International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-13 Issue-6, March 2025

Personalized and Intelligent Agent Based Context-Aware Mobile Learning Framework

Alaa Edein M. Qoussini, Shaima M. Al-Tabib

Abstract: Mobile learning promises the freedom to learn anytime, anywhere. However, effectively integrating personalization within mobile learning environments presents a significant challenge. This research aims to address this challenge by developing a novel framework for personalized content delivery in mobile learning environments (PCDMLE). The proposed PCDMLE framework leverages three key aspects of personalisation: student preferences, academic level, and assessment unit. By dynamically adapting learning content based on these individual characteristics, the framework aims to enhance student performance and simplify the management of diverse learning needs. To achieve this objective, an in-depth literature review was conducted to identify key aspects of personalisation within the context of mobile learning. Based on this review, a framework was developed and subsequently validated through an expert review process. A prototype was then created and evaluated through a six-week experiment. Finally, participant feedback was collected through a survey to assess their evaluation and satisfaction with the framework. The results, derived from both the expert review and participant feedback, demonstrate the framework's effectiveness in delivering personalized content based on the identified aspects. Furthermore, the findings indicate a positive impact on student performance. This research, therefore, makes a significant contribution to the advancement of personalised content delivery within the mobile learning domain.

Keywords: Mobile Learning, Personalized Mobile Learning, Context-Aware, Personalized Content-Delivery and Context-Aware Content-Delivery Framework.

I. INTRODUCTION

Mobile Learning (ML) has emerged as a prominent field due to the widespread availability and accessibility of mobile devices. These devices, including smartphones and tablets, provide convenient and affordable learning opportunities. To effectively leverage the potential of mobile learning in education, it is crucial to develop innovative methods, approaches, models, or frameworks for designing personalized learning applications [1]. A significant challenge in mobile learning is the need for personalization [2]. This involves tailoring learning content and delivery to meet the unique needs and learning styles of individual learners [3]. The unique strength of mobile technologies in Education lies in their ability to tailor learning experiences to individual learners [4]. This personalization involves adapting learning content and interactions to align with each learner's specific abilities and needs [5], that's why personalization is a crucial issue to achieve our goals when using ML [6].

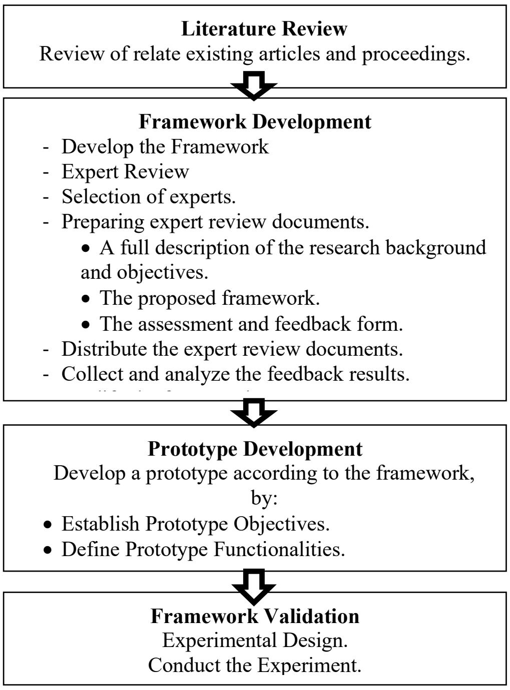
Manuscript Received on 29 October 2019 | First Revised Manuscript Received on 08 January 2025 | Second Revised Manuscript Received on 20 February 2025 | Manuscript Accepted on 15 March 2025 | Manuscript published on 30 March 2025.

*Correspondence Author(s)
Alaa Edein M. Qoussini*, Department of Humanities & Basic Sciences, English Language Scientific College of Design, Muscat, Oman. Email ID: alaa.edein@gmail.com,ORCID ID: 0009-0009-3246-1534
Shaima M. Al-Tabib, Research Office, National College of Automotive Technology, Muscat, Oman. Email ID: Shaimaa@ncat.edu.om

© The Authors. Published by Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP). This is an open access article under the CC-BY-NC-ND license http://creativecommons.org/licenses/by-nc-nd/4.0/

II. RESEARCH METHODOLOGY

To investigate the interplay between the components of a personalised mobile learning system and student performance, this research conducted a comprehensive literature review to identify key aspects of personalisation within the mobile learning context. This led to the development and design of a framework. Subsequently, an expert review validated the framework components. A prototype was then developed for experimental validation, followed by a six-week experiment. Finally, participant evaluations and satisfaction with the framework were gathered through a survey, as illustrated in Figure 1.



[Fig.1: Research Methodology]

To answer the research question "What are the relationships between the components of a personalized content-delivery mobile learning system and students' performance?" two hypotheses were derived for this question as follows:

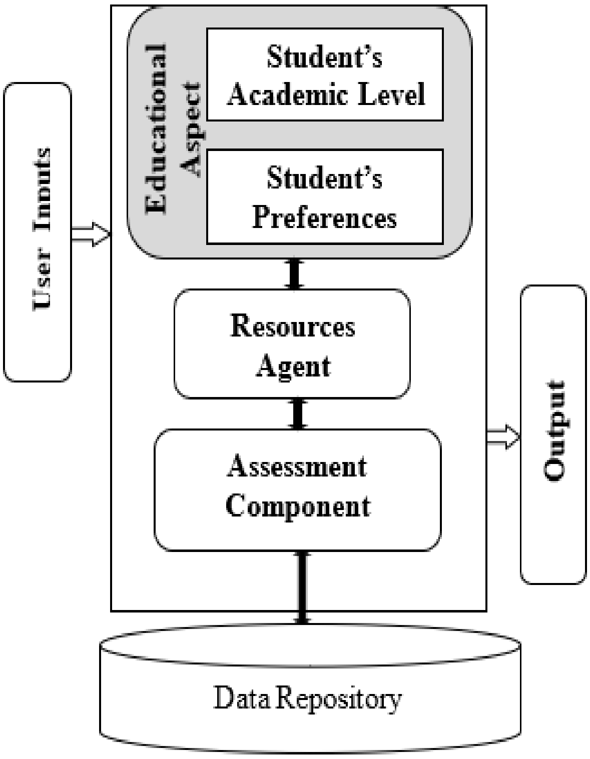
- **H1:** There is a positive relationship between the students' satisfaction with the student's preferences agent and the student's performance.
- **H2:** There is a positive relationship between the students' satisfaction with the

student's academic level agent and the student's performance.

