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PAPER

Personalized Education via Mobile Technology Flexible Learning Frameworks

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ABSTRACT

The prevalence of mobile and ubiquitous computing equipment is transforming how learners conduct their education. Nevertheless, the bulk of educational content generated for desktop platforms is unacceptable for handheld gadgets. Furthermore, some materials that are irrelevant to the preferences of the learner or the contextual environment might reduce the effect of learning and elevate the cost of communication. Furthermore, there is a deficit in the academic structure for mobile learning. This paper proposes personalized adaptation techniques for customized modification contents. This in turn strives to offer adaptive content contingent on learner experience and device capabilities. On top of that, it recommends a few alternatives to producing intelligent and adaptive material for children. Numerous facets of the study are examined to employ the benefits of learner, device, and location modeling in tandem with mobile technology to provide a personalized spread of multimedia-rich resources at any time or anywhere. As an outcome, it delivers proper learning resources and applies the learning style most suitable to the demands and tastes of each learner (personalized learning). Our system enables several types of learning styles to pick from, but the most significant aspect is to pair each learner's characteristics with the right program and learning style. A novel chance for a broad range of learners to boost their knowledge in a tailored manner is made accessible by the adaptation of the material and styles, which enables the learning process to be dynamic. Additionally, our system's resilience and interaction have risen owing to multi-agent system modeling.

KEYWORDS

personalized learning, context-aware technique, hassle-free mobile learning, learning style

1 INTRODUCTION

In the past decades, technology has emerged tremendously and enriched the quality of life in every aspect. One of the advances in technology in the present-day world is the mobile smartphone. In recent years, the object type with the highest usability index has been a mobile device. Users are becoming more and more

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provided with an extensive range of digital capabilities to access information via the internet, attributable to the production of novel and distinctive mobile devices. This promotes the mobile communication industry to deliver new services to users, which include location-aware information delivery, digital content sharing in any format (text, image, audio, video), internet access without constraints on appliances or destinations, as well as personalized assistance based on user preferences and needs [1]. Our study uses context-aware mobile education as the main technique. We encountered mobile learning cartography in the previous investigation concerning wearable, mobile, and ubiquitous computing (see Figure 1). To define mobile learning circumstances, four essential components are recommended: devices, mobility, context, and location. The variations of these features permit an assessment of three categories for mobile learning. (1) Case 1: e-learning and mobile computing collaborate, with significantly greater general mobility. Devices deployed in different scenarios can even access the working and learning surroundings of users. (2) Case 2: the relationship between wearable computing and e-learning, where wearable devices—such as telephones and tablet PCs—are an essential part of mobile technology and can be accessed anywhere. (3) Case 3: the integration of smartwatches, ubiquitous computing, and e-learning, facilitating the ambient intelligence approach to take location and context into thoughtfulness. We discuss the third paradigm in our study as context-aware or contextual mobile learning [2, 3].

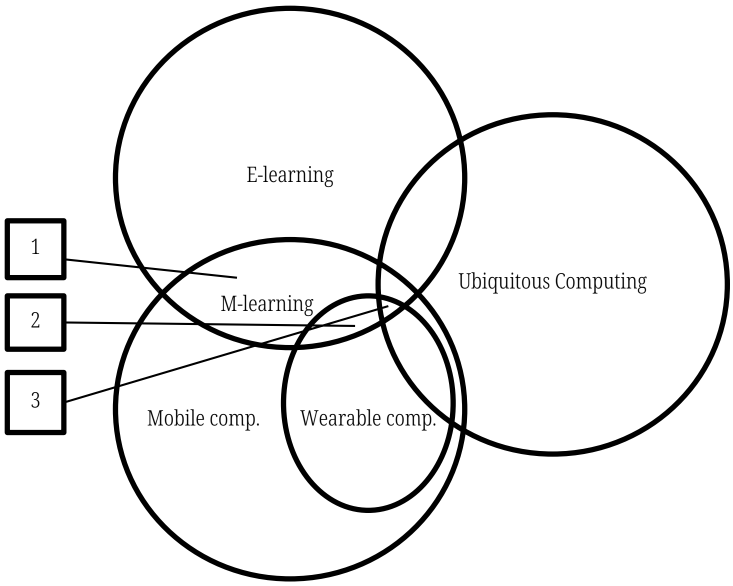

Fig. 1. Mobile learning architecture

One of the primary aspects of the latest advancements is context-aware sensing, which seeks to present end users with suitable services and information about their present situations. Consequently, an attempt to build and put into operation effectively context-aware applications leveraging dynamically generated data collected from actual scenarios encourages further investigation. To establish a proactive learning environment, our goal is to generate a mobile application that becomes more brilliant and resourceful without surrendering vital characteristics like contextual data in dynamic applications [4].

