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Online Instructional Delivery Practices for Improved Physics Learning in National Open University of Nigeria

Pratiques d'enseignement en ligne pour un meilleur apprentissage de la physique à l'Université nationale ouverte du Nigéria

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Abstract

This paper focused on how Open and Distance Learning (ODL) physics can be improved through learners-facilitators' instructional practices in National Open University of Nigeria. The study was guided by four research questions, and it sampled one hundred and twenty learners and twenty facilitators. Instruments used include (i) Learners Instructional Practice for Physics (LIPP); (ii) Learners Online Instructional Strategies for Physics (LOISP); (iii) Facilitators Instructional Practice for Physics (FIPP); and (iv) Facilitators Online Instructional Strategies for Physics (FOISP). These instruments were validated by five experts in physics education and Educational Evaluations for face and content validity. The reliability determined using Cronbach's alpha and value was found to be 0.75, 0.72, 0.70 and 0.69 for LIPP, FIPP, LOISP and FOISP, respectively. Descriptive statistics were used to analyze the data. Results on effective learner-related instructional practices in enhancing online physics education showed that learners should focus on social nature of learning and promote collaboration with other students for motivation. Also, it was found that learners should demonstrate prerequisite technology skills for the use of website. The importance of good study skills through course was emphasized. On the instructional practices that would enhance online physics programme by the facilitators, it was found that facilitators should employ regular action research to evaluate the success or failure of physics programme as well as provide learners with continuous, support and feedback. Also, scaffolding of virtual discourse construction should be made available for the learners. The instructional strategies that could be adopted by learner and facilitator to enhance practices in online practical physics classes revealed tutorial based computer, drill and practice, problem solving type and virtual laboratory among others. It was recommended that Physics facilitators and learners should keep abreast with the global online pedagogical best practices, for *positive learning outcome in physics.*

Key words: Online physics, Instructional delivery, learners-facilitator, Learning strategies, Open and Distance Learning.

Résumé

Cet article s'est concentré sur la manière dont le programme de physique dans l'enseignement ouvert et à distance (ODL) peut être amélioré grâce aux pratiques pédagogiques des apprenants-facilitateurs à la National Open University of Nigeria. L'étude a été guidée par quatre questions de recherche et a échantillonné cent-vingt apprenants et vingt animateurs. Les instruments utilisés comprennent (i) la pratique pédagogique des apprenants pour la physique (LIPP); (ii) le stratégies d'enseignement en ligne des apprenants pour la physique (LOISP); (iii) la pratique pédagogique des animateurs pour la physique (FIPP); et (iv) le stratégies d'enseignement en ligne des facilitateurs pour la physique (FOISP). Ces instruments ont été validés par cinq experts en enseignement de la physique et en évaluations pédagogiques pour la validité de la forme et du contenu. La fiabilité déterminée à l'aide de l'alpha et de la valeur de Cronbach s'est avérée être de 0,75, 0,72, 0,70 et 0,69 pour LIPP, FIPP, LOISP et FOISP, respectivement. Des statistiques descriptives ont été utilisées pour analyser les données. Les résultats sur les pratiques pédagogiques efficaces liées à l'apprenant pour améliorer l'enseignement de la physique en ligne ont montré que les apprenants devraient se concentrer sur la nature sociale de l'apprentissage et promouvoir la collaboration avec d'autres apprenants pour la motivation. En outre, il a été constaté que les apprenants devraient démontrer des compétences technologiques préalables à l'utilisation du site Web. L'importance de bonnes aptitudes à étudier tout au long du cours a été soulignée. Concernant les pratiques pédagogiques qui amélioreraient le programme de physique en ligne par les animateurs, il a été constaté que les animateurs devraient recourir à une recherche-action régulière pour évaluer le succès ou l'échec du programme de physique et fournir aux apprenants un soutien et une rétroaction continus. En outre, un échafaudage de construction de discours virtuels devrait être mis à la disposition des apprenants. Les stratégies pédagogiques qui pourraient être adoptées par l'apprenant et l'animateur pour améliorer les pratiques dans les cours de physique pratique en ligne ont révélé, entre autres, l'ordinateur, l'exercice et la pratique basés sur des tutoriels, le type de résolution de problèmes et le laboratoire virtuel. Il a été recommandé que les facilitateurs et les apprenants de physique se tiennent au courant des meilleures pratiques pédagogiques mondiales en ligne pour des résultats d'apprentissage positifs en physique.

