The impact of information technology for online learning with the implementation and involvement of students in the creation of conditions and environment

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Abstract: Adaptive e-learning is considered a stimulus to assist learning and increase student engagement. Hence, building suitable adaptive e-learning environments helps to individualize education to reinforce learning goals. This work aims to create an adaptable e-learning environment based on students' learning styles and examine the effect of the adaptive e-learning environment on student engagement. This study also contrasts the suggested adaptive e-learning environment with the standard e-learning strategy. The suggested adaptive e-learning strategy and findings may assist e-learning institutions in building and implementing more individualized and adaptable e-learning environments to increase student engagement. The work is based on mixed research methodologies used to examine the effect in the following manner: The adaptive e-learning environment is designed using the development technique, a quasi-experimental research methodology for performing the research experiment. The student engagement scale measures the following affective and behavioral factors: skills, participation/interaction, performance, and emotions. According to the data, the experimental group is statistically substantially higher than the control group. These experimental findings suggest that an adaptable e-learning environment can motivate pupils to learn. This study makes many practical recommendations: how to develop a foundation for adaptive e-learning based on learning styles and how to execute it; how to improve the impact of adaptive e-learning in education; and how to boost the cost-effectiveness of education.

Keywords: Adaptive e-learning, E-learning, etc., ITC, Students engagement, Students learning styles.

1. Introduction

In contemporary conventional e-learning settings, training has followed a "one style fits all" approach, meaning that all students are exposed to the same learning techniques. This education method does not accommodate pupils' varied learning styles and preferences. The evolution of e-learning systems has facilitated and promoted customized learning, in which education is tailored to a student's unique requirements and learning patterns (Chang, Li, & Huang, 2022). Some customized techniques allow students to pick information that suits their personalities (George & Lal, 2021). An essential aspect of individualized learning is the distribution of course content. In addition, building a well-designed, practical, adaptable e-learning system is difficult owing to the intricacy of adjusting to the various demands of learners (Katsaris & Vidakis, 2021). Regardless of the use of e-learning, changing to adaptive e-learning environments can increase student engagement. However, a learning environment cannot be deemed adaptable if it lacks the flexibility to fit students' learning styles (Olaitan & Mavuso, 2022).

On the other hand, although student participation has become a fundamental problem in learning, it is also a measure of educational quality and whether active learning takes place in courses. Miller, Fassett, and Palmer (2021) indicate that there is a need for further study on student involvement since gauging student engagement is a predictor of academic achievement and learning. It is essential to distinguish

between cause elements like the learning environment and outcome factors like an accomplishment. Therefore, student involvement is a significant study issue since it influences a student's final grade and course dropout rate (Daly-Smith et al., 2018).

Through the shared first-year deanship, the University's strategic plan has prioritized activities that enhance students' higher-order abilities. These include communication, problem-solving, research, and creative thinking abilities. Although the action plan calls for improving these talents via standard first-year academic programs, the student's learning skills must be fostered and engaged more. Consequently, the author's experience, Observed, were the standard methods of teaching in the "learning skills" course, in which the topic is provided to all students in one way that is reliant on their grasp of the subject, notwithstanding the variety of their learning styles.

According to several research, insufficient consideration is given to the requirements and preferences of individual students, and as a consequence, all students are treated similarly. It is advised that further study be conducted on the effect of educational technology on the development of abilities and performance of various learners. This "one-size-fits-all" approach indicates that all learners must use the same learning style prescribed by the e-learning environment. Subsequently, a study of the relevant literature demonstrated that an adaptive e-learning environment might alter learning outcomes to meet the identified gap. Adaptive e-learning environments depend on the learner's preferences and learning style as a reference that aids in the creation of adaption.

To validate the preceding, the author performed exploratory research through an open interview that contained specific questions with a sample of fifty students in the learning skills department of the standard first-year curriculum. Eighty-eight percent of students said that the method in which they are presented does not take into account their peculiarities and that they lack personal learning that is consistent with their work style. Eighty-two percent of students said they could not access adaptive instructional material that encourages student engagement. The author addressed the research issue accordingly. What is the preferred method of delivering course information, and what questions were posed about the challenges they confront while taking a course on "learning skills"?

This study adds to the current body of information about the topic. It is crucial because it enhances comprehension of the issues involved in building adaptive environments based on the learning style parameter. This paper is afterward organized as follows: The next part discusses the relevant work referenced in the literature, followed by the study methodology, data collection, findings, discussion, and finally, some conclusions and future trends.

2. Theoretical Framework

This section presents a concise literature overview of adaptable E-learning environments according to learning styles.

2.1. Adaptive E-Learning Environments Based on Learning Styles

The use of adaptive e-learning in higher education has evolved more slowly, and the obstacles that slowed its deployment remain. All learners have access to the same tools provided by the learning management system, but depending on their learning styles and preferences, they need different information. The interactive e-learning environment necessitates analyzing the learner's preferred learning method, either before the course delivery, such as with an online exam, or during the course delivery, such as with student response monitoring (Gao, Guo, & Coates, 2022).

In e-learning settings, instructional materials are adapted based on several well-designed procedures. The adaptive e-learning framework attempts to tailor instructional material to the preferences and requirements of the students. Adaptive e-learning (AEL) environments, according to Sweta (2021) depending on building a model of each learner's requirements, preferences, and learning styles. It is well acknowledged that such adaptable behavior may boost the growth and performance of learners, hence enhancing the quality of the learning experience. Through variety, interaction, adaptation, feedback, performance, and predictability, the following characteristics of adaptive e-learning environments may be

identified: Adaptive framework taxonomy and features relate to a variety of factors, but adaptive learning consists of at least three: a model of the structure of the information to be taught with specific learning outcomes (a content model). The student's expertise is based on achievement, a technique of evaluating student strengths (a learner model), and a method of matching educational materials and how it is provided in a tailored manner (an instructional model). In recent years, there has been a rise in research on adaptive e-learning. Adaptive e-learning is projected to grow at an accelerated rate across all levels of education (Sayed et al., 2023).

Numerous studies have shown the efficacy of adaptive e-learning in providing e-content to learners by their requirements and learning styles, enhancing the process by which students acquire information, experiences, and higher-order thinking abilities. Student features of learning style are widely employed to create tailored learning experiences since they are seen as a significant problem and a crucial effect on learning.