The framework of this essay is as follows: In Section 2, mobile technology presents a customized environment for mobile learning. In Section 3, an extensive guide to AR in the mobile education architecture will be offered. A particular instance of how this augmented reality technique was adapted for its distinctive planning is provided in Section 4. The last section of Section 5 highlights the more precious, optimized foundation for collaborative mobile learning through virtual reality.

2 RELATED WORKS

[5] Ubiquitous learning has grown into a reality primarily as an outcome of the quick advancement of innovative communication and information mechanisms. Consumers are always on the go, respond to dynamic circumstances, and rely on several platforms for interaction (PC, PDA, tab, phone, etc.). The projected style attempts to benefit individuals by giving them passages. These are based on the preferred teaching styles of each learner and are appropriate for their current condition. As a consequence, we put forward an adaptation engine that was constructed on integration rules, which function as the connection between the course information and the learner's profile. For that reason, of our approach has three objectives: (1) supply a learner profile that includes four features: personality type, behavioral type, psychological state, and context; (2) showcase the course information employing XML markup language; and (3) achieve the adaptation rules that compose the adaptation engine. As an outcome, there are multiple alternatives. In this case, one might utilize XML annotations to assure automatic adaptation, or someone might supply supplementary learner parameters like facial expressions to boost adaptation.

[6] This investigation recommended an adaptive and unique system architecture for a ubiquitous learning environment that tackles the diversity of educational content and handheld gadgets. Moreover, emerging goods are proposed based on Top-K and clustering technologies. Moreover, learners' experiences and device features are also taken into account while creating adaptive content for students. To verify their features in a ubiquitous learning environment, we propose to run the system on a genuine e-learning system in the future. Another benefit is that supplementary contextual data will be checked on the system to strengthen its connection with the lives of learners. The supplied instructional materials are adaptable enough to deal with both the individual needs of a pupil and the situations that surround them. We find that the context-aware mobile educational platform can enhance learning efficiency and interest while also resolving the new-item look-up during adaptation after the evaluation of a personalized adaptive content system manufactured.

[7] To judge the mobile devices' competencies, wireless network conditions, and diverse learner needs to be paired together, we created a personalized learning content adaptation mechanism (PLCAM). Alongside intelligently supplying beneficial customized instructional information with enhanced fidelity directly to learners, the PLCAM is also able to organize an extensive amount of historical learner requests in a fast way. After transmission, the PLCAM prepares a transformed content version for the upcoming comparable request. The technique relies on the content to define an adaptation data format that represents multiple learner requirements. This format includes the learner selection, hardware characteristics, network instances, and media attributes. Potent personalized learning content can be generated and distributed to learners depending on numerous types of learner preferences. This will increase the success of the content adjustment process and contribute to the user experience in general. Furthermore, our suggested learning content adaptation management scheme (LCAMS) can efficiently use the CADT to locate the relevant personalized learning content that can answer any number of learner prerequisites, as presented by the experimental results of the model PLCAM system.

[8] In this assignment, context-aware technology and associated learning theories were utilized to generate an adaptive e-learning system for lifelong learning.

In comparison to conventional offline reading materials-based mobile learning approaches, the system enables a more versatile, instinctual, and personalized educational environment [9]. The study's courseware recommendation techniques are intended to supply appropriate courseware with a few ideas depending on learner behavior, learning preferences, and the characteristics of the lifelong learner. The outcomes of an experimental trial leveraging the context-aware function provided by RFID technology demonstrated that presenting the "context-aware" and "courseware recommendation" characteristics boosted the quality of learning. Participants who obtained learning support were able to complete their activities sooner and accurately answer a greater quantity of questions. Through the use of the courseware, a suggestion model, CF, and association mining, this system lets participants share their lessons learned and engage in adaptive learning. The positive effects of lifelong learning are reinforced. This strategy delivers a history of distinct learning. Later study may take benefit of this aptitude to analyze learner behavior and bring about adaptive learning.