Mots-clés : physique en ligne, prestation pédagogique, apprenants-facilitateur, stratégies d'apprentissage, apprentissage ouvert et à distance.

Introduction

The current context of globalization recognized that learners can study what they want, when they want and where they want in Open and Distance Learning (ODL). This mode of learning uses a set of approaches that allow open access to education and training provision, freeing learners from the constraint of time and place, and offering flexible learning opportunities to individuals and group of learners (UNESCO, 2002). In the developing countries including Nigeria, online learning has become an important part of higher learning for societal development (FRN, 2004; Rajadurai, Alias, Jaafar, and Hanafi, 2018)

According to National policy of education (FRN, 2004), the aims and objectives of University education is to make optimum contribution to national development by intensifying and diversifying its programmes for the development of high level manpower within the context of the needs of the nation. Physics as one of the major discipline in the university is intended to provide the basic developments needed in the society. Therefore, the stated goal would only be realizable if physics education is given the best attention. According to Okorodudu (2010), wide spread availability of the internet and common access to information with freely available novel technologies and types of social interactions could impact online teaching and learning exercise. In the same vein, Ellermeijer and Ba Tran (2019) asserted that technology can help to make physics education more relevant, authentic and increase the opportunities for investigations by the students. Therefore, the use of technology in teaching doesn't only change the way a teacher teaches, but also the way students learn (Hayes, 2007).

Colbec, Sakulwichitsintu, Turner, and Leonie (2014) reported peer learning as a good method to support student learning, with students able to learn with and from each other. As such, learners' interaction in online might be a source of motivation for meaningful learning. Furthermore, Yulirahmawati, (2008) asserted that educators can use those research findings to improve their competences and teaching and learning process. Introduction of quality research action can therefore be used for enhancing learners-facilitators' practices in online physics classes.

Hassett, Spuches, and Webster (1995) identified the use of email technique to allow students and faculty to join other learners of all ages, from all over the globe, in discussions of mutual educational interest. Furthermore, email can be a medium of sending assignment and peer critiques in online instructional strategy (Kennewell, 2006; Krishnan, 2012). In this way, email can be a useful communication technique in online learning.

Ferguson and Buckingham (2012) asserted that feedback is considered as a vital approach to facilitate students' development as independent learners in ODL in order to monitor, evaluate, and regulate their own learning. Similarly James, Krause, and Jennings, (2010) submitted that feedback is an essential element of improving the learning process of the students. Therefore, feedback is vital for enhancing learning in an online environment.
Hew (2015) opined that to provide a more comfortable, safe, and positive online learning experience, facilitators are encouraged to focus on "the social nature of learning," which emphasizes the need for interactions and discussions among students. Swan (2006) found that 'social nature of learning' is particularly important in encouraging and shaping collaborative activity online to provide both theoretical and practical grounding in the subject, especially physics. From these authors' point of view, some courses are designed to promote interaction and communication in teaching communities in other to foster online articulation, reflection, and collaboration throughout the learning and teaching process (Chan, 2019).

Despite the noble goal of physics, several constraints impede it realization. Physics enrolment which largely defines the developmental status of a nation has been on the decline in Nigeria (Samela, 2010; Mbamara and Eya, 2015). Furthermore, Gambari (2014) reported that physics programme via Open and Distance Learning (ODL) is faced with inadequate technology and digital divide, as well as inadequate customized and modularized courses. Other challenge are absence of good instructional practice in the use of computer-based technology for online teaching of physics and low enrolment of students in physics in Nigeria tertiary institutions (Mlambo, 2007; Ojih, Esiakpe, Okafor, 2016).

Considering the nature of ODL programme in removing most barriers in education and the need to adopt effective and efficient online instructional practices and strategies for the problems confronting physics, it is imperative that the learners and facilitators view on these issues be sought.

