Journal for Educators, Teachers and Trainers
The PROFESIOLab electronic, peer-reviewed, open-access Magazine

ISSN 1989 – 9572

DOI: 10.47750/jett.2023.14.01.067

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Journal for Educators,Teachers and Trainers, Vol. 14 (1)

https://jett.labosfor.com/

Date of reception:27 Nov 2022

Date of revision: 16 Jan 2023

Date of acceptance: 18 Feb 2023

Dr. Farhan Yetaim Alenezi (2023). Future University Learning Environment Requirements for Implementing Adaptive Learning Technology.*Journal for Educators, Teachers and Trainers,*Vol. 14(1). 720-732

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Future University Learning Environment Requirements for Implementing Adaptive Learning Technology

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ABSTRACT
The purpose of this study is to determine the future requirements of university learning environments and suggest proposals for implementing adaptive learning technology (ALT) in university learning environments. The sample consists of 42 faculty members in Saudi universities who specialise in educational technology, and the study employs both quantitative and qualitative research methods (42 participants answered the questionnaire, with 13 being selected for semi-structured interviews).
The study's findings found that the sample agreed on the future requirements of university learning settings for implementing adaptive learning technology to a considerable extent, as it contained four categories of requirements, namely course design, online learning management, learning flexibility, and technology management.
The study's findings also included a number of recommendations for enhancing university learning settings. The most important include developing special learning management systems for adaptive learning, investing in artificial intelligence (AI) applications and implementing the virtual tutor programme, developing future formative assessment systems based on AI tools, spreading the adaptive learning culture, and providing particular finance budgets for developing university learning environments in accordance with adaptive learning technology requirements.

Keywords: higher education, educational technology, e-learning, artificial intelligence, AI, foreseeing.

INTRODUCTION

Technological progress affects all aspects of life, particularly education, where technological innovations contribute to the development of contemporary learning methods that are compatible with the current generation of students' requirements and needs, in accordance with their abilities and competencies, in light of educational foundations, to substantively advance educational outcomes, in accordance with future requirements and rapid technological growth.
Adaptive learning is perhaps one of the products of modern technology, as it is defined as a form of e-learning that adapts to the student's performance, and allows bypassing the content that the student already knows and reviews and repeats content that the student finds difficult by presenting it in a variety of ways based on how student learns most effectively, introducing further subject matter based on student interest (Bennett, 2018). Adaptive learning technology is more effective at producing results and more efficient at helping students learn, which leads to faster results. It is also stronger at adapting quickly to different educational environments and dealing with many various types of students who learn in different ways, providing them with educational content via particular smart methods of teaching that are based on their skills and interests (Toth, 2021).
ALT also enables real-time course adaptation based on each individual students need, as their particular strengths and weaknesses are recognized and the lesson is altered to personalise by matching the diverse learning needs of all students (Gupta et al., 2023).Adaptive learning creates an individualised learning plan (also known as a learning policy) that chooses the most suitable learning resources based on the learner's innate characteristics (Li et al., 2020)
When compared to traditional classrooms, adaptive learning invests in advanced e-learning platforms that can provide learners with a more adaptive and effective learning experience. Learning policies are the most important component of these systems, which are algorithms that create or rather select the learning paths and materials, depending on various information such as the learners' current ability level and content (Li et al., 2021).
Adaptive learning is based on a highly tailored e-learning recommendation system that adjusts to each learner's learning rate. A well-designed recommendation strategy describes a series of steps to meet the goal of

optimising the learner's learning proficiency through full use of learning behaviour data, using psychological assessment models to track learner competence in knowledge points (Lopez et al., 2019).

It is important to note that adaptive learning is mostly based on constructivist learning theory. The essential principle of constructing, on the other hand, is that each person constructs their own understanding based on prior information and experience. Furthermore, constructivism promotes the use of problem-solving as well as practical experience as a means of constructing and demonstrating knowledge in significant ways (Phelps, 2019).

This is congruent with the adaptive learning theory, which is centred on activating the learner's role and increasing self-awareness. In addition to testing student performance and offering feedback, adaptive learning courses use particular methods to provide content based on the student's interests and capabilities.

According to research by Kotsyuba et al. (2022), adaptive learning focuses on the student actively engaging in self-learning, assessing the student's strengths and weaknesses as well as taking into account their experiences and interests, and providing personalised learning based on their own educational paths.

Minn's (2022) study highlighted the expansion of online learning, which was facilitated by the various types of instructional materials available on the internet, such as MOOCs and smart teaching systems, emphasising the importance of personal learning through adaptive learning, and recommending investing in AI technologies for adaptive educational environments in order to provide learning content. The study also stressed the importance of adaptive learning in allowing students to apply their learned skills to new contexts by employing their various skills to tackle any difficulties they confront.

Furthermore, Kabudi et al (2021) study indicated that AI applications are among the most important technical tools capable of contributing to adaptive learning environment development due to their ability to provide unique educational content and adapt to students' individual needs of students. In addition, AI applications can be incorporated into the design of adaptive learning environments in order to address numerous learning issues and enhance users' learning experiences.

According to Tenorio et al. (2022), adaptable learning environments should be developed so that teachers can define learning goals and evaluate student interaction with the available learning resources. Their research also found that it is vital and beneficial to design tailored assignments for learners based on their requirements and abilities in order to help them interact and accomplish their intended learning targets.