3 METHODS AND MATERIALS

3.1 Learner adaptation

The learner modification includes a learner model that incorporates a learner's distinctive features, which include learning preferences, knowledge levels, and demographics. The learning diagnosis implemented in this study consists of an educational diagnosis and a learning-style diagnosis, which facilitates the comparison of an individual's expertise levels and learning preferences.

Establish with knowledge. Knowledge diagnosis in AMLS extends back to the nodes associated with network diagrams in BN models to evaluate learners' levels of knowledge and highlight probable misconceptions. It initially analyzes which potential errors constitutes a certain concept's incorrect interpretation before delivering customized, adaptive learning guidance. A learner's level of comprehension of a topic or concept is evaluated using their knowledge level. If the thought's knowledge level is poor (*i.e.*, $NL_k < 0.7$), the knowledge concept is chosen as the incorrect variable. A diagnosis technique is going to draw a probabilistic inference regarding an anticipated misconception (e.g., NL_j) by referencing the conditional probability tables (CPTs) in the BN model once the AMLS has detected all the variables of the misconception (*e.g.*, NL_1, NL_2, …, NL_{j-1}) in a test. The phrase that follows is an algebraic equation for the shared probabilistic distribution of the judgment mechanism $Q(NL_1, NL_2, \ldots, NL_m)$:

$$Q(NL_1, NL_2, \ldots, NL_m) = \prod_{j=1}^{m} Q(NL_j \mid qb(NL_j)) \tag{1}$$

There are quite several instances of misconception variables in Equation 1, $qb(NL_j)$. Furthermore, it is the most recent set of NL_j variables. Evidence is the value attributed to the measured variables $qb(NL_j)$. The empirical basis for knowledge detection is based on the knowledge evaluation's conclusion. In one instance, the BN model illustrates the subsequent three concepts: "for loop" (S), "while loop" (X), and "loop" (M). The BN diagnosis process can be represented by the probabilistic model $Q(M \mid S = 'U', X = 'G')$, which calculates the possibility that the individual can understand the concept "loop" (L) when they are familiar with the concept "for" (S) but not the concept "while loop" (X). The procedure of diagnosis indicates that the learner should not grasp the meaning of "loop" based on the information collected from the CPT. A very brief explanation of the BN model's learning style is offered in Figure 2. The total number of emails and inquiries responded, in addition to the frequency of forum check-ups, constitute some of the analyzed elements in the processing dimension. The number of Web pages viewed, the total number of inquiries published, and the percentage of assignments sent in are the measured features of the sensory (sensing/intuitive) dimension. The learning-diagnosis module will figure out the outcomes of all appraised attributes (i.e., the random variables in BN models) for each dimension whenever the learning-detection mechanism accumulates the appropriate information from learners' behavior.