Statement of the Problem
Teaching of theory and practical component of physics to students spread all over the world through online learning has been posing challenges. The first is lack of effective online teaching training for facilitators with the consequence of incompetence in integrating technologies into pedagogical online practice to upkeep physics education across the curriculum and deliver opportunities for efficient student –student, student–facilitator communication in virtual environment (Dewes, 2001; Becta, 2004). The second challenge is inability of the facilitator to construct experiences, discussions and assessment that are

germane to students questions and expansion of their idea about scientific knowledge (Hammer, 2000). The third is lack of technical skills that may result in encountering obstacles during the process of usage of necessary technologies for online physics teaching and learning (Balanskat, Blamire, and Kefala, 2006; Özden, 2007; Ghavifekr , Afshari & Amla , 2012). The fourth is having no access to the Internet and lack of hardware which serves as impediment to technology integration in physics programmes (Al-Alwani, 2005). Experientially, unstable power shortage has also been found to be a major factor confronting online physics learning. Furthermore, Mbamara *et. al.,* (2015) reported that fewer numbers of students had continued to enroll in physics programme. As such, the above strands of challenges have been impeding physics education in Open and Distance Learning. The aim of this study is to identify some instructional learners-facilitators' practices to be adopted for effective online physics education programme in National Open University of Nigeria with a view to responding positively to the aforementioned challenges and improve physics performance.

Purpose of the Study:
This study was to identify some learners-facilitators' practices in instructional delivery and strategies that would enhance effective ODL physics education. Specifically, this study sought to determine:

i. Instructional practices that would enhance online physics programme as indicated by the learners.

ii. Instructional strategies that would engender online physics practical lesson classes for learners.

iii. Instructional practices that would enhance online physics programme as indicated by the facilitators.

iv. Instructional strategies that would engender online physics practical lesson classes for facilitators.

Research Questions:
This study was guided by the following research questions:
i. What are the effective learner-related instructional practices in enhancing online physics education programme?
ii. What instructional strategies could be best adopted as a learner to enhance best-practices in online practical physics?
iii. What are the effective facilitator-related instructional practices in enhancing online physics education programme?
iv. What instructional strategies could be best adopted as facilitators to enhance best-practices in online practical physics?

Methodology:

This study adopted a descriptive survey research design to determine some instructional delivery practices that could enhance effective online physics education programme as perceived by learners and facilitators.

Target Population

The target population was all physics education students in National Open University of Nigeria, totalling 200 due to low enrolment in physics. Twelve study centres spread all over the six geo-political zones of Nigeria were purposively selected based on the fact that they have physics education students and facilitators.

Sampling Technique and Sample

The sampling technique used in selecting participants for the study was multistage. First, two National Open University of Nigeria (NOUN) Study Centres with physics education students and facilitators were drawn from each geo-political zone of Nigeria. Secondly, simple random sampling was used to select ten students from each Study Centre. Total students that participated were one hundred and twenty (120). Three physics education lecturers were selected from each of these participating study centres, namely in North West, North East, South South and South East geo-political zones. Also, four physics educators each were selected from South West and North Central zones. This makes the total number of the facilitators to be twenty (20).

Instrumentation

Data was collected using adapted Instrument from Stevenson & Harris (2015). Although the instrument had already been validated, the adapted instruments were subjected to further validation because they were adapted and meant for another population. The four adapted instruments used include (i) Learners Instructional Practice for Physics (LIPP); (ii) Learners Online Instructional Strategies for Physics (LOISP); (iii) Facilitators Instructional Practice for Physics (FIPP), and (iv) Facilitators Online Instructional Strategies for Physics (FOISP).

LIPP and FIPP had two sections; A and B. Section A was on the bio-data of the learners and facilitators while section B consisted of 13 and 15 items designed to assess Learners' Instructional practice for physics and Facilitators' Instructional Best-practice for Physics respectively. Both instruments have Four-point Likert response scale of strongly disagree (1) at one end and strongly agree (4) at the other end which was used to measure all the items. For easy interpretation, respondents' responses to the four Likert scale were categorized into two namely; 1- 2.49 as not effective and 2.5 – 4.0 as effective. The LOISP and FOISP contain items that elicit information from students and facilitators on strategies for enhancing online physics classes, using a close ended questions regime, YES / NO answer. For easy interpretation of these two instruments, responses to the two response scale were grouped into two, namely; 1- 1.49 as Not standard and 1.5 – 2.0 as Standard.

