abdullatif & Gameil, 2021; Amaya Chávez et al., 2020; Eneovo & Ogbuanya, 2021; Iji et al., 2015) and was pertinent for the requisite graduate upskilling and future relevance (Akinbode & Oyelude, 2020; MasterCard, 2023). These findings are important as these skills which are perceived as cultivable via PBL are requisite for the 21st-century workforce and relevant for solving the challenge of general unemployment, youth unemployment and under-employment which cuts across most sub-Saharan African countries (Akinyele et al., 2022; Fox et al., 2016; The World Bank Group, 2023).

Having identified the positive perceptions of teacher trainees on the transition to PBL in higher institutions of learning, this study further investigated strategies that could facilitate the transition to PBL in sub-

Saharan African countries. The findings of this study revealed strategies for the transition to PBL, such as teachers training in the principles and practices of PBL, timely commencement of the lecture and progressive introduction to PBL in one or two subjects and gradually expanding to other subjects, among others. In line with the findings of this study, Hursen (2021) stressed that the implementation of PBL requires significant investment in infrastructure, teacher training, and time than traditional teaching methods. Also, the need for a progressive introduction to PBL is germane considering its novelty. While change as they say is the only constant, adaptation must be done carefully if the benefits of such changes are to be adequately harnessed. This finding aligns with Chatterjee and Corral (2017) and Da Silva et al. (2018). They both noted that the transition to PBL should be done systematically by implementing clearly defined learning outcomes which should be SMART, carefully selecting appropriate problems which should be context-centred (Karan & Lisa Brown, 2022), promoting critical thinking and problem-solving skills (Guo et al., 2020; Karthikeyan, 2021), and providing guidance and support while providing adequate opportunities for feedback which will help students to reflect on their learning and effectively assess the pre-specified learning outcomes. The fact that PBL leverages technology (Al-Abdullatif & Gameil, 2021) will also promote effective learning assessments (also known as Assessment as Learning) through formative, self, peer, and adaptive assessments while employing the use of higher-order items as a 4IR application in education (Oladele et al., 2022; Raza & Hasib, 2022). It is also important to note that the success of the transition to PBL for teacher training in universities rests on adequate stakeholders' involvement with the need to embrace the PBL strategy (AlBuali & Khan, 2018). Worthy of note is the fact that stakeholders' engagement can be enhanced by early involvement from the planning stage which will go a long way in ensuring joint ownership in the transition exercise. Furthermore, collaborating with other schools and organisations to provide opportunities for resource sharing is apt considering the weight of resources required for deploying PBL while bridging the gap between theory and practice and fostering important 21st-century work skills (Karan & Brown, 2022; Luvizu, 2023; Sponsor, 2022; Tsai et al., 2022). Finally concerning implementation strategies, the need for constant monitoring of the implementation of PBL to identify strengths and weaknesses and to adjust where necessary cannot be over-emphasised and is one of the major steps highlighted by Chatterjee and Corral (2017) and Da Silva et al. (2018). Constant monitoring is also relevant for producing a workforce fit for the challenges of the 21st century and building the much-needed 21st-century work skills of adaptability for enhancing graduate employability considering the fast-paced work environments of today's world (Trudeau & Omu, 2017; Papier, 2021).

Considering the challenges of transitioning to PBL in sub-Saharan African countries, the study respondents indicated challenges, such as a lack of self-motivation to learn, access to information for problem-solving and collaborative peering assigned on academic tasks, among others. The finding of this study clearly aligns with that of Getuno et al. (2022), Kiviranta (n.d.) and Hursen (2021). The self-directed challenges tend to be alleviated with the implementation of PBL with empirical evidence that it aids self-motivation with a significant effect on students' achievement (Adigun, 2020; Fatade et al., 2013). Considering self which is one of the major pillars of the theoretical framework of this study is also relevant as it x-rays the students' personal characteristics affecting how an individual views life, such as socioeconomic, and psychological capabilities required for academic and resultantly career success (Chatterjee & Corral, 2017; Da Silva et al., 2018). Worthy of note is the fact that most of these challenges are particular to developing countries usually faced with resource constraints and large class sizes (Getuno et al., 2022; Hursen, 2021). Combating self-directed challenges requires a one-on-one touch with implications for concrete practice opportunities. Also, teacher training which has been highlighted as a major implementation strategy would go a long way in alleviating these challenges (Hursen, 2021).