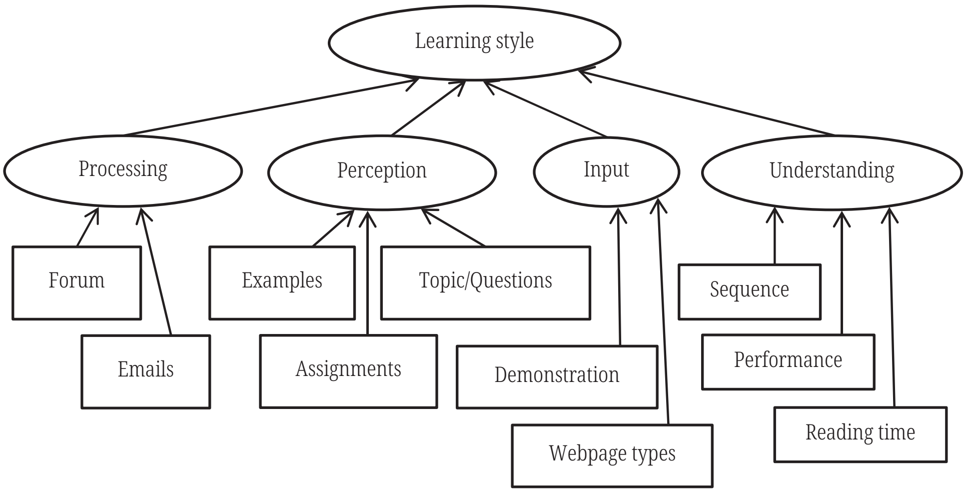

Fig. 2. A brief BN framework to describe models of learning styles

A learning style (LS) containing n dimensions (namely, E_j) can be expressed using the numeral $\prod_{j=1}^{n} E_j \subseteq LS$. The pattern that follows is the method by which learning style dimensions E_j are declared [10]:

$$E_j = Q(Y_1, Y_2, \ldots, Y_k, E_j) = \prod_{k=1}^{m} q(E_j \mid Y_1, Y_2, \ldots, Y_k) \tag{2}$$

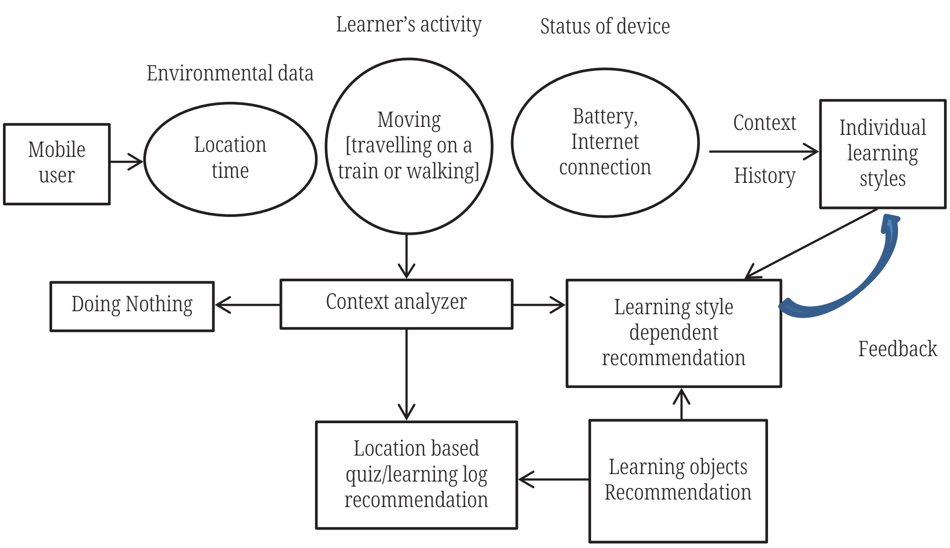

Fig. 3. Customization and context-aware method's workflow

The full method's processing flow is illustrated in Figure 3. It goes ahead as follows: Three different avenues propose the system along with context relating to a learner: his habits, the device's situation, and surroundings data. At this point, it evaluates the external environment and authenticates the device's status, notably its battery threshold and accessibility to the Internet. In a scenario of poor availability, the system could stay unavailable. The system will assess if the learner has easily accessible location-based knowledge if their device has high availability. If they are readily accessible, the system will provide him with learning log updates or location-dependent assessments. The method of instruction will look at the likelihood that the learner is in his preferred learning context if the learner falls short of location-based knowledge. In the above scenario, the system will come up asking him or her to study as part of a message. The context history of all pupils is maintained for reasons of tracking down their distinctive learning needs. Subsequently, the education habit-detecting method is improved based on the learner's response to suggestions based on learning habits [11].

4 IMPLEMENTATION AND RESULTS

Real-world scholarship, wisdom, happiness, comfort of use, and scholarship success were the four parts of educational performance assessment experiments and questionnaires that were studied. A five-point Likert scale, with 1 representing "strongly disagree" and 5 representing "strongly agree," was utilized in the questionnaire. To discover if the two groups' English learning progress varied, the students submitted questions on multiple types of routine situational negotiations and English statements in the pretest and posttest.