Adaptive e-learning environments include the learning style as a factor. Numerous studies have stressed the link between e-learning and learning styles to be motivated in learning circumstances, hence enhancing the learning results. Individuals' learning styles vary while engaging with the knowledge offered (Fatahi, 2019). The term "learning style" refers to the process by which the learner organizes, analyzes, depicts, and integrates this knowledge before storing it in his cognitive source and retrieving the information and experiences in a manner that reflects his method for conveying them. The notion of learning style is based on the fact that students differ in their ways of obtaining knowledge and thinking to assist them in detecting and synthesizing information in their minds and acquiring experiences and abilities. The substantial scientific literature on learning styles has few robust experimental data and little evidence on the efficacy of adjusting education to learning type. There are several models of learning styles, including the model, one of the most well-known models used to define learning styles.The questionnaire provides enhanced insight into information processing preferences (Siddique, Durrani, & Naqvi, 2019). Tonkaboni, Pareshkooh, Manafi, Mendes, and Kharazifard (2023) created the VARK model, which comprises four preferred learning modes of pupils. The letter "V" stands for visual and represents the visual style.

In contrast, the letter "A" stands for auditory and represents the auditory style, and the letter "R/W" stands for "write/read" and represents the reading/writing style. The letter "K" represents the word "Kinesthetic" and the realistic style. Furthermore, VARK differentiates visual learners into graphical and textual or visual and read/write learners (Mirza & Khurshid, 2020). Figure 1 depicts the four categories of The VARK Inventory of Learning Styles.

According to the VARK model, learners are categorized into four groups representing basic learning styles based on their responses to 16 questions, with four possible responses to each question, where each answer corresponds to one of the extremes of the dimension (Sabiston & Leung, 2020) to assist instructors in designing practical courses for students. Visual learners like to receive educational materials and submit assignments using resources such as maps, graphs, and graphics. Learners who can read and write prefer text-based learning tools, such as glossaries, handouts, textbooks, and lecture notes. Aural learners prefer to learn via spoken materials, discourse, lectures, and discussions. Kinesthetic learners prefer direct practice and learning by doing.

Consequently, the purpose of this study is to analyze how these individual factors might be implemented in adaptive e-learning environment practices. Dutsinma and Temdee (2020) provided a framework for an adaptive educational system that personalizes learning material depending on student learning styles and other parameters such as the topic competence level of the learners. This system enabled students to pursue their adaptive learning material pathways depending on their "ils" questionnaire responses. In addition, they offered a framework that may adapt automatically to students' learning styles and recommend online activities with total customization. Similarly, Ibrahim, Yang, Ndzi, Yang, and Al-Maliki (2018) aimed to establish a student's unique learning style and then customize lessons to their distinct interests. According to Mahmood, Raheem, and Nehal (2022) the perceived usefulness of adaptive e-learning that emphasizes learner experience and learning style is greater than

that of a non-adaptive e-learning system. This may also boost the learners' contentment, systems to help students overcome individual obstacles to learning by tailoring instruction to factors including the student's preferred learning style. Recently, researchers have begun to concentrate on ways to tailor e-learning experiences to individual learners based on factors including their preferred method of instruction. The results show that the best learning gains may be achieved via an adaptation strategy considering the learner's preferred learning method and current knowledge level.
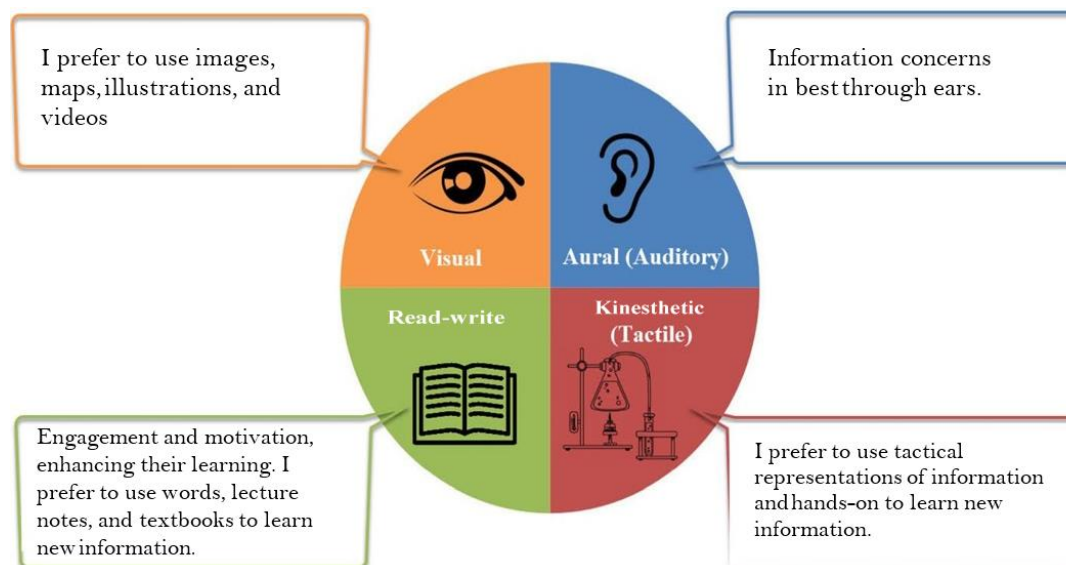

Figure 1.
Learning styles.

2.2. Student Engagement

Prior studies have highlighted the importance of student engagement in addressing academic challenges, including low grades, social isolation, and high rates of school abandonment. It is crucial to encourage active participation to maintain students' interest in the course and, by extension, their learning (Marosan, Savic, Klasnja-Milicevic, Ivanovic, & Vesin, 2022). It is essential for students to actively participate in online learning environments, where they may otherwise feel detached and alone. To what extent do students actively participate in class by interacting with course materials, peers, and the teacher? Extensive studies compared the levels of student involvement in online and offline learning environments. Students' engagement during video viewing was evaluated using many input characteristics and methodologies to test hypotheses about the link between student data and student involvement. Students' viewing duration and assessment participation rates informed the study's input features.

There is a link between students' engagement with course materials and their academic outcomes. Pupils' test results were significantly affected by interactive learning activities and students. Past studies have shown that high levels of student involvement affect course outcomes. For instance, students were advised to use internet resources and take practice tests often to improve their grades. Other research has shown that students who are more engaged in class and complete more surveys have better grades.

Factors that contributed to success in online learning were competence, affect, action, and output. Learning skills include actions like regular practice, focused listening and reading, and note taking. The term "emotion" describes how the student feels about the learning process. The term "participation" describes the student's actions in class, such as those taken during a chat, discussion, or conversation. A good performance may be measured by the outcome, such as a high mark on an exam. In general, children who show high levels of engagement put out an effort to master both the subject matter and the social

and emotional skills necessary to connect well with their peers in the classroom (that is, be motivated by an idea, willing to learn and interact). How a student feels, thinks, acts, and interacts with others creates their level of involvement. One's mental state, emotional investment, and motivation all peak during the intense study. Therefore, as illustrated in Figure 2 the student engagement scale seeks to quantify what students are doing (active thinking), how they connect to their learning, and how they react to material, instructors, and other students. (knowledge, involvement/interaction, output, and feelings). Thus, past studies have expanded beyond comparing online and in-person classrooms to looking at measures to enhance the latter. Evaluations of prior studies on student engagement indicate that learning effort, participation in activities, interaction, and learning satisfaction are all important indicators of student engagement in classrooms. These findings highlight numerous aspects of online classroom design that may be used as indicators of student engagement. Active learning, psychological motivation, effective use of experience, and proficient use of online technology are all characteristics shared by those who excel as distance students. Additionally, they are very articulate, skilled at working in groups, and capable of learning independently.