III. PERSONALIZED CONTENT-DELIVERY MOBILE LEARNING ENVIRONMENT FRAMEWORK (PCDMLE)

Drawing upon existing research [7] on personalization in mobile learning, a framework for personalized content delivery has been developed. This framework incorporates a multi-agent design, integrating key agents identified in the literature, including student preferences and academic level.

As illustrated in Fig. 2, the proposed framework comprises three main components: Educational Aspects and the Assessment component. Those components interact with each other to deliver personalised learning materials to students based on their educational situation (Student preferences, academic level), which contributes to enhancing the students' satisfaction with the system and its output (delivered materials), leading to improved performance accordingly. It is worth noting that there is no specific sequence in the framework, as each aspect is triggered according to the context's needs. The functions and operation of each component are described in the following subsections.



[Fig.2: Personalized Content-Delivery Mobile Learning Environment Framework (PCDMLE)]

A. Educational Aspects Component

Educational aspects component as its name indicate, is one of the most critical components in any educational system, even in traditional learning system or technology-based learning system, in this research this component consists of two main subcomponent that deals with two important aspects related to delivering personalized learning contents, namely, students' academic level (Performance) and learners' preferences towards the learning materials.

B. Student's Academic Level Aspect

In any learning situation, there will be different learners with different cognitive capabilities, which will affect their academic level and advancement, teachers face the challenge of delivering different learning techniques or materials suitable for all learners', according to the National Center of Education Statistics (USA), there are three achievement levels for each class: Basic, Proficient, and Advanced. For each grade, the levels are cumulative; that is, abilities achieved at the Proficient level presume mastery of abilities associated with the Basic level, and attainment of the Advanced level presumes mastery of both the Basic and Proficient levels. The Basic level is not the desired goal, but rather represents partial mastery that is a step toward Proficient [8]. That's why it is most essential to consider learners' level when designing a learning management system [9]. In PCDMLE, the student-level agent is responsible for assigning users to a specific level (junior, intermediate, or advanced) based on their previous performance. For the first login, this agent will ask the student to complete a simple quiz related to the registered subject. Then according to the student's grade the agent will assign the student to one level from the three levels (Junior, Intermediate, and Advanced), If the student is an existing user (not the first login) the agent will retrieve his level from the database, after that the agent will pass the student level to the resources agent such that (1: Junior, 2: Intermediate and 3:Advance) as illustrated in Fig. 3. Advanced users can skip the lesson and move forward to the next one, while junior and intermediate cannot, they need to study the current lesson then conduct an assessment quiz so they can shift to the next lesson.

```
Purpose: This pseudo code is used to capture the
student's academic level.

IF exists(student level) THEN
    RETURN student_level
ELSE
        CONDUCT_QUIZ()
        ASSIGN_LEVEL()
        STORE_LEVEL()
END IF
Next Agent
```

[Fig.3: Student's Academic Level Agent Pseudo Code]

C. Student's Preferences Agent

In PCDMLE framework this agent will automatically check the student's preferences stored in the database, and send the result to content-delivery mechanism to choose learning contents according to these preferences, if there are no preferences the agent will ask the student to assign new preferences as shown in Fig. 4. And student should be able to run this agent to change his preferences when he needs to do so. Student preferences in this context are video, audio, image, text, or URL. Also, students can assign each one of them a value according to the student's priority (First choice = 5, Second=4, and so on).

Retrieval Number: 100.1/ijrte.D7832118419
DOI: 10.35940/ijrte.D7832.13060325
Journal Website: www.ijrte.org

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)
© Copyright: All rights reserved.

```
Purpose: This pseudo code is used to capture the student's
preferences.

IF exists(student preferences) THEN
   RETURN student_prefernces
ELSE
         GET_PREFERENCES ( )
         STORE_PREFERENCES ( )
         RETURN student_prefernces
END IF
Next Agent
```

[Fig.4: Student's Preferences Agent Pseudo Code]

D. Assessment Component

Another critical component is the assessment component [10], since the assessment is one of the key components of any learning system [11], PCDMLE include this component. An assessment task typically involves a stimulus presented by the assessor to elicit a response from the examinee. Traditionally, both the stimulus and the response were conveyed through written materials on paper. More recently, non-print platforms, such as computers, have been used to present the stimulus and response. The increasing use of mobile communication devices such as mobile phones and PDAs has now prompted studies on the use of these mobile devices in assessment [12]. Here, techniques for carrying out mobile assessments need to be considered. Designing effective mobile learning environments requires careful consideration of user needs and the inherent limitations of mobile devices, including limited storage space, processing power, and battery life. Overloading devices with excessive content can lead to performance issues, slow loading times, and a poor user experience. Therefore, it's crucial to optimise content by prioritising core information, presenting it concisely, and employing efficient delivery methods, such as compression and caching. This not only enhances the user experience but also ensures the system's responsiveness by minimizing data processing demands.

The small screen size of mobile phones suggests that short quiz items will be more suitable, as it reduces the amount of scrolling to see the entire item [13]. To enhance user experience, excessive scrolling within a mobile quiz should be minimized. While short-answer responses are possible, a multiple-choice format is initially recommended for its simplicity. Quizzes should be concise to accommodate mobile use in various environments, which can be prone to distractions. The small screen size and resolution of mobile phones can also cause eye strain.