Table 1. Merits of the hypothetical and dominance groups' pretest and posttest

Cluster	Assessment	Learners (N)	Mean (M)	Normal Deviation (SD)	Regular Error (SE)
Hypothetical	Pretest	58	69.938	16.01595	1.89855
	Posttest	58	88.497	16.24593	3.11577
Dominance	Pretest	46	70.933	16.86598	3.48952
	Posttest	46	69.867	19.88298	3.91244

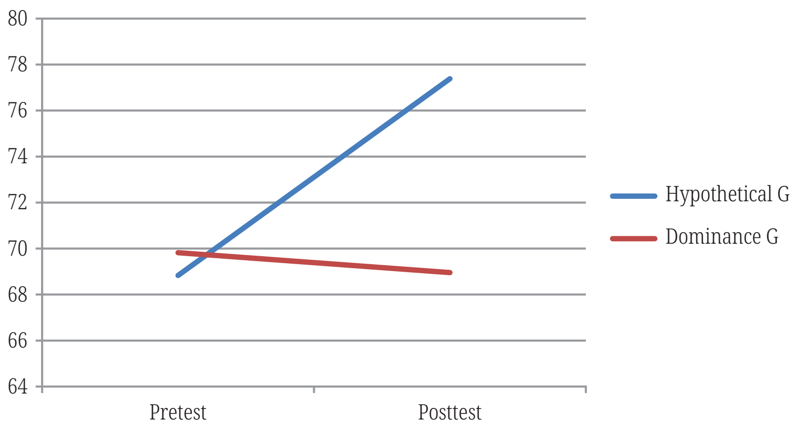

Fig. 4. Pretest and posttest outcomes for the learning assessment contrasting the hypothetical and dominance groups

Clarified in distinct ways, in spite of the experimental group's average pretest score being moderately lower than the dominance group's, the group whose students made use of the PCAR system to learn English obtained higher scores on the posttest (mean = 78.497) than the dominance group (mean = 69.867) (see Figure 4). The students in the hypothetical group who employed the PCAR system had substantially distinct pretest and posttest scores ($t = 3.621$, $p = .025 < 0.05$), which corresponds to the findings of the independent sample t-test for the two groups. The outcomes of the pretest and posttest demonstrated a substantial distinction, revealing that the hypothetical group exhibited an enhanced learning effect compared to the dominant group. Apart from that, the hypothetical group's discrete degree of student scores was fairly comparable in both tests, as evidenced by the analogy of the standard deviation (SD) values from the pretest and posttest (15.00484 and 15.13482, respectively). As an outcome, the comparison of the posttest and pretest mean scores was acceptable and relevant. There was no obvious distinction between the dominant group and the hypothetical group (refer to Table 1). The hypothetical group's pretest average was somewhat lower than the dominance groups. As a consequence, the hypothetical group's posttest English ability improvement range was larger than the dominance groups, as demonstrated by Table 1. As shown by the results, on the posttest, compared with the pretest, every three of the subgroup children exhibited bigger progress (see Figure 5). The bottom third of the management group's average posttest score was only 51.8, demonstrating that learning effects had scarcely revolutionized at all.

