

Pre-Service Science Teachers' Innovativeness and Technology Self-Efficacy as Discriminants of their Acceptance of Learning Management System in Oyo Town

RAIMI, S. O., Ph.D., BOLAJI, O. A., ADESINA, A. E., Ph.D.

General Studies Education Department, School of Education, Emmanuel Alayande College of Education, Oyo, Oyo State

*Corresponding author: e-mail:

ABSTRACT

Evidence in research pointed to the efficacy of Learning Management System (LMS) in revitalising the cognitive, affective and the psychomotor domains of science education. The COVID-19 pandemic brought the new normal world which impinge the more on the need for LMS. Research reports equally documented the positive impacts of students' perceived ease of use and perceived usefulness on technology acceptance. Also, Research findings have affirmed the positive correlation between students' technology self-efficacy and innovativeness. However, there is a dearth of literature on the discriminant effects of pre-service science teachers' innovativeness and technology self-efficacy on their acceptance of LMS. Therefore, this study investigates pre-service science teachers' innovativeness and technology self-efficacy as discriminants of their acceptance of LMS in Oyo town. 322 pre-service science teachers from the two colleges of Education in Oyo town selected using cluster random sampling technique. Three research questions and one hypothesis guided the research. Three validated instruments: Pre-service Science Teachers Innovativeness Scale (PSTIS; R=.85) Pre-service Science Teachers Technology Self-efficacy Scale (PSTTSS, R=.73) and Pre-service Science Teachers' Learning Management System Acceptance Interview (PSTLAI; IRR=.71).. Data were analysed using frequency counts and percentages, mean standard deviation, thematic and discriminant analyses Pre-service Science Teachers have average mean scores in innovativeness and technology self-efficacy. Majority agreed to accept LMS for teaching and learning of science courses. There is a significant pre-service science teachers innovativeness ($\lambda=812$; $F_{(1, 320)}= 74.113$, $p<.05$); and technology self-efficacy ($\lambda=.725$; $F_{(1, 320)}= 121.547$, $p<.05$) discriminant of their acceptance of LMS.. Therefore, all science lecturers should adopt LMS for science teaching and learning to boost the pre-service science teachers' innovativeness and their technology self-efficacy.

Keywords: Acceptance of Learning Management System (LMS), Pre-service science teachers', innovativeness, Pre-service science teachers' technology self-efficacy, Discriminant analysis

Introduction

Antecedent to the new world normal was educational delivery system too transmissional, less active individuals, less active collaboration, non-heuristic delivery, less pragmatic, less hands-on-mind-on, convention instructional system. The new normal world birth the Learning Management System (LMS) which is a technological application software that embed instructional modules, sync the modules with quizzes, forum discussion, assignment, videos, games, active collaboration, instructional analytics that enhances and empowers the learners as well as instructions facilitators with interactivity and engagement (Gambari, 2021; Nguyumen, 2021). Instructional modules embedded in LMS are usually designed with appropriate Instructional System Design (ISD) like ADDIE (An ISD with elements of Analysis,

Design, Development, Implementation and Evaluation). Such succinctly packaged instruction in modules, laden with both the formative and the summative evaluation enriches and enables learners instructional comprehension and learnability.

LMS is premised on the constructivists and behaviourists learning theories. The two learning theories believed that cybernetics, the use of instructional technologies have both stimulating efforts on the learners which enhance their assimilation and accommodation of instruction (Ehinder, 2014; Olagunju & Adesina, 2017). Evidence in research signal that learning management system raises the learners' cognitive, affective and the learners' psychomotor domains of learning. LMS grabs students' attention (Adebiyi, 2019; Gambari, 2021), it enthruses learners' interests (Okebukola,

2021; Gambari, 2021), LMS empowers the learners and instructional facilitators interactivity and engagement in teaching – learning process (Gambari, 2021; Adesina & Bamikole, 2022).

However, irrespective of the instructional merits of LMS in teaching – learning process, its acceptance is still at low ebb. Are students’ acceptance or otherwise of Learning Management Systems (LMSs) a discriminant of their innovativeness and technology self-efficacy? What is the pre-service teachers’ innovativeness?