The four instruments were validated by colleagues at the Faculty of Education, National Open University of Nigeria and University of Ilorin, Science Education Department. The four instruments were given to five experts in physics education and of Educational Evaluations to establish their face and content validity. The reliability of the instruments was determined using Cronbach's alpha and value was found to be and reliability determined as 0.75, 0.72, 0.70, and 0.69 for LIPP, FIPP, LOISP, and FOISP, respectively. Research questions 1 to 4 were answered with frequency counts, percentages, median, and mean using SPSS statistical tool.

Results:

The result of the study is presented in line with the research questions.

Research Question One: What is the effective learner-related instructional practice in enhancing online physics education programme?

Table 1: Pattern of Learner-Related Instructional Practices

SN	Online practices encourage Learners to:	SA	A	D	SD	Mean	Remark
		Freq(%)	Freq(%)	Freq(%)	Freq(%)		
1	Interact with other students for motivation	35 (29.2%)	62 (51.7%)	23 (19.1%)	(0%)	3.10	Effective
		80.9%		**19.1%**			
2	Focus on learning and promote collaboration with other students	40 (33.3%)	13 (10.8%)	66 (55.0%)	1 (0.8%)	2.77	Effective
		44.1%		**55.8%**			
3	Seek opportunities to interact with instructor	- (0%)	79 (65.8%)	40 (33.3%)	1 (0.8%)	2.65	Effective
		(65.8%)		**(34.1%)**			
4	Demonstrate their prerequisite technology skills at the beginning for hardware use	8 (6.7%)	79 (65.8%)	- (0%)	33 (27.0%)	2.52	Effective
		(72.5%)		**(27.0%)**			

5	Demonstrate their prerequisite technology skills at the end for software use.	11 (9.20%)	52 (43.3%)	57 (47.5%)	- (0%)	2.62	Effective
		(52.5%)		**(47.5)**			
6	Actively participate in all online activities.	20 (16.7%)	38 (31.7%)	42 (35.0%)	20 (16.6%)	2.48	Not Effective
		(48.4%)		**(51.6%)**			
7	Demonstrate prerequisite and become more proficient in technology communication skills	6 (5.0%)	46 (38.3%)	68 (56.7%)	- (0%)	2.48	Not Effective
		(43.3%)		**(56.7%)**			
8	Use a variety of communication techniques to enhance online learning.	8 (6.7%)	80 (66.7%)	32 (26.6%)	- (0%)	2.80	Effective
		(73.4%)		**(26.6%)**			
9	Not to publish online biographies for adequate concentration in learning.	8 (6.7%)	78 (65.0%)	33 (27.5%)	1 (0.8%)	2.78	Effective
		(71.7%)		**(28.3%)**			
10	Personalize themselves by publishing online photographs to allow other members of the class visualize them	41 (34.2%)	37 (30.8%)	21 (17.5%)	21 (17.5%)	2.82	Effective
		(65.0%)		**(35.0%)**			
11	Seek not assistance in understanding/ mastering different learning strategies.	16 (13.2%)	79 (65.8%)	24 (20.0%)	1 (0.8%)	2.92	Effective
		(79.0%)		**(20.8%)**			
12	Actively involved through writing and interaction in web-based courses	8 (6.7%)	47 (39.2%)	33 (27.5%)	32 (26.7%)	2.26	Effective
		(46.5%)		**(54.2%)**			

Criterion Mean = 2.50

Table 1 reveals learner-related instructional practice in enhancing online physics education programme. The scale had criterion mean value of 2.50. Also, critical examination of the table indicates that 85% of the items (1, 2, 3, 4, 5, 8, 9, 10, 11, and 12) were higher or equals to the criterion mean of 2.50. However, items such as 6 and 7 had mean value below 2.50.

Research Question Two: What instructional strategies could be adopted as a learner to enhance practices in online practical physics classes?