2.3. Overview of Designing the Adaptive E-Learning Environment

The first issue is addressed by using the analysis, design, development, implementation, and evaluation (ADDIE) phases of the instructional design model. The Adaptive Learning Environment (ALE) is a media-rich, distributed learning space that caters to each student's unique preferences. In addition, the setting may attract students, inspire them to study, and deepen their investment in their education.

Consistency in a learning environment is crucial since it may boost students' drive to study and help them succeed. So that instead of generic information, people get information tailored to their needs. Therefore, a set of instructional design principles for creating an adaptable e-learning framework based on learning styles was established, as shown in the accompanying picture Figure 3.

As shown in the above diagram, one component of the analytic process was cataloging the various teaching and learning resources (syllabi and course plan modules) that were put to use throughout the investigation. The goals for learning were included in the more general goals for learning (C4-C6: analysis, synthesis, evaluation).
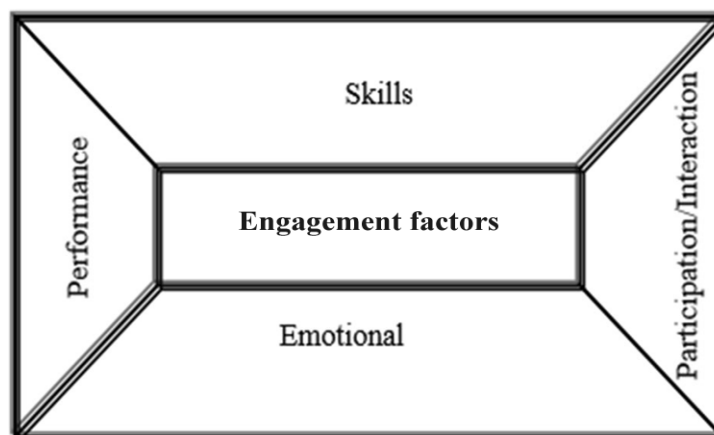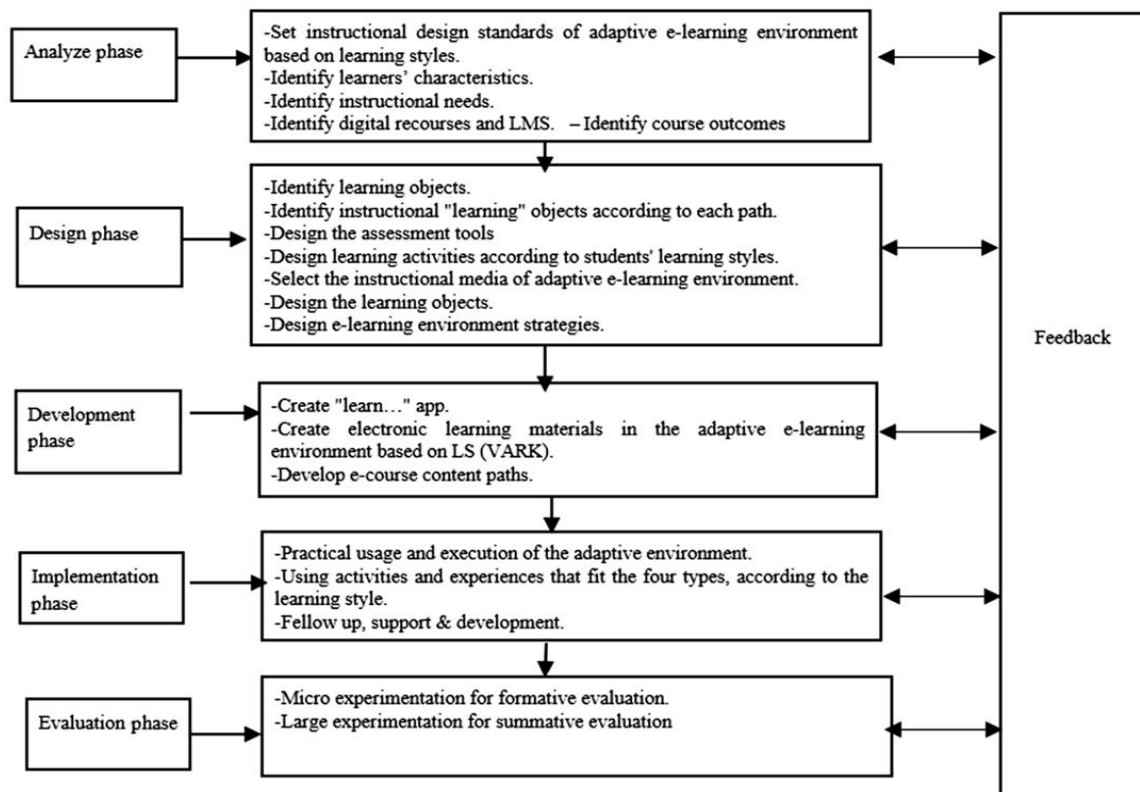

Figure 2.
Engagement factors.

Figure 3.
The ID (Model) of the adaptive e-learning environment.

Course content analysis & learning objective identification

R-WLS content path includes: PPTs, PDFs, announcements, reading assignments, lecture notes, and assignments.

ALS content path includes: Discussion and dialogue, and audio materials, podcast storytelling, brainstorming. puzzles.
.