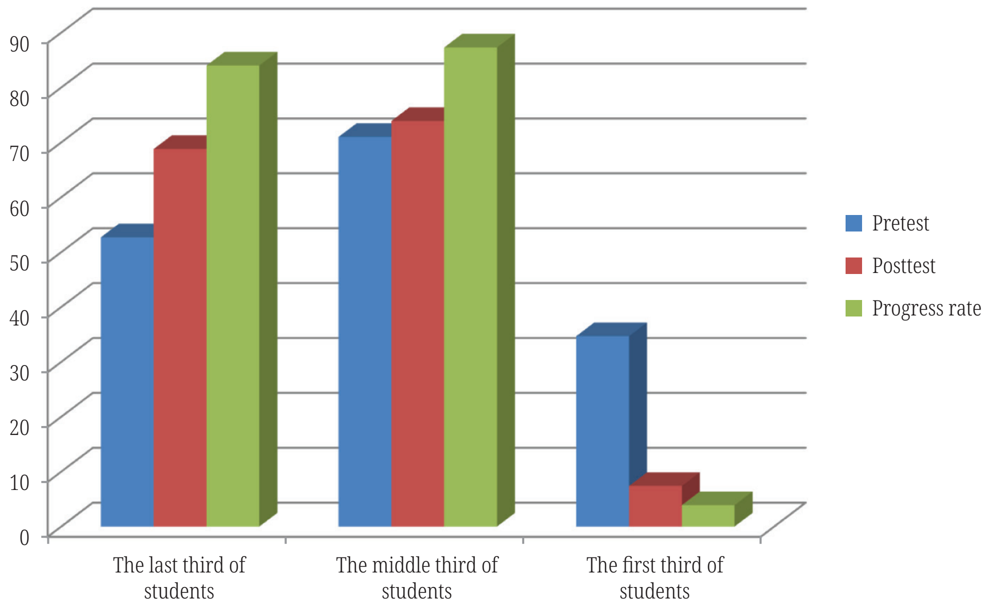

Fig. 5. The hypothetical group's pretest and posttest scores as well as the percentages of progression for each subgroup

Note: Each subgroup is divided into three groups determined by the students' pretest scores, which are displayed in descending order.

Because such pupils lacked suitable auxiliary assistance, learning without the PCAR system gave rise to equivalent learning outcomes. In contrast, the posttest outcomes revealed that the hypothetical class of students who finished very poorly on the pretest made substantial strides by consuming the PCAR system. Not minimally, the middle third of the group of experimenters' pupils progressed in addition. Because the item facility index was applied in the tests—which were intended to evaluate the students with only elementary or general English capacity—the top third of students achieved a relatively small gain. Consequently, we're suggesting that learning knowledge that is more advanced be incorporated into English supplies. The outcomes show that students with lower English fluency profited more from and utilized the PCAR learning system's context-aware recommendation mechanism than students with higher English fluency at the beginning. Evaluations of students' learning influences prompted an analysis of the system's learning consequences for each student in the hypothetical group. This methodology enabled it to locate what the students' true opinions were about the consequences of investigating English. The objective of accumulating the PCAR system evaluations was to Figure out whether the active recommendation learning function and context-aware learning mechanism benefited superior learning.

As a consequence, through reviews and self-comparison, the self-evaluation surveys were premeditated to permit pupils to utilize the PCAR structure to expand on the advantages of their English learning. A five-point Likert scale was adopted for dividing the learning effect's degree of influence; 1 signified dangerous disparity, and five encapsulated strong promise. Five distinct forms of learning-related criticism were provided:

1. Teaching approach (TA): This tactic could boost my linguistic skills and learning proficiency. 2. Learning material (LM): The learning ingredients have become more instructive and beneficial. 3. Context-aware learning interactivity (CALI): As long as context-aware learning is satisfied, it can support interactivity and boost my preparedness to learn diligently. 4. Recommendation learning mechanism (RLM): The approval scholarship contrivance funds adapted linked education content, which is greatly valuable and affirmative. 5. PCAR demand guiding learning (PCAR-DGL): PCAR can soothe my up-to-date difficulties and monitor my education by dynamically changing my education content sequence. As illustrated in Figure 6, the RLM received the highest acceptance assessment (average satisfaction value, 4.1), indicating. As could be seen in Figure 6, the students considered the RLM extremely beneficial and precious, as demonstrated by the highest concurrence rating (average satisfaction value, 4.1) associated with it. Responding to the feedback, the students further believed that the tailored recommendation characteristic would motivate them to investigate pertinent material and allow them to learn English more successfully. Furthermore, pupils awarded the TA and PCAR-DGL values—which are equivalent to guided learning and TA, respectively—positive feedback (the lowest average value was 3.9). This indicates that the PCAR system delivered sufficient educational content that served the specific needs of every pupil. Students discovered that the dynamically responsive learning content based on environment is both practical and captivating, as evidenced by the LM and CALI numbers above the average value of 3.7. The PCAR system's IPCAL algorithm can assist in providing personalized information services and is in alignment with the concept of scenario-aware instruction. As a result, the positive effects of the PCAR system are vital to improving studying English. Considering the PCAR system learning modules, Table 2 provides preliminary results of the users' learning satisfaction survey. It demonstrates that, except for item I1, the context-aware module obtained the highest enthusiastic rating (76.6%). In line with the results, learners feel that learning English improves significantly when they encounter stimulating and pertinent interactions.