Innovativeness is sine qua non to creativity. Being innovative means being creative, bringing new ideas, new products and new strategies to the old paradigms of doing things. Innovativeness and acceptance of innovations (new ideas) like learning management systems (LMSs) are positively correlated (Samsag, 2016; Adesina, 2019). The degree of an individual’s innovativeness predicts individuals’ acceptance of technology (Gambari, 2021; Okebukola, 2021; Obanya, 2021). Creativity or innovativeness was defined by (Torrance (1995) in Agommuohand and Ndirinka (2014) as recognizing the gap in the problem or information, finding ideas or hypotheses testing and developing these hypotheses and transmitting the data obtained. It entails the tendency to generate ideas that may be useful in solving problems.

According to Agommuoh and Ndirinka (2014) individual innovativeness can be due to the need for novel, varied and complex stimulation, need to communicate ideas and values and the need to solve problems. In the new normal world preceded by the Covid-19 pandemic, the three needs came into play “being novel, communicate ideas and values, and to solve problems”. Okankwo (2014) quoting MediaPlanet (2013) identified prospects of technology like Learning Management Systems (LMSs) as relevant to creativity and innovativeness; as a shift towards online experimental field trips and collaborative learning opportunities as access to technology and interest continuous to grow; possibility to use technology to adjust and creative novel paths to meet individual learning needs and technology having positive impacts in contents creation and content delivery in classroom which produces innovativeness.

Bardakel and Arpacı (2019) described innovativeness as any object, idea, technology or practice that is perceived to be new by an individual or group or society. The implementation of a new of significantly improved product

(good and services) or processes, work, organization or external relation. Cokler and Ozbek (2017) conceived innovation from the opinion of Rogers (2003) that any idea, practice or object that is perceived as new by an individual or other unit for adoption. The researchers submitted that individual innovativeness is a theory of developing, adopting or implementation of innovation by an individual. Hunt, Joseph and Cokk (2013) categorized individuals according to innovativeness as innovators, early adopters, early majority, late majority and the laggards or traditionalists. Rogers (2003) gave a percentage representation of each category of innovativeness in any society as innovators (2.5%), early adopters (13.5%), early majority (34%), late majority (34%) while the laggards have the remaining 16% of the society.

Related to pre-service science teachers’ innovativeness is their technology self-efficacy that examines individual capability to will and to accomplish a task. A student’s self-efficacy is predicated by the study, attitude towards an issue, objects or events, the student’s vicarious experiences and the students’ learned behaviours (Bandura, 1997). Technology, which brings innovativeness and creativity, like LMS, does it discriminate the pre-service teachers’ technology self-efficacy?

Bandura (1986) in Banoglu, Vanderlinde and Yildiz (2013) defined self-efficacy as individual judgements about one’s own capabilities to organize himself or herself and get into action in alignment with desired goals. Hence, technology self-efficacy can be described as ones judgement of one potential to use technology. Students with high higher levels of self-efficacy about technology use more and easily accept technological tools and application software and experience less technology-related anxiety. Technology self-efficacy acts as blueprints for the acquisition of the 21st Century skills in effective critical thinking, creativity, communication, collaboration, self-regulation and real world problem-solving skills (Aesaert, et. al, 2013)..

Pre-service science teachers’ technology self-efficacy, according to the International Society for Technology in Education (ISTE, 2008), enhances students to help and inspire fellow students in learning and creativity; able to create and develop learning experiences and evaluate on of lesson with digital tools; able to create a working model for studying and learning processes of the digital age; able to

create a working model for developing digital citizenship and its responsibilities and being concerned with professional development and leadership.

Evidence in research indicated that pre-service teachers with high technology self-efficacy usually have high creativity (innovativeness), being technologically literate, using technology in class, directing and helping others to use technology (Torkzadeh & Van Dyke, 2002; Dogru, 2017; Park & Park, 2020). The study of the pre-service science teachers' innovativeness and technology self-efficacy, as a discriminant of their acceptance of Learning Management System, is premised on the Theory of Reasoned Action (TRA) and the Theory of Planned Behaviour (TPB) of Ajzen (1991). Ajzen suggested that the TPB extended the TRA which apply to situations in which behavior is determined by three beliefs: behavioural beliefs, subjective beliefs and the control beliefs, among such beliefs that can influence technology acceptance are technology self-efficacy and innovativeness. The study on pre-service science teachers' innovativeness and technology self-efficacy as discriminant of their acceptance of learning management system, is pivoted by the Technology Acceptance Model (TAM) by Davis (1989). Davis (1989) explained that individual acceptance or non-acceptance of technology is premised on the individual perceived usefulness and the perceived ease of use of the technology.