Adaptive e-learning course design

VLS content path includes: Graphic presentation, diagrams, pictures, concept maps, graphic models, organizers, discussions, YouTube intructional videos, and visualizations

KLS content path includes: PPTs, role-playing, forums, practical materials, gamification, simulations, case studies and manual activities.
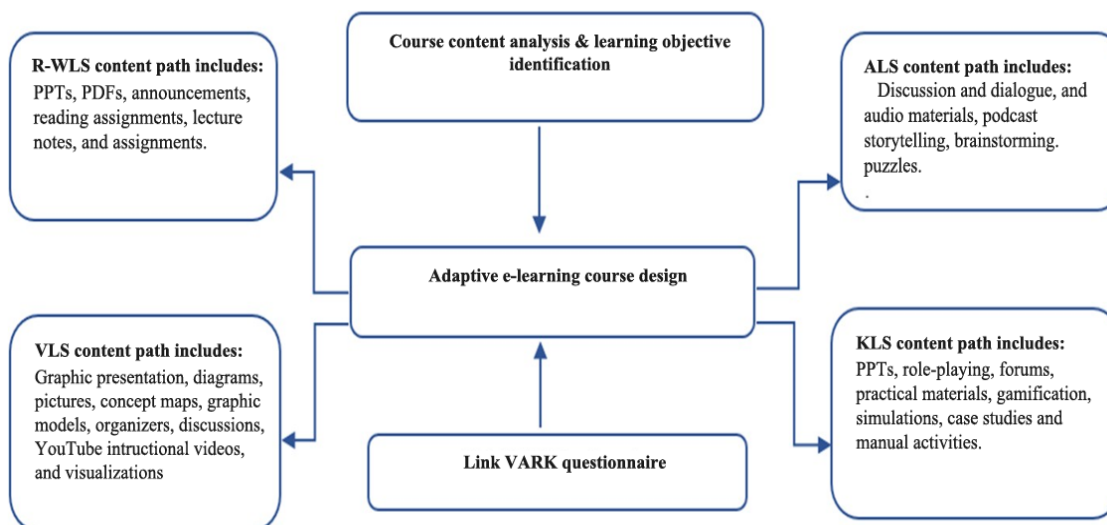
Link VARK questionnaire

Figure 4.
Adaptive e-course design.

In the design phase, we created SMART goals and developed the course content according to the modules' outline. Learning models, methods, and assessments are only some of the four content streams established to provide adaptive education. Navigation and course layout were predetermined. An adaptable structural design determines relationships between components like introductory modules,

course content, and assessments. They were figuring out what goes into each of the four possible routes. The following criteria were used to choose course materials: Figure 4.

As part of the development process, we considered each possible content route and accordingly made media preparations and selections for the e-course. The author completed the storyboard and all material to be used on each storyboard page during this procedure. The materials used to teach each strategy have been sorted into several categories Figure 5.

Following is a link to the author's mobile App for a questionnaire on preferred learning strategies: https://play.google.com/store/apps/details?id=com.pointability.vark. The students then used their learning methods to access the adaptive e-course modules.

These activities occurred during the Implementation phase: Certification of the quality of the course materials by experts in the field. Expert validation (syllabi and modules) check course contents for accuracy. Student learning activities, the capacity to apply to learn, and student responses to modules were all verified as part of the validation process. Every bit of information the student provides about their habits, blunders, navigation, and learning process goes towards refining and perfecting the modules the learner uses.

Five e-learning experts assessed the adaptive e-learning throughout the evaluation process. The framework was then updated to account for the suggestions and criticisms of industry professionals. Included in the examination are checks on the following: content, three types of media, instructional, interface, and use design. The suggested structure was tested using adaptive learners. It had been split in half. Ten students representing the sample participated in the pilot test of the proposed learning environment. Each student's actions, inquiries, and responses were recorded, and their access to and use of instructional materials and the amount of time they spent studying were validated.

3. Methods

3.1. Research Purpose and Questions

The focus of this study is on how the implementation of an adaptable e-learning environment might foster more participation from students. Figure 6 depicts the conceptual framework of the study. As a result, the following questions have been developed for the study: The primary inquiry is, "How does incorporating an adaptable e-learning environment catering to different learning styles (VARK) affect the growth of students? interest in learning?
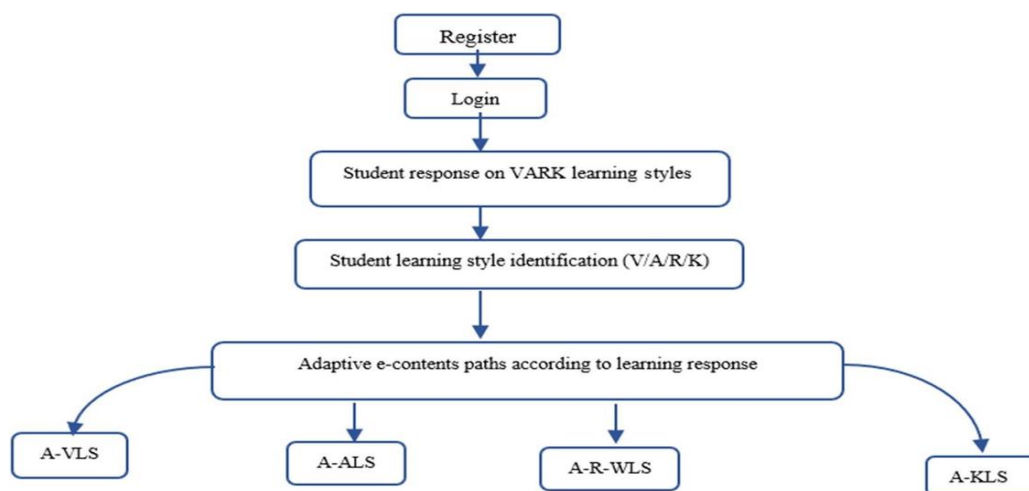

Figure 5.
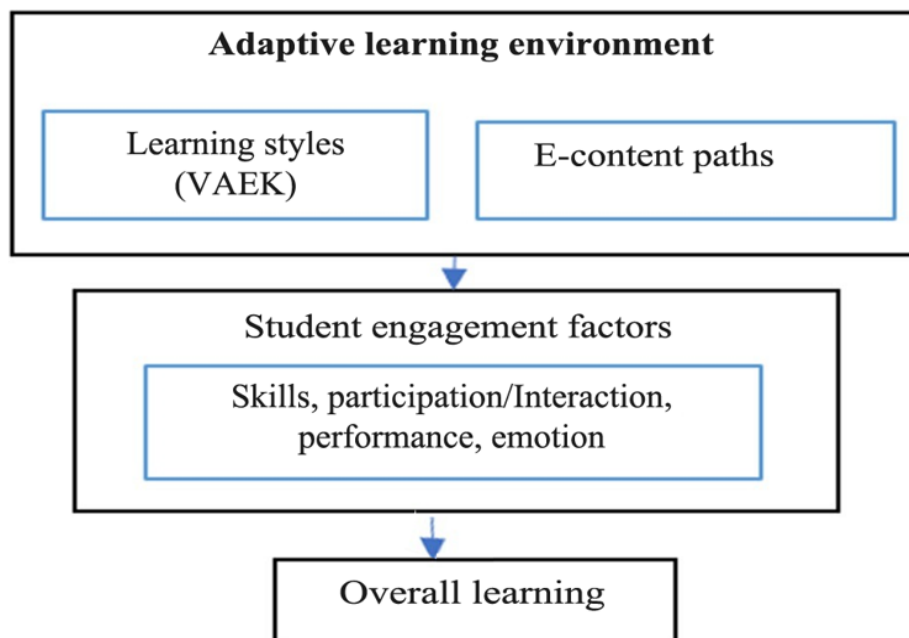Roles and deployment diagram of the adaptive e-learning environment.