Furthermore, minimizing the use of media-rich content is crucial. Downloading and processing multimedia can be expensive and time-consuming, which can negatively impact the user experience.

In the assessment component in PCDMLE, two types of assessments are included, automatic assessment (direct assessment), which take place automatically after the student finish one level or one lesson, to keep track of his academic level and advances, in this type the assessment mechanism is responsible of choosing the suitable questions (multiple choice) from the question bank, then post them to the student to answer, then feedback is given to the student directly. In teacher-initiated quizzes, the instructor selects questions from a question bank to create a quiz. This quiz is then disseminated to all students via a message. This approach enables teachers to assess students' understanding and track their progress.

E. Inputs

Input is a fundamental component of any information system, including the PCDMLE framework. Inputs in this framework are categorized into two types:

- User Inputs: These encompass data directly collected from the user, such as username, password, preferences, and responses to specific actions. It's crucial to consider the limitations of mobile device input units when determining the minimum input requirements.
- Sensor Inputs: Modern mobile devices typically incorporate a range of built-in sensors that provide valuable data. These sensors include: GPS (Global Positioning System), which enables location tracking, and a Gyroscope, which measures the device's orientation.

F. Outputs

In the PCDMLE framework, outputs represent the core objective: delivering personalized learning content. Like any information system, the primary goal of PCDMLE is to produce high-quality outputs. By personalizing the learning experience, PCDMLE aims to enhance student performance. Outputs can encompass various formats, including text, images, audio, and video, to support student learning and academic progress. Additionally, the framework can generate reports for teachers and administrators, providing valuable insights into learner status and activities.

G. Data Repository

In the PCDMLE framework, data storage plays a crucial role [14]. The data repository stores not only user information but also data related to their learning context. It also houses a question bank for quizzes. Furthermore, the data repository will contain a crucial element in the learning process: learning materials and their associated properties.

Data repository in PCDMLE could contain:

- Resources database, which is used to store data related to the learning materials with corresponding lessons.
- The Users database stores student-related information, including username, password, user type (Admin, Teacher, Student), name, ID number, and other relevant details.
- Question Bank database, to store the questions which will be used during the assessment process.

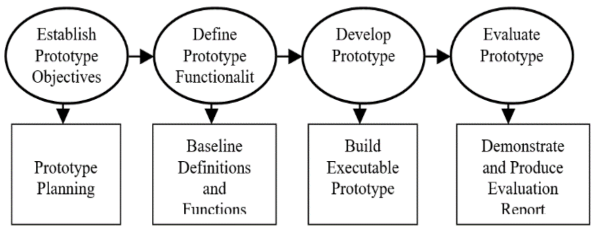
IV. PROTOTYPE DEVELOPMENT

Predicting user interactions, system interoperability, and necessary operations in software development is a challenging task. Thorough requirements analysis and systematic reviews are crucial for mitigating this uncertainty and clearly defining the system's purpose and functionality. However, no amount of analysis can fully replace the value of hands-on experience. Prototyping enables developers and users to experiment with requirements in a tangible manner, allowing them to observe how the system supports their concepts and ideas. While not primarily intended for design validation, software prototypes serve as valuable tools for refining and verifying requirements before committing to a specific implementation. Figure 5 illustrates a process model for

Retrieval Number: 100.1/ijrte.D7832118419
DOI: 10.35940/ijrte.D7832.13060325
Journal Website: www.ijrte.org

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)
© Copyright: All rights reserved.

prototype development.



[Fig.5: Process Model for PCDMLE Prototype Development]

A. Prototype Objectives

The primary purpose of this process is stating the main objectives of constructing the prototype, in this regard, the objectives of developing the PCDMLE prototype in this research are: (i) to implement and convert the proposed framework into a working system, and (ii) to validate the proposed framework through the evaluation of the developed prototype and its functionalities.

B. Prototype Functionalities

In this process (activity), the functional and technical specification of the prototype is identified and listed. According to the literature review process, a mobile learning system should have the following functionalities:

- A personalized content-delivery mobile learning system typically features three distinct user access levels: administrator, teacher, and student. Administrators possess the highest level of system access, enabling them to manage users, content, and system settings. Teachers utilize the system to assign and receive student work, create quizzes, and manage course content. Students primarily interact with the system to access learning materials and engage with assigned activities. The student log-in will present the user with information regarding courses, outstanding work, and links to available resources suitable to the student's context. It will usually provide a way to contact the teacher or course leader if you have any questions. Work can be submitted from the student log-in, which will then be picked up by the teacher or course leader from the admin log-in.
- Learning Management Systems (LMS) typically incorporate an internal messaging system, eliminating the need for separate platforms, such as school-wide email. This centralized communication hub streamlines interactions within the educational institution, keeping all learning-related messages within a secure and controlled environment. This approach enhances safety by preventing unauthorized access and interactions with individuals outside the academic community.
- Learning Management Systems (LMS) offer a suite of features designed to streamline education. Core functionalities include course creation and management, which facilitate the organisation and delivery of learning materials. Furthermore, LMS platforms often incorporate tools for assessment, such as self-marking quizzes and tests, providing valuable insights into student progress. Many LMS also feature robust student data management capabilities, enabling educators to track student performance, identify areas for improvement, and personalise learning experiences for each student. Some advanced systems even offer automated marking functionalities, providing students with immediate feedback on their submitted work.
- Course creation forms the bedrock of any effective Learning Management System (LMS)
- Resource Management, which is one of the core functionalities of a learning management system, is used to add the content and resources that teachers want to teach to a course. Many resources will enable the system to allow students to access these resources (learning materials) according to their needs and context. In this regard, the PCDMLE prototype has the additional functionalities to deliver personalization in content delivery, including the following functionalities (as explained in Chapter Four: Framework Development):