Fig. 1: **Technology Acceptance Model** (Davis, 1989)

With the Ajzen's TPB which subsumed technological acceptance in behavioural, subjective and control beliefs, the Davis (1989) TAM can be modified as:

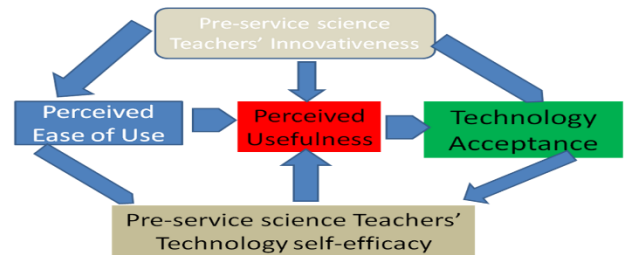


Fig. 2: **Conceptual Framework of Pre-service Science Teachers' LMS Acceptance, Innovativeness and Technology Self-efficacy**
(Adapted from Davis (1989) TAM)

Figure 2 indicates that the pre-service science teachers' innovativeness influences their perceived ease of use of technology like LMS, it influences their perceived usefulness of the technological software which invariably influences their acceptance of LMS. Equally, the pre-service science teachers' technology self-efficacy influences their perceived usefulness, perceived ease of use which invariably influences their acceptance of Learning Management System (LMS).

Statement of the Problem

Acceptance of Learning Management Systems (LMSs) by learners is a function of many constructs such as their perception, attribute, self-concept, self-esteem, mental ability motivational level, innovativeness, self-efficacy especially as related to technology, evidence in research pinpointed the efficacy of LMSs in raising learners' cognitive, affective and the psychometer domains of learning. research reports equally have documented the prediction capacity of students' innovativeness and technology self-efficacy on technology acceptance. However, there is no available research finding on the discriminant of LMS acceptance on learners' innovativeness and technology self-efficacy. Therefore, this study investigates pre-service science teachers' acceptance of learning management systems as a discriminant of their innovativeness and technology, self-efficacy in Oyo town.

Objectives of the Study

The main thrust of the research was to investigate the pre-service science teachers' LMS acceptance as a discriminant of their innovativeness and technology self-efficacy in Oyo town.

The specific objectives of the study were to

- i. examine the level of pre-service science teachers' innovativeness in Oyo town;
- ii. assess the level of pre-service science teachers' technology self-efficacy in Oyo town;
- iii. evaluate the categories of pre-service science teachers as regards acceptance of LMS.

Research Questions

The following questions were answered in the study.

- i. What are the pre-service science teachers' level of innovativeness and technology self-efficacy?
- ii. Which categories of pre-service science teachers are most prominent based on innovativeness?
- iii. What are the categories of the pre-service science teachers, based on LMSs acceptance?

Hypothesis

A null hypothesis tested at 0.05 level of significance guided the study:

There is no significant pre-service science teachers' innovativeness and technology self-efficacy as discriminants of their acceptance of LMS as in Oyo town.

Methodology

A mixed methods of qualitative and quantitative types of research in concurrent triangulation of descriptive survey research was adopted for the study. All the science pre-service teachers of Federal College of Education (1094) and Emmanuel Alayande College of Education (792) constituted the population of the study. The sample of 330 were selected from the total

population using the cluster random sampling technique based on students' types of institution (Federal and State) and their gender (male and female). A total of 130 and 200 pre-service science teachers were randomly selected from the three levels of EACOED and SPED respectively. Three research instruments: Pre-service Science Teachers Innovativeness Scale (PSTIS) Pre-service Science Teachers Technology Self-efficacy Scale (PSTTSS) and Pre-service Science Teachers' Learning Management System Acceptance Interview (PSTLAI). PSTIS was adopted from Whitely (1987) Innovativeness scale, the whole 20 items – scale was revalidated for construct validity. The internal consistency was measured using Cronbach's Alpha which yield a value of 0.85.