Figure 6.
The conceptual framework (Model) of the research questions.

Two related research issues emerge from this: a) "How is the adaptive e-learning environment designed for instruction?" b) "How does an adaptive e-learning approach based on (VARK) learning styles affect students' engagement development (skills, participation, performance, and emotions) in contrast to traditional e-learning?"

3.2. Research Hypotheses

The research aims to verify the validity of the following hypothesis:

H_1: *Students in the experimental group exposed to the adaptive e-learning environment had pre-application ratings on the students' engagement measure that were not significantly different from those in the control group exposed to the traditional e-learning environment.*

H_2: *Mean scores on post-application measures of students' engagement factors favor the experimental group (adaptive e-learning) compared to the control group (traditional e-learning) at the (0.05) level of statistical significance.*

3.3. Research Design

Using a pre-and post-test design, this study might be considered quasi-experimental. As shown in Figure 7 there was a strong relationship between certain factors and others in the research.
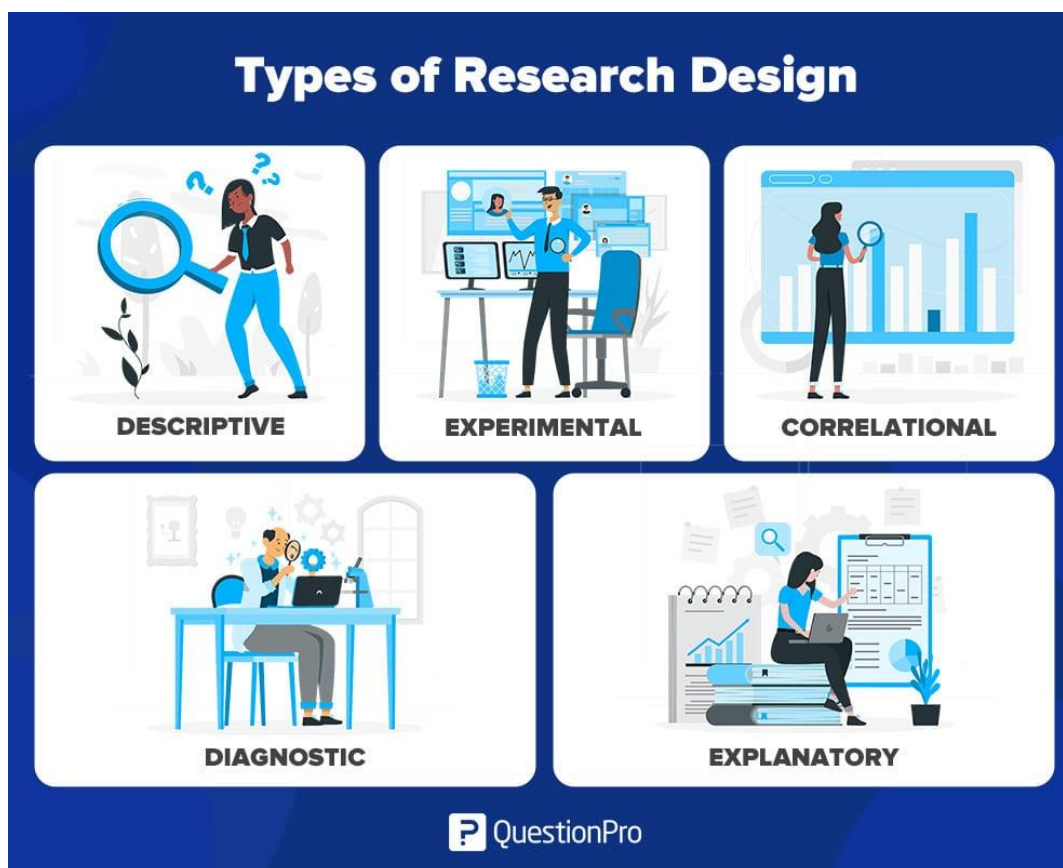
Figure 7.
Research "experimental" design.

In both cases, participants were briefed on the learning activities tracks; however, those in the experimental group were told to use the adaptive learning environment to achieve the desired outcomes, while those in the control group were shown the standard e-learning environment devoid of the adaptive e-learning parameters.

Table 1.
Students' demographic data.

Age	Gender		Total
	M	**F**	
Experimental students	36	24	60
Control group	31	27	58

3.4. Research Participants

Individuals in the sample ranged in age from 17 to 18, and all were enrolled in the "learning skills" course offered by the common first-year deanship. All students were selected during the first semester of the 2019-2020 school year, taught by the same professors. Two classes (a total of 118 students) were randomly chosen from the learning skills department to participate in the study. Two groups were randomly selected, with the first as a control group (N = 58; 31 males and 27 females) and the second as an experimental group (N = 60; 36 males and 24 females). Sample student "Demographics statistics" are included in Table 1. The kids had never seen these materials before. Participants in the control group were required to participate in a more traditional online education setting. They would be exposed to the

course material without the benefit of any adaptive e-learning parameters based on their learning styles. The control group was not exposed to the adaptive e-learning based on learning styles that the experimental group used to acquire the identical course elements inside the e-course. In addition, all the students who agreed to participate in the study had to read the rules and sign that they understood them.

3.5. Research Instruments

The variables (skills, participation/interaction, performance, and emotions) that made up the student engagement scale were used as indicators in this study. Students' interest in the "learning skills" course was measured before and after participating in the experiment using a pre-post scale.

3.6. VAEK Questionnaire

When conducting studies in education, questionnaires are often used as a data collection tool. The VAEK questionnaire was administered digitally, with students filling it out using a custom mobile app and then entering their responses into the database. According to its classification, the questionnaire's 16 questions were divided into four categories (kinesthetic, auditory, visual, and R/W). The validity and trustworthiness of a time to fill out the VAEK Cronbach's alpha are used to test the trustworthiness of a study's findings by gauging its internal consistency. Correlations between items and factors, as well as between factors themselves, were used to determine internal consistency. The VAEK questionnaire has a Cronbach's Alpha correlation value of 0.83, demonstrating its reliability and suitability for use in subsequent studies. In general, readings over 0.70 are considered quite reliable.