V. EXPERT REVIEW RESULTS

Table I: Expert Responses on the Feedback Form

Q	Question	Yes	No	Partially	Satisfaction
1.	To what extent do you see that the framework is sound?	5	0	1	83%
2.	Are the relationships between the framework components clear and reasonable?	5	0	1	83%
3.	Are the introduced personalization aspects sufficient?	5	0	1	83%
4.	Have the objectives of the framework been achieved? In particular, is the Framework as a whole technically satisfactory?	6	0	0	100%
5.	Has each component been contributing significantly to the overall Framework?	5	0	1	83%
6.	To the best of your estimate, have agents used in a manner consistent with the principle of cost, efficiency and effectiveness.	6	0	0	100%
7.	Is the framework consistent with real-world situations (Applicable)?	5	0	1	83%
8.	Do you see that the framework is consistent with the standards?	5	0	1	83%
9.	Do you think that the framework provides the necessary control and freedom for the users?	6	0	0	100%
10.	According to your experiences does the framework deliver personalized learning materials (as an output)?	6	0	0	100%
11.	To the best of your estimate, have agents been used to achieve the intended learning progress?	5	0	1	83%
12.	Is there evidence that the research has/will produce significant scientific, educational, technical, commercial, social, or environmental impacts (where applicable)?	5	0	1	83%
13.	Do you feel that the delivered learning materials by the framework will be reliable?	5	0	1	83%
14.	Do you think the framework will contribute to enhancing students' performance?	6	0	0	100%
15.	The delivered materials by the framework will support the students' advancement in the course.	6	0	0	100%
16.	Is the proposed framework complete?	5	0	1	83%
	Total				89%

This phase involved collecting feedback from six experts with diverse backgrounds on the proposed framework. Data was gathered through assessment and feedback forms, which were subsequently analyzed quantitatively. The results of this expert review are presented above.

Table I summarizes the expert feedback, demonstrating a high level of agreement on the framework's completeness (89%), its alignment with

© Copyright: All rights reserved.

principles of efficiency and effectiveness (100%), and its ability to achieve its objectives (100%). All experts also confirmed that the framework provides users with appropriate control and freedom, and that it effectively supports student learning and academic enhancement. Importantly, all experts agreed that the framework successfully delivers personalized learning materials.

While five out of six experts (83%) found the framework applicable to real-world situations and its delivered materials reliable, all experts concurred on its overall completeness.

Based on the expert feedback, minor modifications, including the addition of an assessment component, were incorporated into the final framework.

VI. FRAMEWORK VALIDATION

The primary goals for this phase were to validate the framework through an experiment and to obtain student feedback on the prototype, thereby determining students' opinions on the role and value of the delivered personalised learning materials about their academic performance.

A. Experiment Results

For the validation and evaluation purposes of the framework, an experiment was conducted using the previously developed prototype. Recalling this, the research will evaluate the students' performance and their evaluation of the prototype. The total number of participants in this study was 90 students from one subject in the general mandatory courses (Basic Computing Skills) at the college level, distributed as shown in Table II.

Table II: Distribution of the Participants Among Groups

Experimental Group	Control Group	
PMLMS	E-Learning (Moodle)	Traditional
30	30	30
Total		90 students

B. Post-Test Marks

To evaluate the effectiveness of our system on students' performance, we collected the final marks of both the control group and the experimental group. The students' marks were normally distributed for both the experimental and control groups. The marks were analysed using a paired sample t-test, and the results are presented in Tables III.a and III.b. Which show that the system was effective in enhancing students' performance, since there is a significant difference between the groups with $t = 2.859$ and $p < 0.05$ ($p = 0.008$) between the experiment group and the control sub group e-learning, also the mean mark were (81.07) for the experiment group and (76.23) for the e-learning control group. At the same time, there is a significant difference between the experimental group ($t = 4.355$, $p = 0.000$, which is less than 0.05) and the marks average for the experimental group (81.07), which is higher than the marks average for the second sub-control group (72.27).

Table III (a): Means of Groups Marks

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	ExMarks	81.07	30	7.239	1.322
	ModMark	76.23	30	8.589	1.568
Pair 2	ExMarks	81.07	30	7.239	1.322
	cgMarks	72.27	30	8.678	1.584

Table III (b): The Statistical Post-Test Analysis between Groups

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	St. Deviation	Std. E Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	ExMarks ModMarks	4.833	9.259	1.690	1.376	8.291	2.859	59	.008
Pair 2	ExMarks CgMarks	8.800	11.068	2.021	4.667	12.933	4.355	59	.000

*$p<0.05$

C. Questionnaire on Students' Satisfaction Analysis

Student's Preferences Results with students' performance, Results of simple regression for testing Hypothesis 1:

$H1_0$: There is no relationship between the students' satisfaction with the student's preferences agent and the student's performance.

$H1_1$: There is a positive relationship between the students' satisfaction with the student's preferences agent and the student's performance.

During the analysis, we will reject $H1_0$ if $p<0.05$ and accept $H1_1$ if $p<0.05$.

Table IV: ANOVAb (H1)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.448	1	4.448	13.964	.001[b]
	Residual	8.919	28	0.319		
	Total	13.367	29			

a. Predictors: (Constant), STP
b. Dependent Variable: GRADE

Based on Table IV, since the significant value is ($p=0.001$), which is less than 0.05, it indicates that at least one of the dependent variables, i.e., students' preferences for agent performance, has a significant relationship with the dependent variable, i.e., students' performance. Furthermore, coefficients also need to be determined to find the direction of this relationship. In this research, since there is one dependent variable (student's performance), Table IV can be interpreted as follows: student's preferences and agent performance have a significant relationship with student's performance.

Table V: Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.397	0.854		1.635	.113
	STP	0.799	0.214	0.577	3.737	.001

a. Dependent Variable: GRADE

Table V shows that the significant value of the independent variable

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)
© Copyright: All rights reserved.

