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### Online Formative Assessments and Undergraduates' Psychomotor Skills

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#### Abstract

*Online learning assessments have metamorphosed instruction's bearing by providing students with great learning opportunities over the web tailored to drive exploratory inquiry. The study sought to investigate the role of online formative assessments in enhancing students' psychomotor skills in Physics. The Researchers adopted descriptive research and purposively sampled 187 300-level physics students in Southeast universities in Nigeria. The instrument for data collection was titled "Online Formative Assessment and Psychomotor Skills Scale" (OFAPSS), developed by the researchers. The instrument (OFAPSS) was validated by three experts from the Department of Science Education, University of Nigeria, Nsukka. The internal consistency of OFAPSS was determined using Cronbach's Alpha, and a reliability index of 0.87 was obtained. Mean and standard deviation were used to address the three research questions that guided the study. From the study findings, students agreed that online formative assessment enhanced their psychomotor skills in Physics, among others. In line with findings, the study recommended, among others, that teachers and school administrators should utilize and encourage students to explore online formative assessment platforms that will enhance their psychomotor skills in learning physics.*

**Keywords:** Assessment, Formative Assessments, Online Formative Assessment, Physics, Psychomotor skills

#### Introduction

The advent of the internet has continued to lend handy benefits in almost every facet of life, particularly for instruction in our learning spaces. The creep-in of the internet into our learning spaces has been accompanied by many online capabilities including online assessment tools,

which is gradually metamorphosing the landscape of assessments among other phases of students' learning experiences. Serially, the shift has been towards assessments that improve the quality of students learning (formative assessment), with less emphasis on the summative assessment of learning. In the views of Biggs and Tang (2011), assessment for learning has been widely discussed to improve students' achievement and has been an ancient strategy for catalyzing learning. Nworgu (2015); and Novita and Yang (2021) agree in their account that the role of formative assessment extends to helping teachers and students identify areas where improvement is much required. Suffice then to say, that formative assessments are diagnostic which could help improve learning.

Online formative assessments (OFAs) are becoming increasingly popular in our learning spaces and constantly adapted to, owing to the rising tide of technology and its transforming role in assessment practices. The twenty-first-century student has access to computers, tablets or smartphones which provide the learning convenience to interact and to engage online formative assessment tools. Among such numerous online formative assessment tools are Hurix, Socrative, Mentimeter, Poll Everywhere, Hahoot, Quizlet Live, Thing link, TestGorilla, Google Forms, Moodle, Nearpod, EDpuzzle, Quizizz, Flipgrid, Formative, SMART Lab, Class Flow, Turnitin, among others. These interactive formative assessment tools are increasingly taking centre stage due to the flexibility, customization and immediate feedback they offer which serve useful essence while learning is ongoing. A myriad of empirical evidence from studies endorses online formative assessments for its role in improving students learning and achievement (Gikandi, 2010; Phelps, 2010; Dermo, 2011; Furnham, Batey & Martin, 2011; Gikandi, Morrow & Davis, 2011; Lemanski, 2011; Russell & Barefoot, 2011; Wilson, Boyd, Chen & Jamal, 2011; Goldstein & Behuniak, 2012; Baleni, 2015; Verma, 2020). Online formative assessment can also be viewed as a form of guided inquiry that can facilitate the improvement of students' psychomotor skills (Septyowaty, Azizahwati, & Syafii, 2023). According to Hofstein (2017); Orji and Ike (2020); Kennepohl (2021); and Balmeo (2022), science process skills are fundamental components of students' psychomotor learning.

Effective learning requires the attainment of a significant portion of the a priori instructional objectives. According to Bloom (1956), as cited in Airasian (1994), educational learning objectives are defined in a tripod of perspectives: the cognitive domain, which entails the knowledge component of the learning concept; the affective domain, which has to do with the feelings associated with the learning content; and thirdly, the psychomotor domain, which encapsulates performance of tasks associated with the learning content. Perhaps one can say, that the usefulness of instruction is expressed in motor skills which involves "the doing of learning". Sadly, studies have shown that learning by doing, otherwise described as learning for productivity is often relegated in most learning spaces in developing countries (Yani, Safitri, Usman & Dahlan, 2020), a situation in which Nigeria is not exempted. This puts students in difficult situations concerning achievement in psychomotor skill areas in physics at such terminal examinations where the emphasis for assessment is summative.