3.7. Students' Engagement Scale

Reading up on student involvement led to the creation of the engagement scale. Students' involvement was evaluated using the Dixson scale. Competencies, participation/interaction, performance, and affective dimensions were the four main components of the assessment. Following these guidelines, the author modified the original "Dixson scale." The author adapted the Dixson scale, which consists of 48 statements, into Arabic. Expert advice led to a simplification of the instrument down to 27 questions more suited to the context of higher education. There is a 5-point scale used to assess the scale's effectiveness. There were four components to the final version of the engagement scale, and they were as follows: Ten factors were used to gauge skill involvement, including attendance, reading course materials, and effort. Active participation/interaction engagement (five things) to assess having a good time and contributing to the group's ongoing discourse frequently. The required level of performance was (five items) on the assessment exam, with a passing score representing a complete set and ascertaining whether or not a course was fascinating based on how emotionally invested you are (using these seven factors). Therefore, the goal of the scale is to assess the levels of student involvement before and after being exposed to adaptive e-learning against traditional e-learning.

Competence in using the engagement scale and its validity and reliability The reliability of the scale factor scores, as measured by the alpha coefficient, was shown. The internal consistency for each of the four subscales is high (0.80–0.87). Overall, Cronbach's alpha showed that the instruments employed in this investigation were reliable (alpha = 0.81), indicating their accuracy. Instruments developed and utilized in this study have high levels of validity and reliability, allowing for precise evaluations of students' interest in and effort put into their coursework. To test the reliability and validity of the scale, it was used on a subset of students (20 in total) before administering to the whole experimental population. However, the instrument showed a correlation value of (0.74-0.82), demonstrating a level of validity that allows its usage. Cronbach's alpha and the correlation coefficient for the interaction scale are shown in Table 2.

However, professionals were consulted for their thoughts on the scale's language clarity and usefulness as a gauge of students' involvement. They were encouraged to provide amendments they thought were necessary to ensure the scale's content validity.

Table 2.
Correlation coefficient and Cronbach's Alpha of engagement scale.

Students' engagement factors	Validity Pearson correlation	Reliability alpha cronbach
Skills	0.70	0.80
Participation/Interaction	0.82	0.84
Performance	0.78	0.87
Emotional	0.74	0.83
Full scale	0.79	0.81

Table 3.
Entry-level experimental and control groups in students' scores on skills, participation, performance, and emotional scores for the pre-test "students' engagement."

Engagement factor	Group	No	Arith mean	Std. D	T "value"
Skills	Experiment	60	21.07	1.89	0.464
	Control	58	24.25	1.72	
Participation/Interaction	Experiment	60	13.57	1.47	0.514
	Control	58	11.34	1.31	
Performance	Experiment	60	12.70	1.20	0.321
	Control	58	13.43	1.11	
Emotional	Experiment	60	11.23	1.45	0.397
	Control	58	12.62	1.52	
Whole engagement scale	Experiment	60	26.76	1.84	0.632
	Control	58	24.91	1.78	

3.8. Research Procedures

To test the first hypothesis that "there is no statistically significant difference between the students' mean scores of the experimental group that exposed to the adaptive e-learning environment and the scores of the control group that exposed to the conventional e-learning environment in pre-application of students' engagement scale," the author used the engagement tool to measure the homogeneity and group equivalence of the two groups.

Before experimenting, we used the t-test on independent samples to verify that the two groups were comparable on the engagement scale. There was no pre-experiment difference in student involvement between the two groups (t-values were not significant at the 0.05 level of significance).

Table 3 shows that the overall level of student involvement and each aspect of student engagement was not significantly different between the experimental and control groups at $p > 0.05$. The results indicated similarities between the two groups before the beginning of the study.

3.9. Learner Content Path in an Adaptive E-Learning Environment

Adaptation in e-learning settings is predicated on the aforementioned well-designed mechanisms. Kinesthetic, auditory, visual, and R/W learning styles are all represented in the catalogued categories of accommodating resources. This analysis focused on the first half of the current school year, which began in the fall of 2019. Eleven of the course's modules focused on the adaptive learning exercise's theme of "adaptive learning." The tests and activities were linked to chapters in the textbook. All of the course's items were taught by the same person and were required to complete the same assignments and get the same grade to minimize extraneous differences. Students in the experimental group were instructed to bring smartphones to class. They downloaded an adaptive learning application and set up individual accounts. They were given access to a custom-made channel within the program and training on entering learning objects into the program with the correct default settings. Students in the experimental group of this adaptive online course are given a survey to fill out on a specially designed mobile app. There are

four options available to them. The students may answer the questions. Students' replies to the findings reveal the right solution, yet the learning module is flagged as unfinished because of it. It doesn't matter how a pupil responds to a question; the right one is always identified instantly.

Figure 8 provides a graphical representation of the results of the VAEK Questionnaire, which may be used to identify a person's preferred learning method. The student's experience studying in this individualized learning space is shown in Figure 4. Students were able to see where they were about the learning skills course and the overall system. It helped pupils focus on developing the knowledge and abilities most attracted them. Digital curricular resources were made available to students after they had progressed to a certain point in the online learning platform. Afterward, students might go forward via the several approaches provided by the suggested system, allowing them more control over their learning speed. The "flowchart" below depicts the student's journey through an adaptable e-learning environment as determined by the (VAEK) learning styles (visual, auditory, kinesthetic, reading/writing) Figure 9. Previous design models of the adaptable framework relied on student responses to a "Learning Styles" questionnaire. Students' findings will determine which of the four learning styles—"Visual," "Aural," "Read-Write," and "Kinesthetic"—they will be directed toward. At first, the student was free to complete the online engagement scale at their leisure. When asked how long it would take, they said "engagement scale." Based on the first findings of the VARK questionnaire, the system generated a personalized learning plan to fill the gap. The learner model represents crucial student attributes such as background knowledge, learning style, and learning goals. Every member of the experimental and control groups had their weight and height measured before and after the study. Treatment was the sole variable in the experiment (using the adaptive learning environment).
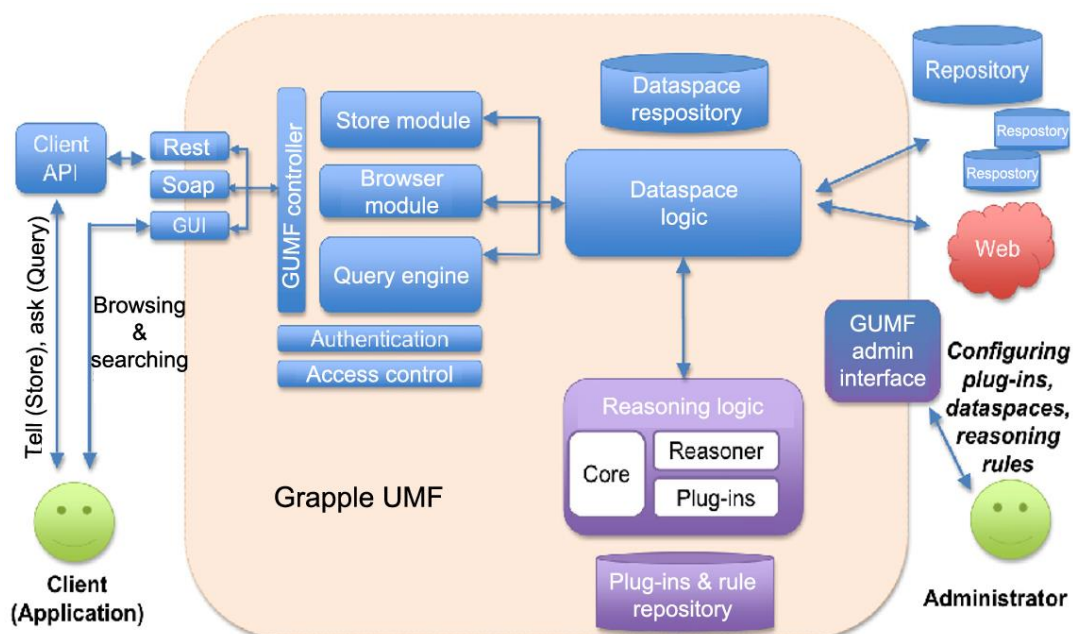