(students' performance) is less than 0.05 (p=0.001), and this indicates that the relationship between students' preferences and agent performance is significant. And since the unstandardized coefficient for students' preferences for agent performance is positive (0.799) and the p-value is 0.001, it can be interpreted as follows: there is a positive relationship between the independent variable (students' preferences for agent performance) and the dependent variable (students' performance). Also, the unstandardized coefficient of students' preferences for agent performance (0.799) means that a one-unit increase in students' preferences for agent performance will result in a predicted 0.799-unit increase in students' performance. The regression formula between students' preferences, agent performance, and students' performance is as follows:

Student's performance = 1.397 + 0.799 student's preferences + gent performance

Therefore, as a result, we reject H10 and accept H11, since the p-value (0.001) is less than 0.05 and the unstandardized coefficient is positive (0.799).

Student's Academic Level Results with students' performance, Results of simple regression for testing Hypothesis 2:

$H2_0$: There is no relationship between the students' satisfaction with the student's academic level agent and student performance.

$H2_1$: There is a positive relationship between the students' satisfaction with the student's academic level agent and student performance.

During the analysis, we will reject H0 if $p < 0.05$ and accept H1 if $p < 0.05$.

Table VI: ANOVA (H2)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.830	1	5.830	21.659	.000b
	Residual	7.537	28	.269		
	Total	13.367	29			

a. Predictors: (Constant), STLE
b. Dependent Variable: GRADE

Based on table VI, as the significant value is (p=0.001), which is less than 0.05, it indicates that at least one of the dependent variables, i.e., student's academic level, agent performance, has a significant relationship with the dependent variable, i.e., student's performance. Furthermore, coefficients also need to be determined to find the direction of this relationship. In this research, with one dependent variable (students' performance), Table VI can be interpreted as indicating that students' academic level and agent performance have a significant relationship with students' performance.

Table VII: Coefficients (H2)

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	2.913	0.368		7.924	.000
	STLE	0.435	0.093	0.660	4.654	.000

a. Dependent Variable: GRADE

Table VII shows that the significant value of the independent variable (student's performance) is less than 0.05 (p=0.000), and this indicates that the relationship between student's academic level and performance is significant. And since the unstandardized coefficient for students' educational level agent performance is positive (0.435) and the p-value is 0.000, it can be interpreted as there is a positive relationship between the independent variable (students' academic level agent performance) and the dependent variable (students' performance). Also, the unstandardized coefficient of student's academic level agent performance (0.435) means that a one-unit increase in student's location agent performance will result in a predicted (0.435) increase in student's performance. And the regression formula between students' academic level and performance is as follows:

Student's performance = 2.913 + 0.435 student's academic level + gent performance

Therefore, as a result, we reject H20 and accept H21, since the p-value (0.002) is less than 0.05 and the unstandardized coefficient is positive (0.423).

D. Overall Model Testing Results of the Direct Relationships between the Component Scores and Students' Performance

To test the overall direct relationships model, a multiple regression analysis was conducted. However, before conducting the multiple regression, a correlation test was performed to ensure that the independent variables were not correlated with each other. The results of the correlation test showed that there was no significant correlation between the variables, as shown in Table VIII. The result of multi regression analysis indicated that the independent variables (student preferences and student academic level) accounted for significant amount of the student performance, R^2=0.926, F(5,24)= 59.909, p<0.01, indicating the higher student satisfaction about the independent variables the higher students' performance as shown in table IX.

Table VIII: Coefficient Correlations

Model			STP	STLE
1	Correlations	STP	1.000	-.023
		STLE	-.023	1.000

Table IX: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change
1	.962a	.926	.910	.20326	.926	59.90	5	24	.000

a. Predictors: (Constant), STP, STLE
b. Dependent Variable: GRADE

To find the contribution of each of the independent variables (students' preferences and students' academic level) in the dependent variable (student performance), Table X summarises the results. From the table, we can figure that all the independent variables contribute positively to the dependent variable; all beta

Retrieval Number: 100.1/ijrte.D7832118419
DOI: 10.35940/ijrte.D7832.13060325
Journal Website: www.ijrte.org

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)
© Copyright: All rights reserved.

values are positive, and all of the independent variables have a significant p<0.01. The highest contribution comes from the student device variable (t=5.970, Beta=0.420), followed by the network speed variable (t=4.297, Beta=0.283), while the least contributor is student preferences (t=3.099, Beta=0.194).

Table X: Coefficients

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.645	.347		-1.857	.076
	STL	.182	.063	.204	2.877	.008
	STP	.269	.087	.194	3.099	.005

After we have this "working" model to predict the students' performance, we might decide to apply it to predict the students' grades according to their satisfaction with the independent variables. The results showed that there is a significant correlation at p<0.01 (0.962) between both actual grade and predicted grade (GRADE'), as shown in Table XI.

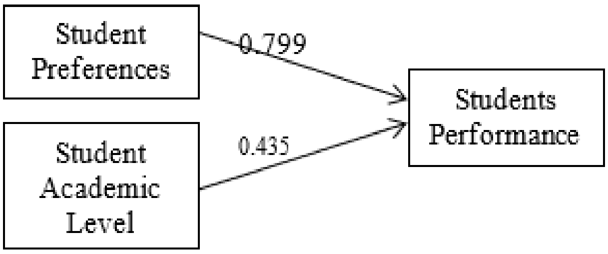
Table XI: Correlations between Actual Grade and the Predicted Grade

		Predicted	GRADE
Predicted	Pearson Correlation	1	.962**
	Sig. (2-tailed)		.000
	N	30	30
GRADE	Pearson Correlation	.962**	1
	Sig. (2-tailed)	.000	
	N	30	30
***. Correlation is significant at the 0.01 level (2-tailed).*			