Although, the study focuses on undergraduates, chief examiners' reports of West African Examination Council (WAEC) and National Business and Technical Examinations Board (NABTEB) over the years blame the poor achievement in Physics on the unsatisfactory performance of students in skill-based areas in the subject. This implies that the problem of poor achievement of students in Physics may likely be caused by students' poor psychomotor skills. According to Nworgu (2016), psychomotor skills, otherwise physical skills, entail actions which involve the use of the body in the performance of activities such as coordination, manipulation,

fluency, strength, and speed among others. Conforming to Ferris and Aziz (2005), such skills cover actions which demonstrate recognition; handling; basic, competent and expert use of instruments, tools and materials; planning of work operations; and expert evaluations of outputs and improvement. These skills are necessary for the development of psychomotor skills of students in Physics. However, consistent with the view of Yani, Safitri, Usman and Dahlan (2020), the present study frames psychomotor skills to encapsulate recognition and handling of tools and materials; use of tools and materials, analyzing and planning of work procedures; and interpretation and presentation of experimental results.

To mitigate the exigency for the improvement of students' psychomotor skills in physics, the study considered probing the role of online formative assessments in enhancing students' psychomotor skills in Physics, in light of the great learning opportunities tailored to drive exploratory inquiry which students experience over the web. To this end, the study sought to investigate the role of online formative assessments and students' psychomotor skills in Physics.

### **Research Questions**

The study was guided by the following questions:

1. What are the Physics students' psychomotor skills that can be measured through online formative assessments?
2. To what extent does online formative assessments improve students' psychomotor skills in Physics?
3. In what ways can online formative assessments be used for improving students' psychomotor skills in Physics?

### **Methods**

The design adopted for this investigation is descriptive. A descriptive study according to Nworgu (2015) is one in which the researcher studies a representative portion of the entire population to provide information about the characteristics of the population in focus. The study was carried out in South-East universities in Nigeria, specifically, the five federal universities, including the University of Nigeria, UNN Nsukka; Nnamdi Azikiwe University; Michael Okpara University of Agriculture, Umudike; Federal University of Technology, Owerri; and Alex Ekwueme Federal University, Ndufu- Alike, Ikwo. The population of the study comprised all the Physics education students in the universities.

A purposive sampling procedure was employed to sample 187 300-level physics students who took part in the study. The instrument for data collection was a four-point Likert response type scale developed by the researchers titled "Online Formative Assessment and Psychomotor Skills Scale" (OFAPSS). The OFAPSS elicited responses to the use of online formative assessments and how it impacted physics students' psychomotor skills. The instrument (OFAPSS) was validated by three experts from the Department of Science Education, University of Nigeria, Nsukka. The internal consistency of OFAPSS was determined using Cronbach's Alpha and a reliability index of 0.87 was obtained. Mean and standard deviation obtained from the analyses of data using SPSS v.25 were used to address the research questions which guided the study. A criterion mean of 2.50 was adopted to interpret the output from the analysis.

### **Results**

Findings from the analysis of data collected were presented in tables in line with the research questions posed in the study.

**Research Question One:** What are the Physics students' psychomotor skills that can be

S/N	Item Statement	N	Median	Decision
1.	My recognition of Physics tools can be measured through online formative assessments.	187	2.72	Agree
2.	My handling of Physics tools can be measured through online formative assessments.	187	3.07	Agree
3.	My usage of Physics tools can be measured through online formative assessments.	187	3.34	Agree
4.	My control of Physics tools can be measured through online formative assessments.	187	3.30	Agree
5.	My operation of Physics tools can be measured through online formative assessments.	187	3.33	Agree
6.	My analyzing of Physics work procedures can be measured through online formative assessments.	187	2.83	Agree
7.	My planning of Physics work procedures can be measured through online formative assessments.	187	2.97	Agree
8.	My interpretation of Physics experimental results can be measured through online formative assessments.	187	2.81	Agree
9.	My presentation of Physics experimental results can be measured through online formative assessments.	187	2.72	Agree
10.	My evaluation of Physics experimental results can be measured through online formative assessments.	187	2.93	Agree
<b>Cluster Total Mean</b>			<b>3.00</b>	<b>Agree</b>

measured through online formative assessments?