Lastly, the tested hypothesis based on the study participants' demographics revealed no significant differences in the perception of pre-service teachers based on gender, age and level of study while significant differences based on discipline (social sciences) and region (West Africa) were recorded. While previous studies show that

PBL has been implemented extensively in the sciences (engineering, medicine – Dahms & Stentoft, 2008; Tugwell, 2020; Saloojee & Van Wyk, 2013; biology – Adigun, 2020; Mathematics – Fatade et al., 2013; Iji et al., 2015), the result of this study indicates that the field of social sciences is receptive to PBL. However, careful and progressive implementation strategies are required with constant monitoring as highlighted by Chatterjee and Corral (2017) and Da Silva et al. (2018). Careful implementation is important if significant improvements in graduate outcomes in teacher education are to be achieved as shown in studies in other fields revealed by Al-Abdullatif and Gameil (2021) and Okolie et al. (2021) among others. Also, at the regional level, the study participants from West Africa followed by Southern Africa accounted for the significance of perceptions of the transition to PBL. The readiness of graduates for PBL in these regions may be a directional way to solving the general challenge of unemployment in Nigeria and South Africa as experienced in most sub-Saharan African countries (Akinyele et al., 2022; Fox et al., 2016; O’Neill, 2023; The World Bank Group, 2023) which was adduced to graduates’ deficiency in 21st-century skills (Akinbode & Oyelude, 2020; MasterCard, 2023). This position is also strengthened considering that PBL holds the potential to equip graduates with digital literacy, independent thinking, and self-directed and adaptive learning skills which would aid their smooth integration into fast-paced work environments (Oladele et al., 2022; Papier, 2021; Trudeau & Omu, 2017). By embracing PBL, the sub-Saharan African region can empower educators to thrive in complex educational settings, fostering innovation and sustainable development in the process. This study sets the stage for an in-depth exploration of the subject, urging further research into the practical implementation, outcomes, and potential transformation of teacher education through PBL methodologies.

Conclusion

This study concluded that teacher trainees in African higher education institutions who are mostly within the Gen Z category of learners are receptive to the transition to PBL and recommended strategies that could aid a smooth transition, such as teacher training, timely commencement of the lecture, and progressive introduction to PBL among others. They also noted the need to circumvent the challenges with adequate teacher training as a major factor, among others, in harnessing the full benefits of PBL for teacher training.

Recommendations

The following recommendations are made based on the conclusion of this study.

1. A systematic approach should be employed by teacher training higher educational institutions when transitioning to PBL using the implementation proposed by Da Silva et al. (2018) and Chatterjee and Corral (2017).
2. Lecturers should be trained on identifying appropriate learning problems while transitioning to PBL considering that the population of students are mostly Gen Z learners.
3. The curriculum should be revamped considering the local context, including cultural and social norms and language to enhance a smooth transition to PBL.
4. Educational institutions should synergise to alleviate the resource constraint which may hamper the transition to PBL.
5. Educational institutions should also improve partnerships with the education industry to improve graduate training for workplace relevance.

Limitations

A major limitation of this study was that the participants of this study were mostly from West and Southern African countries. Therefore, teacher training higher education institutions in these countries may rely more on the recommendations of this study for practice while further research involving different participants from East/Central and North Africa could adequately inform their practices and adequately guide implementation.

Conflict of Interest

The authors declare no conflict of interest.

Ethics Statements

The studies involving human participants were reviewed and approved by the University of Johannesburg Ethics Committee with Ethical Clearance Number: Sem 1-2023-050. The participants were presented with a pre-section in the questionnaire where they indicated their informed consent to participate in this study.

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