Figure 8.
Visual example from "learning of the learning styles" identification and adaptive e-learning course process.
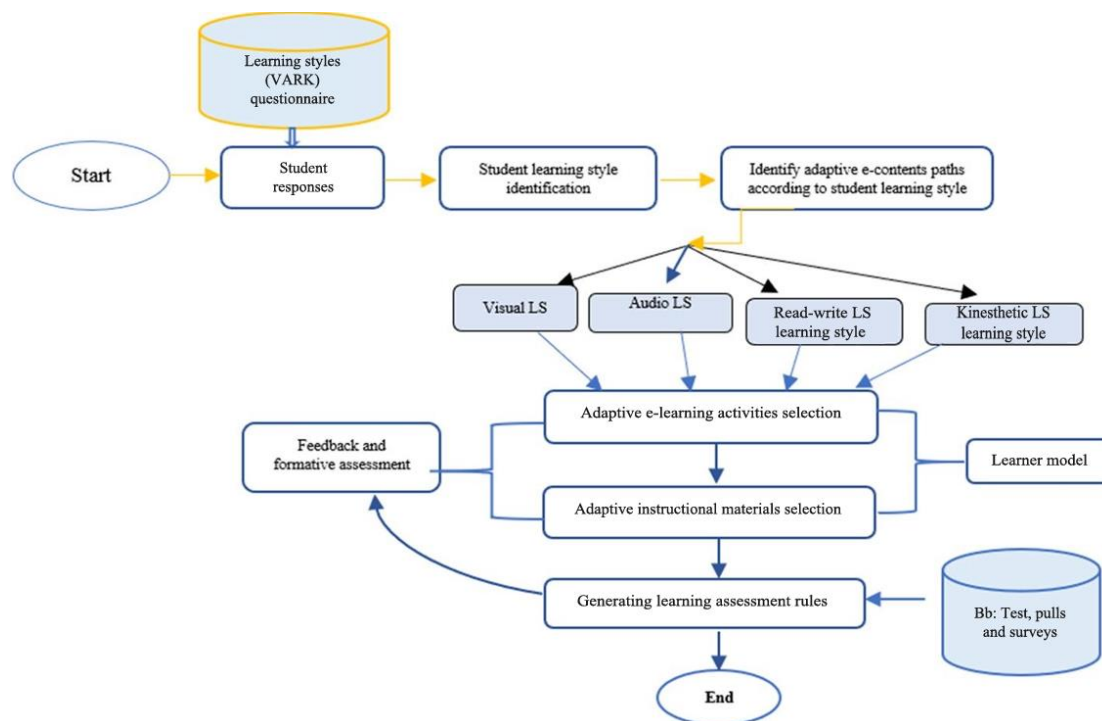
Figure 9.
Student learning path.

4. Findings

To respond to the second question, which reads, "How does adaptive e-learning that takes into account students' individual preferences for learning (VARK) affect students' engagement (skills, participation/interaction, performance, and emotion) compared to more traditional forms of online instruction?"

It was determined whether or not the statement "There is a statistically significant difference at the level (0.05) between the students' mean scores of the experimental group (adaptive e-learning) and the scores of the control group (conventional e-learning) in post-application of students' engagement factors in favor of the experimental group" was true. The findings of the two study groups' applications of the engagement scale elements were compared using arithmetic means, standard deviations, and "T"-test values to conclude the null hypothesis.

There was a statistically significant difference between the two groups on the post-test measuring engagement (Table 4, p 0.05), with the experimental group achieving considerably higher mean scores on the engagement elements items.

Testing the effectiveness of the suggested adaptive e-learning led to the experimental investigation. The two groups measured past behavioral involvement in this issue using independent sample t-tests. Research results showed that students in the innovative e-learning group outperformed their peers in the control group.

Cohen's (d) method was used to look into whether or not adaptive learning can considerably increase student engagement, where student engagement is the dependent variable. A low ES is 0.20, a moderate is 0.50, and a high ES is 0.80. However, using means and standard deviations, we determined the impact size between experimental and control group scores on the student engagement measure post-test using (d and r). The results indicated a Cohen's d = 0.826 and an Effect-size r = 0.401. The mean in the treated group is in the 79th percentile of the untreated group, as shown by the ES of 0.824. (Large effect). When comparing treated and untreated students, effect sizes may be expressed as the average percentile rank of

the average treated student. It has been determined that the ES for the treated group is 0.0 since their mean is at the 50th percentile of the untreated group. The treated group's mean ES of 0.8 places it at the 79th percentile of the non-treated group. Since impact size is a crucial determinant of the robustness of the study, the findings demonstrated that the dependent variable was significantly changed across all four dimensions of behavioral engagement (knowledge, performance, participation/interaction, and emotion).

Table 4.
Descriptive data and independent sample t-tests of the pre-test results.

Engagement factor	Learning group	No	Mean	Std. D	t value	p
Skills	Experimental group	60	34.81	1.34	4.086	0.001*
	Control group	58	23.34	1.79		
Participation/Interaction	Experimental group	60	21.05	1.09	2.210	0.002*
	Control group	58	13.26	1.43		
Performance	Experimental group	60	25.86	1.47	2.071	0.003*
	Control group	58	14.60	1.35		
Emotional	Experimental group	60	24.93	1.84	2.909	0.001*
	Control group	58	13.07	2.03		
Average score	Experimental group	60	38.87	1.80	4.738	0.003*
	Control group	58	26.13	2.17		

Note: *p < 0.05, *Significant at 0.05 level.

5. Discussions and Limitations

This article examines how implementing an adaptive e-learning environment might influence the growth of student interest and participation growth. The purpose of this research was to provide guidelines for creating a personalized online education platform that considers individual differences in how people learn. It was determined that proficiency, participation/interaction, performance, and affect all have a role in students' dedication to e-learning. The characteristics of engagement significantly impact the learning results. All of the items on this factor are connected in some way to the mental processes that are being measured. For instance, discussions with course materials, classmates, and teachers were all included in the context of the participation/interaction aspect.