PSTTSS was adapted from Banoglu, Vanderlinde and Yildiz (2015). Professional Self-efficacy Scale for information and computer technology teachers, the 35-items were culled from the original 53-item scale and was subjected to critique and revision and was found construct valid.. Validated PSTTSS was subjected to Cronbach's Alpha reliability which yielded the internal score of 0.73. PSTLAI, was a self-constructed scale with initial ten items. The ten items was validated by experts in psychometrics and their critiques reduced the items to 5. The 5-items PSTLAI was subjected to Interrater reliability of fleirs kappa which yielded a value of 0.71. The researcher as well as the assistants administered the instruments (PSTIS & PSTTSS) on the sampled participants, 33 of the sample were randomly selected for in-depth interview. 322 completely filled and retrieved questionnaire forms and the qualitative data were used for analysis. Frequency counts and percentages were used to describe the respondents socio-demographic variables, mean, standard deviation, thematic analysis were used to answer the research questions. Discriminant analysis was used to test the hypothesis at 0.05 level of significance.

Results

Table 1: Socio-demographic attributes of the Respondents

| Variable | Frequency | Percentage (%) |
|---|------------|----------------|
| Gender | | |
| Male | 133 | 41.31 |
| Female | 189 | 58.69 |
| Total | 322 | 100.0 |
| School types | | |
| Federal | 196 | 60.87 |
| State | 126 | 38.13 |
| Total | 322 | 100.0 |
| Age Group | | |
| 15 – 19 yrs | 59 | 18.32 |
| 20 – 24yrs | 209 | 64.91 |
| 25- 29 yrs | 36 | 11.18 |
| 30yrs & above | 18 | 5.59 |
| Total | 322 | 100.0 |
| Levels of Education | | |
| 100 | 135 | 41.83 |
| 200 | 104 | 32.30 |
| 300 | 83 | 25.78 |
| Total | 322 | 100.0 |
| Acceptance of Learning Management System | | |
| No, I do not ACCEPT LMS | 146 | 45.34 |
| Yes, I ACCEPT LMS | 176 | 54.66 |
| Total | 322 | 100.0 |

Table 1 revealed that there are 133 (41.31%) male, 189 (58.69%) female. 196 (**60.87%**) federal, 126 (**38.13%**) state, 59 (**18.32%**) 15 – 19 years, 209 (64.91%) 20-24 years, 36 (11.18%) 25-29 years, 18 (5.59%) 30 years and above respondents. 135 (**41.83%**) 100 level pre-service science teachers, 104 (**32.30%**), 200 (31) and 83 (**25.78%**) 300 level respondents. 146 (**45.34%**) do not want to accept

learning management system (LMS) while the remaining 176 (**54.66%**) of the respondents in the distribution intend to accept LMS..

Answer to Research Questions

Research Question I: What are the pre-service science teachers' level of innovativeness and technology self-efficacy?

Table 2: Mean and Standard Deviation of Pre-service Science Teachers' Innovativeness, Technology Self-efficacy and Acceptance of Learning Management System (LMS)

| s_Accept | | Mean | Std. Deviation | Valid N (listwise) | |
|-------------------|----------------|---------|----------------|--------------------|----------|
| | | | | Unweighted | Weighted |
| Accept LMS | inno_score | 44.3182 | 6.40008 | 176 | 176.000 |
| | tech_self_effi | 71.5341 | 7.73556 | 176 | 176.000 |
| Do Not Accept LMS | inno_score | 37.0685 | 8.68662 | 146 | 146.000 |
| | tech_self_effi | 62.2329 | 7.28914 | 146 | 146.000 |
| Total | inno_score | 41.0311 | 8.33558 | 322 | 322.000 |
| | tech_self_effi | 67.3168 | 8.83911 | 322 | 322.000 |

From Table 2, the pre-service teachers' mean scores for innovativeness is 44.32 (SD=6.40), that of technology self-efficacy is 71.53 (SD=7.74) for those that accepted learning management System (LMS); 38.09 (SD=8.89), 62.23 (SD=7.29) innovativeness and technology self-efficacy for those that do not accept LMS respectively. And for the totality of the group, 41.03 (SD=8.36) for pre-service science teachers' innovativeness and mean score of 67.32 (SD=8.84) for technology self-efficacy. Out of the obtainable score of 80 for pre-service teachers' innovativeness, they have an average mean score of 41.05. For the pre-service teachers' technology self-efficacy, out of 140 obtainable scores, they average 67.32.