The summary of hypotheses testing is presented in Table XII. The summary indicates that all p-values are less than 0.05, and all unstandardized coefficients are positive (greater than 0.00). This suggests that there are positive and significant direct relationships between the components (agents) and the students' performance. Fig. 6 illustrates the proposed framework with the statistical output. The hypotheses were tested using a statistical technique, i.e., simple regression analysis. The outcomes of the tests are presented in Table XII, showing the acceptance status of all hypotheses:

Table XII: Summary Results for Hypothesis Testing

No	Hypothesis	Un standardized Coefficients	p-value	Outcome
1	H1: There is a positive relationship between the performance satisfaction of the student's preferences agent and the student's performance.	0.799	0.001	Accepted
2	H2: There is a positive relationship between the performance satisfaction of the student's academic level agent and the student's performance.	0.435	0.000	Accepted



[Fig.6: Unstandardized Coefficients from Statistical Output of Hypothesis Testing]

E. Hypothesis Related to the Relation between the Components and Students' Performance

$H3_0$: There is no relationship between the students' satisfaction with the student's preferences agent and the Overall System satisfaction (OA).

$H3_1$: There is a positive relationship between the students' satisfaction with the student's preferences agent and the Overall System satisfaction (OA).

During the analysis, we will reject $H3_0$ if p<0.05 and accept $H3_1$ if p<0.05.

Table XIII: ANOVAb (H3)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.395	1	4.395	13.565	.001^{b}
	Residual	9.072	28	.324		
	Total	13.467	29			
a. Dependent Variable: OA b. Predictors: (Constant), STP						

Based on Table XIII, since the significant value (p = 0.001) is less than 0.05, it indicates that at least one of the dependent variables, i.e., students' preferences for agent performance, has a significant relationship with the dependent variable, i.e., Overall System satisfaction (OA). Furthermore, coefficients also need to be determined to find the direction of this relationship. In this research, with one dependent variable (Overall System Satisfaction (OA)), Table XIII can be interpreted as indicating that students' preferences for agent performance have a significant relationship with Overall System Satisfaction (OA).

Table XIV: Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.383	.862		1.605	.120
	STP	.794	.216	.571	3.683	.001
a. Dependent Variable: OA						

Table XIV shows that the significant value of the independent variable (Student preferences) is less than 0.05 (p=0.001), and this indicates that the relationship between students' preferences, agent performance and Overall System satisfaction (OA) is significant. And since the unstandardized coefficient for students' preferences agent performance is positive

Retrieval Number: 100.1/ijrte.D7832118419
DOI: 10.35940/ijrte.D7832.13060325
Journal Website: www.ijrte.org

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)
© Copyright: All rights reserved.

(0.794) and p-value is 0.001, it can be interpreted as follows: there is a positive relationship between the independent variable (students' preferences agent performance) and the dependent variable (Overall System satisfaction (OA)). Also, the unstandardized coefficient of students' preferences for agent performance (0.794) means that a one-unit increase in students' preferences for agent performance will result in a predicted 0.794 increase in Overall System satisfaction (OA). And the regression formula between students' preferences, agent performance, and Overall System satisfaction (OA) is as follows:

OverAll System satisfaction (OA) = 1.383 + 0.794 student's preferences gent performance

Therefore, as a result, we reject H30 and accept H31, since the p-value (0.001) is less than 0.05 and the unstandardized coefficient is positive (0.794).

F. Student's Academic Level Results with Overall System satisfaction (OA)

$H4_0$: There is no relationship between the Overall System satisfaction (OA) of the student's academic level agent and Overall System satisfaction (OA).

$H4_1$: There is a positive relationship between the Overall System satisfaction (OA) of the student's academic level agent and Overall System satisfaction (OA).

During the analysis, we will reject $H4_0$ if $p<0.05$ and accept $H4_1$ if $p<0.05$.

Table XV: ANOVAb (H4)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.832	1	4.832	15.671	.000[b]
	Residual	8.634	28	.308		
	Total	13.467	29			
a. Dependent Variable: OA						
b. Predictors: (Constant), STLE						

Based on table XV, as the significant value is (p=0.000), which is less than 0.05, it indicates that at least one of the dependent variables, i.e., student's academic level, agent performance, has a significant relationship with the dependent variable, i.e., Overall System satisfaction (OA). Furthermore, coefficients also need to be determined to find the direction of this relationship. In this research, with one dependent variable (Overall System Satisfaction (OA)), Table XV can be interpreted as indicating that students' academic level and agent performance have a significant relationship with Overall System Satisfaction (OA).

Table XVI: Coefficientsa (H4)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant	3.028	.394		7.695	.000
	STLE	.396	.100	.599	3.959	.000
a. Dependent Variable: OA						

Table XVI shows that the significant value of the independent variable (Overall System satisfaction (OA)) is less than 0.05 (p=0.000), and this indicates that the relationship between students' academic level, agent performance and Overall System satisfaction (OA) is significant. And since the unstandardized coefficient for student's academic level agent performance is positive (0.396) and p-value is (0.000), it can be interpreted as, there is a positive relationship between the independent variable (student's academic level agent performance) and the dependent variable (OverAll System satisfaction (OA)). Also, the unstandardized coefficient of student's academic level agent performance (0.396) means that a one-unit increase in student's location agent performance will result in a predicted (0.396) increase in Overall System satisfaction (OA). And the regression formula between students' academic level, agent performance, and Overall System satisfaction (OA) is as follows:

OverAll System satisfaction (OA) = 3.028 + 0.396 student's academic level gent performance

Therefore, as a result, we reject H40 and accept H41, since the p-value (0.000) is less than 0.05 and the unstandardized coefficient is positive (0.396).