Table 2. Mean and standard deviation between experimental and dominance groups for willingness and interest

No.	Question	Strong Agree	Agree	No Comment	Disagree	Strongly Disagree
11	The context aware segment is supportive to consequence learning of English	29.3%	49.5%	20%	5.5%	0%
12	The recommendation module is compassionate to provide suitable learning contents	27%	49.4%	21.8%	5%	2%
13	The whole learning tasks is caring to promote self-learning effect	28.5%	48.8%	21.4%	5.7%	0%

Furthermore, the results stated that modifying the direct education program depending on each learner's environment was expected to enhance m-learning users' deep memory because it aided quicker incorporation of English vocabulary, conversations, and idioms in a way that was applicable to real-world situations. Our suggested learning module supports learners in their learning processes, as illustrated by the significant support that was reached for Item I2 in Table 2. As stated in distinct ways, learners' understanding and implementation of the English they have learned by carrying out speeches, essays, and vocabulary exercises can be effectively boosted by the PCAR system's active recommendation learning module. The discussion indicated that the module can also enhance English application skills in a variety of everyday life scenarios and save a significant amount of time spent looking for appropriate learning resources. These findings showed that the relaxed culture in the PCAR system generally met the majority of the learners' learning loads and matched their facility level by employing an appropriate filtering mechanism. Furthermore, the system's context-aware and recommendation learning features effectively reduced search times and led participants down the correct educational methods, which further encouraged self-learning. As demonstrated by their reaction to I3 (refer to Table 2), the learners' satisfaction with the PCAR system's learning functions therefore topped 75%. The outcomes for the students who benefited from self-fragmentary time indicate that the hypothetical group witnessed greater improvements in active learning than the dominance group [12].

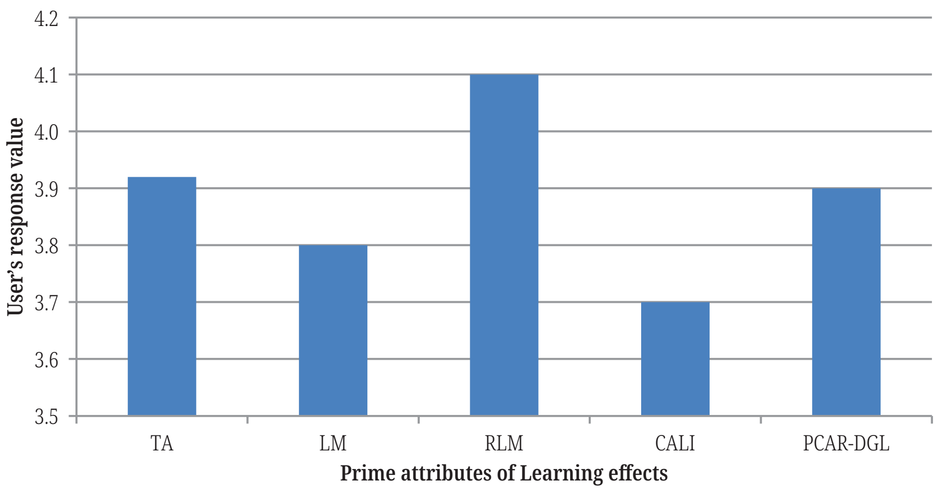

Fig. 6. The hypothetical group's self-evaluations of the learning effect throughout a semester of utilizing the PCAR learning system

5 CONCLUSION

This study effort supplies a novel context-aware recommendation learning technique that can utilize a 3G, 4G, or wireless local area network to present learners with pertinent English learning content dependent on their location and surroundings. With a smartphone or other mobile device that has the PCAR system installed, participants can access their learning material at any time, regardless of where in the world they are. The hypothetical results confirmed the proposed approach for enhancing English learning. Learning modules contained a multimedia learning subsystem that can support personal learning behavior analysis mixed with a context-aware system to identify learners' environmental details and, in consequence, recognize the most beneficial learning content package for students in many different kinds of environments. A learning recommendation subsystem was designed to support personalized learning suggestions. An engaging education infrastructure was built in this study for transforming academic material for different kinds of learners. This software acts as a simulated English learning environment, which could assist with self-learning numerous cultures.

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