Research Question 2: Which categories of pre-service science teachers are most prominent based on innovativeness?

Table 3: Most prominent pre-service science teachers' categories based on innovativeness

| Pre-service Science Teachers Innovativeness Categories | Frequency |
|--|-----------|
| Innovators | 5 |
| Early Adopters | 28 |
| Early Majority | 95 |
| Late Majority | 104 |
| Laggards | 90 |
| Total | 322 |

From Table 3, there are 5 innovators, 28 early adopters, 95 early majority, 104 late majority and 90 laggards in the distribution. There are more of late majority among the pre-service science teachers based on innovativeness.

Research Question 3: What are the categories of the pre-service science teachers based on LMSs acceptance?

From table 2, there are 176 (54.66%) pre-service science teachers that accepted the use of Learning Management System (LMS) in teaching and learning whereas a comparatively lower 146 (45.34%) do not accept the use of LMS. And from the thematic analysis of the qualitative data collected from the in-depth interview:

"The use of LMS for Lectures"

Having explained the intricacies of Learning Management System (LMS) to the pre-service science teachers, majority of the respondents agreed that they would appreciate and accept the use of LMS in teaching and learning science.

"The use of LMS for Assignments"

The majority of the respondents interviewed accepted to adopt LMS in submitting their assignment. They reasoned that since LMS would afford them the opportunity to collaborate and discuss with their colleagues in the forum, they identified that such an arrangement would foster effective compilation of assignment and better performance.

"The use of LMS for Tests"

Majority of the respondents equally accepted to use LMS for test or quizzes, they think of opportunity to practice online, have proper mastery of the concepts taught and a boost in their tests performance using LMS.

“The use of LMS for Collaboration and forum discussion”

The pre-service teachers wanted LMS the more for this purpose of coming together in collaboration and forum discussion to explain the course contents together, prepare

their assignment together and have tutorial or examination preparation together irrespective of space and time.

“Ethics in the use of LMS”

many of the respondents did not have the knowledge of the ethics of the use of technology like learning management system (LMS). Majority confess that they are not aware of the dos and don'ts of technology.

Hypothesis Testing

A null hypothesis tested at 0.05 level of significance guided the study:

“There is no significant pre-service science teachers acceptance of LMS as technology self-efficacy in Oyo town.”

Table 4: Tests of Equality of Group Means

| | Wilks' Lambda | F | df1 | df2 | Sig. |
|----------------|---------------|---------|-----|-----|------|
| inno_score | .812 | 74.113 | 1 | 320 | .000 |
| tech_self_effi | .725 | 121.547 | 1 | 320 | .000 |

From Table 4, the test of equality of mean of pre-service teachers' innovativeness is significant ($\lambda=.812$; $F_{(1, 320)}= 74.113$, $p<.05$); that of technology self-efficacy is also significant ($\lambda=.725$; $F_{(1, 320)}= 121.547$, $p<.05$) in discriminating between those that accepted LMS and those that do not accept the technological software. This means that when the value of the pre-service teachers innovativeness was removed from the independent factors the discriminant value was .812, if technology self-efficacy was removed, the value becomes .725.

Table 5: Summary of Canonical Discriminant Functions

| Function | Eigenvalue | % of Variance | Cumulative % | Canonical Correlation |
|----------|-------------------|---------------|--------------|-----------------------|
| 1 | .624 ^a | 100.0 | 100.0 | .620 |

a. First 1 canonical discriminant functions were used in the analysis.

Table 5 revealed that the Eigen value of Pre-service science Teachers' innovativeness and technology self-efficacy as discriminants of acceptance of LMS is .624 with 100.0% of variance and .620 canonical correlations. This means that the magnitude of discrimination of the Pre-service science Teachers' acceptance of LMS or not is .624 and the joint correlation of the two antecedent factors to the pre-service science teachers' acceptance of LMS is 62.4%.