**Table 1** Physics students' psychomotor skills on online formative assessments

Result in Table 1 shows that all the physics students psychomotor skills can be measured through online formative assessments at an acceptable level ( $\bar{x} = 3.00$  and  $SD = 0.32$ ), above the benchmark mean of 2.50. The responses ( $\bar{x} = 3.07$  and  $SD = 0.26$ ) for item 2 (on measuring handling of Physics tools through online formative assessments) shows the least variation in the students' response which implies that most of the students agree that handling of Physics tools can be measured through online formative assessment. The analysis of data collected also shows ( $\bar{x} = 2.72$  and  $SD = 0.81$ ) for item 9 (on measuring presentation of Physics experimental results through online formative assessments) shows the largest variation in the students' response which implies that most of the students vary in their resolve on measuring student presentation of Physics experimental results through online formative assessments.

**Research Question Two:** To what extent does online formative assessments improve students' psychomotor skills in Physics?

S/N	Item Statement	N	$\bar{X}$	Decision
1.	Online formative assessment enhances my physical skills in Physics.	187	3.28	High Extent
2.	Online formative assessment develops my ability to manipulate Physics tools.	187	3.28	High Extent
3.	Online formative assessment develops my ability to operate Physics tools.	187	3.30	High Extent
4.	Online formative assessment develops my ability to recognize Physics tools.	187	3.19	High Extent
5.	Online formative assessment develops my ability to handle Physics tools.	187	3.13	High Extent
6.	Online formative assessment develops my ability to use Physics tools.	187	2.67	High Extent
7.	Online formative assessment helps me identify areas for improvement in my manipulative skills in Physics.	187	3.03	High Extent
8.	online formative assessment help me develop confidence in my manipulative skills in Physics.	187	2.82	High Extent
9.	Online formative assessment improves my ability properly present my Physics experimental results.	187	2.62	High Extent
10.	online formative assessments help me develop my ability to plan work procedures in Physics.	187	3.30	High Extent
<b>Cluster Total</b>			<b>3.06</b>	<b>High Extent</b>

**Table 2: Extent of improvement of students' psychomotor skills due to online formative assessment**

Result in Table 2 shows a high extent ( $\bar{x} = 3.06$  and  $SD = 0.37$ ) of improvement on students' psychomotor skills due to exposure to online formative assessments, above the benchmark mean of 2.50. The responses ( $\bar{x} = 3.30$  and  $SD = 0.58$ ;  $\bar{x} = 3.30$  and  $SD = 0.55$ ) for items 3 and 10 respectively (on operating Physics tools and planning work procedures in Physics) had the highest means which implies that most of the students believe that online formative assessments improve their abilities to operate Physics tools and to plan work procedures in Physics. Item 9 on presenting Physics experimental results showed a low response in the cluster ( $\bar{x} = 2.62$  and  $SD = 0.59$ ). The analysis of data collected also show ( $\bar{x} = 3.03$  and  $SD = 0.35$ ) for item 7 (identifying errors). This implies that most of the students unanimous in their response that online formative assessment helps identify areas for improvement in Physics manipulative skills.

**Research Question Three:** In what ways can online formative assessments be used for improving students' psychomotor skills in Physics?

S/N	Item Statement	N	$\bar{X}$	Decision
1.	Engaging in online formative assessments in the form of interactive simulation can improve my manipulative skills in Physics.	187	3.08	Agree
2.	Streaming online videos of my manipulation of Physics tools and receiving relevant feedback can help improve my manipulative skills in Physics.	187	3.26	Agree
3.	Answering online quizzes can help improve my manipulative skills in Physics.	187	3.58	Agree
4.	The feedback I receive from online submission of my offline recorded videos can help improve my manipulative skills in Physics.	187	3.53	Agree
5.	Online formative assessments in the form of games with challenging levels and rewards can help improve my manipulative skills in Physics.	187	3.55	Agree
6.	Online formative assessments targeted at analyzing other people's manipulation of Physics tools can help improve my manipulative skills in Physics.	187	2.58	Agree
7.	Online formative assessments targeted at criticizing the flaws in other people's manipulation of Physics tools can help improve my manipulative skills in Physics.	187	3.03	Agree
8.	Using challenging tasks from online formative assessments to target my learning goal can help improve my skills in manipulating Physics tools.	187	2.75	Agree
9.	Online practice sessions with friends can help improve my manipulative skills in Physics.	187	2.48	Disagree
10.	Online mobile applications that offer guided practice and progress tracking sessions can help improve my manipulative skills in Physics.	187	3.25	Agree
<b>Cluster Total</b>			<b>3.11</b>	<b>Agree</b>