G. Overall Model testing Results of the Direct Relationships between the Component Scores and Over All System Satisfaction (OA)

To test the overall direct relationships model between the five independent variables and the dependent variable (Over All System satisfaction (OA)), a multi regression analysis was conducted, but before conducting the multi regression a correlation test was performed to ensure that the independent variables are not correlated, results of correlation showed that there was no significant correlation between the five variables as shown in table XVII. The result of multi regression analysis indicated that the five independent variables (Network speed, student device, student location, student preferences and student academic level) accounted for significant amount of the Over All System satisfaction (OA), R^2=0.829, F(5,24)= 23.263, p<0.01, indicating the higher student satisfaction about the independent variables the higher students' performance as shown in table XVII.

Table XVII: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.910[a]	.829	.793	.31018	.829	23.263	5	24	.000
a. Predictors: (Constant), STP, STLE, NS, STD, STL									
b. Dependent Variable: GRADE									

To find the contribution of each of the independent variables (network speed, student device, student location, student's preferences and student academic level) in the dependent variable (Overall System satisfaction (OA), as shown in Table XVIII, summarises the results. from

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)
© Copyright: All rights reserved.

From the table, we can figure that all the independent variables contribute positively to the dependent variable since all beta values are positive and all of the independent variables have a significant p<0.01. The highest contribution comes from the student device variable (t=4.486, Beta=0.479), followed by the network speed variable (t=4.071, Beta=0.407), while the least contributor is student level (t=1.778, Beta=0.184).

Table XVIII: Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.140	.530		-.264	.794
	STL	.180	.063	.204	2.877	.009
	STP	.260	.087	.194	3.099	.007

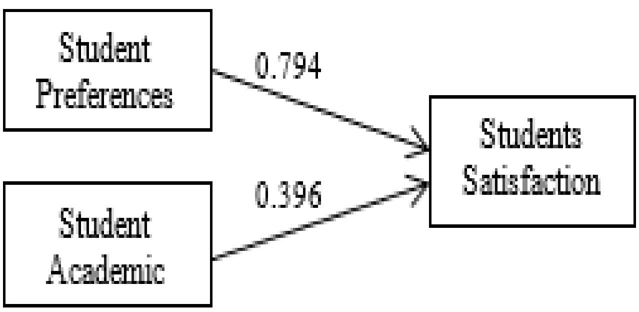
After we have this "working" model to predict Overall System satisfaction (OA), we might decide to apply it to predict students' Overall System satisfaction (OA) based on their satisfaction with the independent variables. So, we use the following formula:

OverAll System satisfaction (OA)= (0.180*STL) + (0.260*STP)-0.140

The summary of hypotheses testing is presented in Table XIX. The summary indicates that all p-values are less than 0.05, and all unstandardized coefficients are positive (greater than 0.00). This suggests that the direct relationships between the components (agents) and Overall System satisfaction (OA) are positive and significant. Fig. 7 illustrates the statistical output of the hypothesis. The hypotheses were tested using a statistical technique, i.e., simple regression analysis. The outcomes of the tests are presented in Table XIX, showing the acceptance status of all hypotheses:

Table XIX: Summary Results for Hypothesis Testing

No	Hypothesis	Un standardized Coefficients	p-value	Outcome
3	H3: There is a positive relationship between the students' satisfaction with the student's preferences agent and the students' overall satisfaction with the systems.	0.794	0.001	Accepted
4	H4: There is a positive relationship between the students' satisfaction with the student's academic level agent and the students' overall satisfaction with the system.	0.396	0.000	Accepted



[Fig.7: Unstandardized Coefficients from Statistical Output of Hypothesis Testing]

H. Hypothesis Related to the Relation between the Students' Overall Satisfaction with the Systems and Students' Performance

H5: There is a positive relationship between the students' Overall (OA) satisfaction with the system and Student performance.

Results of simple regression for testing Hypothesis 5:

$H5_0$: There is no relationship between the students' Overall (OA) satisfaction with the system and Student performance.

$H5_1$: There is a positive relationship between students' overall satisfaction (OA) of the system and Student performance.

During the analysis, we will reject H0 if p < 0.05 and accept H1 if p < 0.05.

Table XX: ANOVAb (H5)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.352	1	5.352	41.455	.000[b]
	Residual	3.615	28	.129		
	Total	8.967	29			
a. Dependent Variable: Student Performance						
b. Predictors: (Constant), Overall System Satisfaction						

Based on Table XX, the significant value (p = 0.000) is less than 0.05, indicating that at least one of the dependent variables, i.e., student performance, has a substantial relationship with the dependent variable, i.e., Overall System Satisfaction (OA). Furthermore, coefficients also need to be determined to find the direction of this relationship. In this research, with one dependent variable (Student performance), Table XX can be interpreted as indicating that Overall System Satisfaction (OA) has a significant relationship with student performance.

Table XXI: Coefficientsa (H5)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.800	.445		4.046	.000
	Overall System Satisfaction	.630	.098	.773	6.439	.000
a. Dependent Variable: Student Performance						

Table XXI shows that the significant value of the independent variable (Overall System satisfaction (OA)) is less than 0.05 (p=0.000), and this indicates that the relationship between Overall System satisfaction (OA) and student performance is significant. And since the unstandardized coefficient for Overall System satisfaction (OA) is positive (0.630) and the p-value is 0.000, it can be interpreted as there is a positive relationship between the independent variable (Overall System satisfaction (OA)) and the dependent variable (student performance). Also, the unstandardized coefficient of Overall System satisfaction (OA) (0.630) means that a one-unit increase in Overall System satisfaction (OA) will result in a predicted (0.630) increase in student performance. Therefore, as a result, we reject H50 and accept H51, since the p-value (0.000) is less than 0.05 and the unstandardized coefficient is positive (0.396).

© Copyright: All rights reserved.

VII. CONCLUSION

This research provides some insight into the challenges facing personalisation in mobile learning environments. A framework is proposed that can assist and guide designers and developers of mobile learning systems. This framework can also aid educational institutions in planning and designing their mobile learning systems. Through the proposed framework, only a prototype was developed. The results of testing this prototype showed that it is valuable and capable of enhancing students' performance. However, this prototype can be improved by utilising more advanced technology and incorporating additional functionalities to assist and support students throughout their learning process.