Table 6: Discriminant analysis of Pre-service Science Teachers' Innovativeness, Technology Self-efficacy and Acceptance of LMS

| Test of Function(s) | Wilks' Lambda | Chi-square | df | Sig. |
|---------------------|---------------|------------|----|------|
| 1 | .616 | 154.601 | 2 | .000 |

From Table 6, there is a significant discriminant of Pre-service science Teachers' innovativeness, technology self-efficacy and acceptance of LMS ($\lambda=.616$; $\chi^2=154.601$; $p<.05$). This means, collectively, the two independent variables, Pre-service science

Teachers' innovativeness and technology self-efficacy can jointly discriminate the Pre-service science Teachers' acceptance of LMS up to 38.4%.

Table 7: Standardized Canonical Discriminant Function Coefficients of Pre-service Science Teachers' Innovativeness, Technology Self-efficacy and Acceptance of LMS

| | Function |
|----------------|----------|
| | 1 |
| inno_score | .625 |
| tech_self_effi | .793 |

From Table 7, the standardized canonical discriminant function coefficients of pre-service science teachers' innovativeness is .625 and that of Pre-service science Teachers' technology self-efficacy is .793.. This implies that the pre-service science teachers' innovativeness

Discussion

From the answered research questions, it was discovered that the pre-service science teachers have average mean scores of innovativeness and technology self-efficacy. These findings might be as a results of the rareness of such skills although highly expedient in the 21st century but extremely inadequate in majority of learners. Many students do make use of their technological gadgets without having the mastery of its full utilization, thus lowering their technological self-efficacy. Many of the respondents equally have inadequate requisite ethical skills of using technology. The pre-service science teachers' innovativeness that is around average reveals that the majority of the respondents were less innovative, really, they are tagged as "Late Majority" according to Hunge's classification of individuals based on innovativeness. This (These) results find support in Torkzadeh and Van Dyke (2002), Dogru (2017), Park and Park (2020) that students' innovativeness and technology self-efficacy are directly related , increase in pre-service science teachers' technology self-efficacy, increase in their innovativeness and vice versa.

Also, from the answered research questions, more than half of the respondents acceded to the use of LMS in teaching and learning science. This is also a corroboration to the preceding results that the pre-service science teachers have average scores of innovativeness and technology self-efficacy. Majority of the students are ready to use the technological software for lecturing, ready to

positively discriminate Pre-service science Teachers' acceptance of LMS up to 62.5 %, and that of Pre-service science Teachers' technology self-efficacy positively discriminate pre-service science teachers' acceptance of LMS up to 79.3 %..

adopt it in assignment, ready to use it for tests, they are willing to accept the package for collaboration and forum discussion, although majority of them lack the requisite ethics of using the technological software (LMS).

From the tested hypotheses, it was revealed that the two independent variables, pre-service science teachers' innovativeness and technology self-efficacy significantly discriminated the pre-service science teachers' acceptance of Learning Management System (LMS).. this results is in tandem with Ajzen (1991) theory of planned behaviour that pre-service science teachers acceptance of LMS is contingent on their planned innovativeness and technological self-efficacy. It could be noted that Davis (1989) Technology Acceptance Model (TAM) equally buttresses the findings that the pre-service science teachers' perceived ease of use and perceived usefulness which are affected by their innovativeness and technology self-efficacy invariable discriminate their acceptance of LMS.

Conclusion

From the answered research questions and the tested hypothesis, it could be deduced that the pre-service science teachers have moderate innovativeness skill and moderate technology self-efficacy; that majority of the pre-service science teachers' are late majority as regards innovativeness; that majority of the pre-service science teachers are willing to accept Learning Management System (LMS) for their teaching and learning of science. Moreover, the pre-service

science teachers' innovativeness and technology self-efficacy significantly discriminate their acceptance of LMS.

Recommendations

From the findings of the study, the following are recommended:

- i. The lecturers should adopt and integrate Learning Management System (LMS) with the course for science students since majority of them are willing to accept the technological tool and thus build their innovativeness and technology self-efficacy;
- ii. The college management should along with the academic union, organise training, workshop and seminars on needed skills to adopt and integrate LMS in science teaching and learning to boost pre-service science teachers' innovativeness and technology self-efficacy.

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