Table 2: Learners instructional strategies in online practical physics classes

SN	Encourage the use of:	YES	NO	Median	Remarks
		Freq(%)	Freq(%)		
1	Virtual laboratory	88 (73.3%)	32 (26.7%)	2.0	Standard
2	Computer Simulation	66 (55%)	54 (45%)	1.5	Standard
3	Mobile laboratories	74 (61.7%)	19 (4.2%)	2.0	Standard
4	Asychronisation Learning	66 (55.0%)	54 (45.0%)	1.5	Standard
5	Synchronisation Learning	51 (42.5%)	69 (57.5%)	1.5	Standard
6	Puzzle based learning	66 (55.0%)	54 (45.0%)	1.5	Standard
7	Tutorial based computer	83 (69.2%)	37 (30.8%)	2.0	Standard
8	Drill and Practice	82 (68.3%)	38 (31.7%)	2.0	Standard
9	Informational instruction	68 (56.7%)	52 (43.8%)	1.5	Standard
10	Educational Game	68 (56.7%)	52 (43.8%)	1.5	Standard
11	Problem Solving Type	75 (62.5%)	45 (37.5%)	2.0	Standard
12	Practical Oriented Instruction	60 (50.0%)	60 (50.0%)	1.5	Standard
13	Learning Affairs Managing Type	68 (56.7%)	52 (43.3%)	1.5	Standard

Criterion Median = 1.50

Table 2 depicts the instructional strategies that could be best adopted as a learner to enhance practices in online practical physics. A cursory look at the table shows that the median values of the items were higher than the criterion median of 1.50. This indicates that any of the strategies could be adopted by the learner in fostering their learning in online practical physics. However, strategies such as drill and practice, virtual laboratory, mobile laboratories, problem solving type and, tutorial based computer are best adopted compare to other strategies.

Research Question Three: What are the effective facilitator-related instructional practices in enhancing online physics education programme?

Table 3: Pattern of Facilitator-Related Instructional practices

SN	Encourages facilitator to	SA	A	D	SD	Mean	Remark
		Freq(%)	Freq(%)	Freq(%)	Freq(%)		
1	Provide students with continuous, frequent support and feedback.	4 (20.0%)	6 (30.0%)	10 (50.0%)	- (0%)	2.70	Effective
		50.0%		**50.0%**			
2	Use action research regularly to evaluate the success/failure of the course on his promotion.	8 (40.0%)	6 (30.0%)	6 (30.0%)	- (0%)	3.10	Effective
		70.0%		**30.0%**			
3	Forward responses at the end of each course to avoid duplication.	5 (25.0%)	7 (35%)	8 (40.0%)	- (0%)	2.85	Effective
		60.0%		**40.0%**			
4	Personalize communications between student-teacher	8 (40.0%)	6 (30.0%)	6 (30.0%)	- (0%)	3.10	Effective
		70.0%		**30.0%**			
5	Use of email technique to allow communication between students and faculty.	1 (5.0%)	13 (65.0%)	6 (30.0%)	- (0%)	2.75	Effective
		70.0%		**30.0%**			
6	Use variety of communication technique to provide for greater empathy and personal approach than web site.	6 (30.0%)	8 (40.0%)	6 (30.0%)	- (0%)	3.95	Effective
		70.0%		**30.0%**			
7	Plan for increase time for students' activities in the course	7 (35.0%)	9 (45.0%)	- (0.0%)	4 (10.0%)	2.95	Effective
		70.0%		**10.0%**			
8	Maintain separate e -mail account for web course.	2 (10.0%)	10 (50.0%)	6 (30.0%)	2 (10.0%)	2.60	Effective
		60.0%		**40.0%**			

9	Clearly delineate institution policy on cheating and plagiarism at start of course.	8 (40.0%)	(0.0%)	12 (60.0%)	- (0%)	3.40	Effective
		40.0%		**60.0%**			
10	Personalize communications among their colleagues only.	5 (25.0%)	2 (10.0%)	11 (55.0%)	2 (10.0%)	2.50	Effective
		35.0%		**65.0%**			
11	Give faculty members reduced load and increase support to develop course materials.	5 (25%)	11 (55%)	4 (20.0%)	- (0%)	3.50	Effective
		80.0%		**20.0%**			
12	Teach, while the students take notes.	7 (35%)	4 (20.0%)	9 (45.0%)	- (0%)	2.90	Effective
		55.0%		**45.0%**			
13	Scaffold virtual discourse construction	5 (25.0%)	6 (30.0%)	9 (45%)	- (0%)	2.80	Effective
		55.0%		**45.0%**			
14	Emphasize importance of good study skills through course	3 (15.0%)	17 (85.0%)	- - (0.00%)	**-** (0.00%)	3.15	Effective
		100%		0%			
15	Closely monitor each learner's progress on study skills.	3 (15.0%)	5 (25.0%)	11 (55.0%)	**1** (5.0%)	2.50	Effective
		40%		60%			