DECLARATION STATEMENT

After aggregating input from all authors, I must verify the accuracy of the following information as the article's author.

- **Conflicts of Interest/ Competing Interests:** Based on my understanding, this article has no conflicts of interest.
- **Funding Support:** This article has not been sponsored or funded by any organization or agency. The independence of this research is a crucial factor in affirming its impartiality, as it was conducted without any external influence.
- **Ethical Approval and Consent to Participate:** The data provided in this article is exempt from the requirement for ethical approval or participant consent.
- **Data Access Statement and Material Availability:** The adequate resources of this article are publicly accessible.
- **Author's Contributions:** The authorship of this article is contributed equally to all participating individuals.

REFERENCES

1. Ciampa, K. (2014). Learning in a Mobile Age: Investigation of Students' Motivation. Journal of Computer Assisted Learning, (vol. 30, pp.82-96). DOI: https://doi.org/10.1111/jcal.12036
2. Filhuo, N. F., & Barabosa, E. F. (2013). A Requirement Catalogue for Mobile Learning Environment. Coimbra, Portugal: ACM. DOI: https://doi.org/10.1145/2480362.2480599
3. Qoussini, A. E., & Jusoh, Y. (2014). A Review on Personalization and Agent Technology in Mobile Learning. 2014 International Conference on Intelligent Environment (pp. 260-264). Shanghai: IEEE. DOI: https://doi.org/10.1109/IE.2014.49
4. Qoussini, A. E., Jusoh, Y. Y., Murad, M. A., Jabar, B. A., Pa, N. C., & Tabib, S. M. (2016, Feb). Platform and Device Independent Mobile Learning Architecture. Austrailan Journal for Basic and Applied Sciences Research, (Vol. 10, Issue-4, pp.1-9). Retrieved from https://www.ajbasweb.com/old/ajbas/2016/February/1-9.pdf
5. Alepis, E., & Mivou, M. (2014). Extending Mobile Personalization to Students with Special Needs. In Object-Oriented User Interfaces for Personalized Mobile Learning (pp. 47-64). Intelligent Systems Reference Library 64, Springer. DOI: https://doi.org/10.1007/978-3-642-53851-3_5
6. Braunhofer, M., Elahi, M., Ge, M., & Ricci, F. (2014). Context Dependent Preference Acquisition with Personality-Based Active Learning in Mobile Recommender Systems. P. Zaphiris and A. Ioannou (Eds.), LCT 2014(Part II), (pp. 105-116). DOI: https://doi.org/10.1007/978-3-319-07485-6_11
7. Qoussini, A. E., Jusoh, Y., & Tabib, S. (2015, September). A Review on personalization in Mobile Learning. International Journal of Computer Science Issues, (Vol. 12, Issue 5, pp. 17-26). https://typeset.io/pdf/a-review-on-personalization-in-mobile-learning-1d5vf19ph5.pdf
8. NCES. (2012). U.S. Department of Education. Retrieved 2 28, 2016, from National Centre for Education Statistics (USA): https://nces.ed.gov/nationsreportcard/achievement.aspx
9. Alharbi, S., & Drew, S. (2014). Mobile Learning System Usage: An Integrated Framework to Measure Students' Behavioural Intention. Science and Information Conference August 27-29 (pp. 906-911). London, UK: www.conference.thesai.org. DOI: https://doi.org/10.1109/SAI.2014.6918294
10. Hassan, M. H., Alhoban, F., & Hourani, M. (2016). Using Mobile Technologies for Enhancing Student Academic Experience: University of Jordan Case Study. International Journal of Interactive Mobile Technologies IJIM, (Vol. 10, Issue 1). DOI: https://doi.org/10.3991/ijim.v10i1.4809
11. Qoussini, A. E., Jusoh, Y. Y., Murad, M. A., Jabar, M. B., ChePa, N., & Tabib, S. M. (2016). Location-Based Context-Aware Mobile Learning Framework. Journal of Applied Sciences Research, (Vol. 12, Issue 11, pp. 1-8). https://www.aensiweb.net/AENSIWEB/jasr/jasr/2016/November/1-8.pdf
12. Harchay, A., Cheniti-Belcadhi, L., & Braham, R. (2014). A Context-Aware Framework to Provide Personalized Mobile Assessment. Interaction Design and Architecture(s) Journal - IxD&A, N. (Vol. 23, Issue-2014, pp. 82-97). DOI: https://doi.org/10.55612/s-5002-023-006
13. Kim, T.-H., & Jin, S.-H. (2015). Development of auditory design guidelines for improving learning on mobile phones. Computers & Education, (Vol. 91, Issue 2015, pp. 60-72). DOI: https://doi.org/10.1016/j.compedu.2015.09.011
14. Lee, J. H. (2014). Synchronous Mobile Learning System to Cope with Slow Network Connection. Y. Luo (Ed.): CDVE 2014 (pp. 171 - 174). Springer International Publishing Switzerland. DOI: https://doi.org/10.1007/978-3-319-10831-5_25

AUTHOR'S PROFILE

Alaa Edein Moustafa Qoussini is an Assistant Professor in Information Systems who is a member of the English Language, Basic Sciences and Humanities Department in the Scientific College of Design, Muscat, Oman. His research interests include mobile learning, Mobile Learning Adoption, and the application of artificial intelligence in Mobile Learning.

Shaima' Mohammad Al-Tabib is an Assistant Professor in Educational Technology who is the head of the research office in the National College of Automotive Technology, Muscat, Oman. Her research interests include Mobile Learning, Mobile Learning Adoption, Mobile Learning Utilisation, and Artificial Intelligence in Mobile Learning.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of the Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)/ journal and/or the editor(s). The Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP) and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.

© Copyright: All rights reserved.