**Table 3: Ways in which online formative assessments can be used for improving Physics students' psychomotor skills.**

Result in Table 3 shows an acceptable level ( $\bar{x} = 3.11$  and  $SD = 0.27$ ), above the set benchmark mean of 2.50 indicating that students agree that students' psychomotor skills can be improved in certain ways of formative assessment. Item 3, on answering online quizzes, had the highest mean response ( $\bar{x} = 3.58$  and  $SD = 0.50$ ); indicating that most students agree that answering online quizzes can help improve students' manipulative skills in Physics. The result also indicates ( $\bar{x} = 2.48$  and  $SD = 1.00$ ) for item 9 (on online practice sessions with friends) had the least mean responses and the highest variation recorded in the study, implying that most of the students disagree with improvement in students' manipulative skills in Physics due to engagement in online practice sessions with friends. Yet, their responses opinions were very different.

## **Discussion of Findings**

The result of this study shows that physics students agree that psychomotor skills in Physics can be measured through online formative assessments. Moreso, the physics students are aware that these psychomotor skills can be measured through online formative assessments. The awareness of some online formative assessments and engagement of some could be for the purpose of improving their psychomotor skills in Physics. Given also, that most students in tertiary institutions have access to the internet of things, in one way or the other, it is believed that they may have assessed one or more of these online formative assessments relevant to the psychomotor skills necessary in Physics. This result may also be plausible because students are becoming more aware of the fact that the world is technology-driven and its relevance stems from what one is capable of doing. This may have been the reason why the students are keen to identify the online formative assessments. The result of this study is more likely due to the global demand for more technically inclined individuals to work the industrial economy. This finding aligns with the position of Yani, Safitri, Usman and Dahlan (2020).

The findings of this study also show that online formative assessment has the potential to enhance students' psychomotor skills in Physics. From the outcome of the study, evidence shows that students' engagement in online formative assessments can trigger an improvement in students' psychomotor skills. This may be so because online formative assessments extend learning by presenting new challenges which may further shape the trajectory of instruction and refine the teacher's methodology for goal-inclined learning. With the huge interest to explore and to discover more, students may go the "extra mile" to learn what once posed a challenge during the online formative assessment. The great flexibility and adaptive essence of the online formative assessment make it accessible from any remote device or location, thereby increasing students' comfort while presenting learning far from the classroom, yet unfailingly guiding instruction as well. The findings of the study strengthen the evidence drawn from the studies of Gikandi, Morrow & Davis, 2011; Lemanski, 2011; Russell & Barefoot, 2011; Wilson, Boyd, Chen & Jamal, 2011; Goldstein & Behuniak, 2012; Baleni, 2015; Verma, 2020.

The findings of this study also indicated that students' psychomotor skills can be improved upon in certain ways of formative assessment. If properly applied, online formative assessments will yield the desired result in improving students' psychomotor skills. The findings of the study drew attention to the issue of engaging in online practice sessions with friends. The study showed that this is likely to be counterproductive as friends may abandon the essence of the online formative assessment and drift perhaps to other irrelevances. However, this has not ruled out the place of productive friendships which may encourage one another. This perhaps may be the likely cause of high variation with respect to the postulation. However, the evidence from the study shows that at most times, it may not improve students' psychomotor skills when students engage online formative assessments in practice sessions with their friends.

## **Conclusion and Recommendations**

The penetration of technology has warranted the current drive for assessments to be carried out over the web with a focus on improving the quality of guiding instruction. Students access online formative assessments to improve their learning and in particular their psychomotor skills. The goal is that online formative assessments can be deployed to measure and to improve students' psychomotor skills. However, the ways in which these online formative assessments are deployed

can have a consequential impact on the desired outcome. Hence, the researchers recommend the following in line with the findings of the study:

1. Students should be encouraged and motivated to utilize online formative assessment resources for improving their psychomotor skills in learning Physics.
2. Teachers should be encouraged, perhaps with incentives, to incorporate online formative assessments in their pedagogy.
3. The government should partner with assessment experts and bodies like the Educational Assessment and Research Network in Africa (EARNiA) and tech-inclined companies for workshops and seminars for teachers on best practices in “online formative-psychomotor assessments”. Again, given the high cost of accessing internet resources and purchasing associate smart devices, the government should step in to subsidize the cost of accessing the network by ensuring free access to educational resources and other technological devices.
4. School administrators should be encouraged to furnish their schools with the required technological devices and access to internet facilities to drive online formative assessments that improve Physics students’ psychomotor skills.
5. Education curriculum planners and policymakers should consider integrating online formative assessments into the curriculum to improve Physics psychomotor skills.

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