Criterion Mean = 2.50

Table 3 depicts facilitator-related instructional practices in enhancing online physics education programme. The scale had criterion mean value of 2.50. Also, the table showed that the mean values for all of the items were above or equals to the criterion mean of 2.50. The results show they are potent instructional practices in enhancing online physics education.

Research Question Four: What instructional strategies could be best adopted as a facilitator to enhance best-practices in online practical physics classes?

Table 4: Facilitators Instructional Strategies in Online Practical Physics Classes

SN	Encourage the use of:	YES	NO	Median	Remarks
		Freq(%)	Freq(%)		
1	Virtual laboratory	15 (75%)	5 (25%)	2.0	Standard
2	Computer Simulation	11 (55%)	9 (45%)	1.5	Standard
3	Mobile laboratories	12 (60%)	8 (40%)	1.5	Standard
4	Asychronisation Learning	11 (55%)	9 (45%)	1.5	Standard
5	Synchronisation Learning	8 (40%)	12 (60%)	1.5	Standard
6	Puzzle based learning	11 (55.0%)	9 (45.0%)	1.5	Standard
7	Tutorial based computer	15 (75%)	5 (25%)	2.0	Standard
8	Drill and Practice	14 (70%)	6 (30%)	1.5	Standard
9	Informational instruction	12 (60%)	8 (40%)	1.5	Standard
10	Educational Game	13 (65%)	7 (35%)	2.0	Standard
11	Problem Solving Type	13 (65%)	7 (35%)	1.5	Standard
12	Practical Oriented Instruction	10 (50.0%)	10 (50.0%)	1.0	Not standard
13	Learning Affairs Managing Type	8 (40%)	12 (60%)	1.0	Not standard

Criterion Median = 1.50

Table 4 revealed the instructional strategies that could be best adopted as a facilitator to enhance best-practices in online practical physics classes. A cursory examination of the table shows that the median values for larger percentage of the items were higher than the criterion median of 1.50. This indicates that any of these strategies could be adopted by the facilitator in enhancing online learning of physics education. However, some of the instructional strategies (such as oriented instruction and learning affairs managing type) were not too good to be adopted.

Discussion:

In general, eighty five percent of the learners-related instructional practices were perceived to enhance online physics education which focused on learning that promotes collaboration with other students. This finding support the view of Hew (2015), who reported that instructors should focus on the social nature of learning with emphasis on interactions and discussions between students. This also agrees with Swan (2006) who asserted that it is important to encourage collaborative activity online with emphasis on both theoretical and practical physics learning. Collaboration and social nature of learning instructional practices that enhanced online physics as evidenced in this study could help to solve the autonomous and self –regulated learning problems. Thus, improve students learning gains.

In this study, learners demonstrated prerequisite technology skills for the use of website. This confirms the findings of Ellermeijer & Ba Tran (2019) who showed that technology can make physics education more relevant, authentic and linked to real life, as well as increase the opportunities for investigations by the students. The skills of the learners in technology obtained in this investigation might make the student adjust their environment to virtual learning environment needed for optimum performance in online physics. In contrast, Kirkwood and Price (2006) asserted that technology-led innovations do not in themselves lead to improved educational practices.

Furthermore, learners-related instructional practices showed learners' should seek opportunities to interact with facilitators. This finding is consistent with the view of Ferguson and Buckingham (2012) who stated that student interactions can be supported by facilitators through online discussion forums; thereby learners and facilitator interact for meaningful learning in a virtual environment. The learners' strive to interact with facilitators might result in goal oriented learning in physics, since facilitators' role is to monitor and regulate important aspect of the learning process in ODL.