Consequently, the degree to which students engage with course materials, one another, and their teachers may be anticipated. These findings are consistent with the literature's emphasis on the need to provide students with learning resources that are unique to them to increase their motivation. Learning styles-based adaptive e-learning heavily focuses on behavioral engagement, whereby students take charge of their education while actively engaging in online sessions. The results of the lessons become more effective as a result. Learning styles are represented in this study as one of the usually accepted concerns as a reference for modifying the e-content route. The experimental data demonstrated that students who learned using this method gained more excellent knowledge. According to feedback from students in the control group, the adaptive eLearning environment was engaging and effective in keeping their attention. Students said that the adaptive eLearning environment was conducive since it allowed them to practice recalling the course material, which improved their overall perception of the course. This might be why the kids in the test group did so well academically and were much more engaged in class than their counterparts in the control group. This study evaluated two distinct types of e-learning environments, both aimed at getting students invested in a course that teaches them new skills by delivering and

evaluating information online. Higher involvement in the experimental group than in the control group suggests that the student's learning styles were better accommodated in the BB activities. Adaptive learning has been beneficial since it gives students access to high-quality opportunities tailored to their individual needs and preferences as learners. However, it should be highlighted that the scope of this research is limited to the customization of learning materials in response to individual differences in learning styles. There's also the matter of content-specific modification. Similar results have been found in other research, demonstrating the usefulness of an adaptable e-learning setting. Unlike other studies, this one considers the University as a case study, the VARK Learning styles selection, engagement variables, and the closed learning management system.

The research results showed that students with different learning preferences (kinesthetic, aural, visual, and read/write) benefited from using adaptive material. There are several reasons for this: The design of adaptive e-content for skill acquisition relied on the introduction of an ideal learning environment for learners and the provision of support for learning adaptation by the learning style, encouraging learners to learn directly, achieving knowledge building, and enjoying the learning process. The findings bore that up; moreover, they pointed to the need to tailor one's teaching and learning methods to each student's unique preferences and aptitudes. Consistent with the results is an adaptable e-content design that facilitates varied ways of thinking about knowledge amongst learners via the presentation of information and skills in a sequential fashion based on the adaptive e-learning framework.

Thus, the outcomes above can be attributed to the following: the diversity of course content elements (texts, static images, animations, and video), a variety of tests and activities, diversity of learner characteristics, and the excellent design of the adaptive e-learning environment taking into account the learners' learning styles and preferences according to its instructional design (ID) standards.

Adaptive e-learning technologies have been proven to boost students' learning knowledge and engagement in "skills, performance, interaction, and emotion." Still, research also shows that these environments only moderately affect students' long-term material retention.

The topic of how adaptive eLearning that considers different learning styles might be included in multiethnic courses has received very little attention in recent years. Limited empirical research on teaching effectiveness to individual learning styles has shown conflicting results. It has shown that students may benefit from adaptive eLearning tools in their education and growth. Findings like these suggest that adaptive eLearning is a worthwhile learning strategy since it piques students' interest and encourages them to participate in the learning process.

According to the findings of the experiments, the suggested setting considerably improved students' learning outcomes compared to the traditional e-learning classroom (without adaptive technology). Consequently, incorporating the suggested changes into the learning environment may pique the pupils' interest. Additional data shows how an adaptable environment may improve other dimensions of quality, such as student engagement.

6. Conclusions and Implications

This research aimed to create an adaptable e-learning setting where students of a course in learning skills may engage in various forms of interactive learning activities. Many people have been interested in this study area, yet many issues remain unresolved. This study establishes and fills several research gaps by creating an active adaptive e-learning environment that has been found to boost student engagement. The study's primary findings showed a statistically significant difference in learning outcomes and good outcomes for adaptive e-learning students, suggesting that this approach to online education may be helpful in the higher education setting. It also added to the body of knowledge around adaptive e-learning systems. The results indicated that student engagement might be increased via adaptive e-learning considering various learning styles. As a result, the use of adaptive e-learning that considers students' preferred learning methods considerably raised levels of participation. Researchers have shown that students have various preferences regarding how they study best. In addition, individual differences in how people learn may be very significant. Thus, the best educational settings are those that tailor their

output to the need of the pupils. Students will be more engaged and motivated to study if teachers take the time to create high-quality, individualized learning materials and activities. Learning styles, in conclusion, provide a solid foundation upon which to build instructional materials grounded on various learning theories.

Implications for the classroom may be drawn from this research on the impact of adaptive e-learning on student engagement. The results may first be used to inform the evolution of blended-learning adaptive settings. Second, the findings stress the need to conduct more quasi-experimental and descriptive studies to fully comprehend the merits and pitfalls of implementing adaptive e-learning at universities. Third, the study's findings suggest that putting students in an adaptive e-learning environment rather than a traditional one would help them become more involved in the learning process and build their knowledge instead of passively absorbing it. Fourth, further study is required to develop efficient settings in which adaptive learning may be used at universities to boost student achievement and interest in studying. Finally, the research demonstrates that adaptive e-learning enables students to learn on their own time, which improves their learning and knowledge of course content, such as expanding their understanding of learning skills course topics beyond what they could learn in a traditional e-learning classroom.

6.1. Contribution to Research

The research aims to provide complex data on the effects of adaptive e-learning on learning outcomes. However, this study's findings have real-world applications for anyone with a stake in higher education; specifically, the study's authors want to help university instructors implement new methods of instruction that will increase their students' interest in and class participation. The course is meant to provide teachers with a blueprint for creating adaptable online classrooms that cater to students' learning styles and needs in various settings.

6.2. Research Implication

References, interactive media, films, podcasts, narrative, simulation, animation, problem-solving, games, and readily available educational tools all contribute to a more positive learning experience for students in an online classroom. It's also flexible enough to allow various approaches to learning. This study paves the way for further research into applying the "adaptive e-learning" method throughout the curriculum, diverse learning contexts, and a wide range of online courses. Meanwhile, the suggested setting has generated a lot of excitement for potential educational uses thanks to its beneficial effect on student engagement. More in-depth studies of learning preferences among students at various universities will pave the way for tailoring online instruction to individual students' needs.

6.3. Policy and Practice Implications

More student involvement might be achieved via the use of adaptive e-learning that takes into account individual differences in the way people learn.

A comparison of traditional online learning with an adaptive system demonstrates its superiority.

Institutional Review Board Statement:
Not applicable.

Transparency:
The author confirms that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Competing Interests:

The author declares that there are no conflicts of interests regarding the publication of this paper.

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