The facilitator-related instructional practices in enhancing online physics education programme showed that facilitators should employ regular action research to evaluate the success or failure of physics programme. This is in agreement with Yulirahmawati (2008) who asserted that educators can use research findings to improve their competences and skills in pedagogy. Regular conduct of action research is important because of the need to proffer solution to the problems of low enrolment and poor performance in online physics. Apata (2017) had reported perennially low achievement in physics.

In this study, use of email technique allows communication between students and faculty. This is in tandem with Hassett, Spuches and Webster (1995) who asserted that electronic is a useful educational tool that can enhance learning in any curriculum, also it allows students and faculty to join other learners of all ages, from all over the globe, in discussions of mutual educational interests. The email technology could give facilitators privilege to monitor the performance of their learners in specific tasks, who could also render support and receive feedback from the learners.

Further finding on facilitators-related instructional practices in enhancing online physics revealed that students are to be provided with continuous, frequent support and feedback. This is in line with Ferguson and Buckingham (2012) who asserted that feedback is considered as a vital approach to facilitate students' development as independent learners in order to monitor, evaluate, and regulate own learning. Also, the finding agreed with James, Krause, and Jennings (2010) who submitted that feedback is an essential element of improving the learning process of the students. This finding from this study might be ascribed to facilitators' ability to calibrate and determine the trajectory of learning in online physics through meaningful learner's support and assessment.

Also, facilitators were found to have clearly delineated institution policy on cheating and plagiarism at start of course. This is in agreement with Stonecypher and Willson (2014) that faculty and students should jointly participate in the policy's development and enforcement and receive initial orientation and regular reinforcement of the policy. Since one of the problems of ODL is the propensity to malpractices in assignments, test and examination. Therefore, this finding could bring self-discipline that ensures learners' realization of the needs and aspirations. The facilitators further provided scaffolding virtual discourse construction as evidenced in this study. This agrees with the finding of Liadi (2013) who asserted that mental representation of the virtual context is a necessary basis of successful online conversations. It is possible that provision of scaffolding virtual discourse in online physics could aid scientific visualization in physics.

Facilitators' emphasis on importance of good study skills through course might help students develop habit that will result in productive study for good performance.

Most of the instructional strategies considered such as virtual laboratory, mobile laboratories, and problem solving type, tutorial based computer and drill and practice are best adopted compared to others. This is in tandem with the findings of Sun and Chen (2016) who reported that failure of any University to make technology effective in its learning system might lose the chance to improve student outcomes and expectation of students' that are accustomed to technology in their daily life. Popularity that technologies have gained in removing time and space barriers in education might be responsible for the magnitude of this result. However, oriented instruction and learning affairs managing type were adjudge not too good to be adopted by the facilitators. This could be ascribed to the unpopularity of the latter among the web-based instructional strategies.

Conclusion

It was found that students and facilitators' related instructional practices were enhanced in online physics education in the following areas: learners should focus on social nature of learning and promote collaboration with other students; they should also demonstrate prerequisite technology skills for the use of website and seek opportunities to interact with facilitators to enhance online learning in physics. Facilitators should employ regular action research to evaluate the success or failure of physics programme as well as providing learners with continuous, frequent support and feedback. Scaffolding of virtual discourse construction should be made available to learners, who should also be provided with clearly delineated institutional policy on cheating and plagiarism at commencement of a course. The study also revealed the use of email technique to allow communication between students and faculty. The instructional strategies considered were found standard, except Oriented instruction and Learning affairs managing type. The instructional practice and instructional strategies that were found effective and standard respectively could be adopted in NOUN and other ODL institutions in the developing countries.

However, the learners recorded 'not effective' for items that are crucial to online success in physics learning. The items are (i) demonstrate prerequisite and become more proficient in technology communication skills, (ii) actively participate in all online activities.

Furthermore, for items on instructional strategies the facilitators recorded 'Not Standard' for 'Practical Oriented Instruction'. The responses show that the awareness of learners and facilitators about online learning is low. Therefore, there will be need to organize awareness programme that is physics online learning oriented, to improve physics learners and facilitators' knowledge for better performance.

Recommendations:

The following recommendations were made:

1. Physics facilitators and learners at the National Open University of Nigeria should be abreast with global online pedagogical best practices, for positive learning outcome in physics.

2. Physics facilitators should be given online pedagogical training that would identify learners' needs for realization of physics goals.

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