According to Vincent-Ruz and Boase (2022), in undergraduate education, students need to be encouraged to interact in discipline-specific thinking and to learn the particular topic of their choice. Academic staff face the challenge of fairly engaging all of their students, regardless of their educational background and level of understanding. Their research found that adaptive learning environments using digital technology are the only way to personalise learning on a wide scale in the context of higher education courses. The study's findings demonstrated that adaptive learning may satisfy the equal needs of all students, leading to positive changes in pedagogical behaviour and academic achievement. The study advocated adding adaptive learning in its approaches to address the requirements of their students as a critical tool for faculty members in numerous disciplines.

Kochetkov (2022) predicts that adaptive learning will become the governing paradigm for education in the future because it encourages instructional activity associated to the teacher and student's shared creative manifestations. Their study advised implementing adaptive learning on a broad scale in teaching and learning settings in higher education institutions, using a participatory and innovative approach, and providing the appropriate technical infrastructure, programmes, and resources for its effectiveness.

According to the Zhao et al. (2022) study, the adaptive learning system provides learners with a supporting environment that offers active services to fulfill them to a significant level, as well as the possibility for individualised learning based on varied individual characteristics. The study also demonstrated that adaptive education dynamically delivers relevant learning resources in accordance with the learners' personal requirements, which leads to effective learning improvement.

According to Bayounes and Saadi (2022), in order to adopt adaptive learning, intelligent transportation systems (ITS) in learning management systems must accomplish their main objective of continuing to support learning content, activities, and resources that adjust to the particular needs of individual learners, and are influenced by the learner's motivation. The education management system should connect the learner's intent to the learning strategies and provide many channels for the learner's goal. ITS should adaptively enable the learner to realise their objective through the determined method based on learner motivation and the relevant learning situation or unique learning style.

One of the most significant benefits and advantages of technology, according to the study by Sridharan et al. (2021), is the availability of a wide range of resources on the internet, however, this makes it more difficult to choose the most useful resource. Each learner has a unique learning style, efficiency, and preferred mode of instruction. In order to address this difficulty, an adaptive learning management system was created. Each student receives a personalized course that is tailored to their own level of knowledge and preferred learning style. The course is continually updated in accordance with the student's progress. Materials are graded based on

student comments regarding the quality and relevancy of each item in a knowledge base that is regularly updated utilising web scraping.
According to Burak and Gultekin (2022), the adaptive learning environment has a beneficial impact on students' academic performance, participatory learning skills, and to a lesser extent independent learning skills. It also works well to close the achievement gap caused by different learning preferences and levels of knowledge.

Study Problem
It is critical to create teaching and learning environments that are tailored to students' needs and skills, as well as the features of the contemporary era. These are the most crucial characteristics of increasing technological advancement and development. It is also critical to invest in technology development in order to create novel learning environments that improve learning effectiveness and graduation quality, such as adaptive learning environments. Much research (for example, Jagadeesan and Subbiah, 2022; Wang et al., 2020; Phelps, 2020) has confirmed the efficiency of adaptive learning and its suitability for students in the age of technological growth, with its various positive traits and advantages.
As a result, many studies (Wan & Yu, 2020; El-Sabagh, 2021; Kuo & Chang, 2022) have recommended that universities implement adaptive learning as one of the most viable strategies to resolve educational challenges, elevate educational quality, and classify graduates with the required qualifications based on their needs and capabilities, as well as the requirements of the digital age.
In contrast, the study by Mirata et al. (2020) affirmed that regardless of the growing interest in higher education institutions in adaptive learning as an unique concept based on information in teaching, institutional leaders positive attitude towards its adoption, and the success rates of earlier studies on its efficacy, the precise utilisation of adaptive learning in university education systems is limited, and among the most significant obstacles that have prompted this lack of institutional support for the approach.
Additionally, despite the fact that universities have e-learning management systems and other technical tools for teaching, the researcher noticed as a university faculty member that the learning environments in universities lack the conditions necessary for using adaptive learning. As a result, this study has set out to determine what those conditions were. The following key question might be used to define the study problem: What are the future requirements of university learning environments for implementing adaptive learning technology?

Study Questions
This study aims to provide answers to the following questions:
1. What are the future requirements of course design for university learning environments to implement adaptive learning technology?
2. What are the future requirements for online learning management for university learning environments to implement adaptive learning technology?
3. What are the future requirements for learning flexibility in university learning environments to implement adaptive learning technology?
4. What are the future requirements of technology management in university learning environments for implementing adaptive learning technology?
5. What are the suggestions for developing university learning environments for implementing adaptive learning technology?

Aim of the study
The study's purpose is to evaluate the future needs of, and to make recommendations for, constructing university learning environments in order to implement adaptive learning technology.

Importance of the study
The study's significance arises from the importance of adaptive learning and its benefits, which enable learning to take place according to the learner's requirements and unique abilities by utilising appropriate learning methods for each individual student, as well as by investing in modern technologies such as AI and more. Identifying the specifications of university adaptive learning environments (including course design, online learning management, learning flexibility, and technology management) assists university decision-makers in developing relevant strategies to achieve them, working to ensure their availability in university learning environments, allowing for the effective use of adaptive learning and benefiting from its many advantages on the one hand, and investing in modern technologies on the other.
In addition to supplementing the library with a theoretical and conceptual framework on adaptive learning technology in university learning environments and the fundamental conditions for its effective application, the quality of the educational process is improved.

Participants
In the second semester of the academic year 2022/2023, semi-structured interviews were performed with 13 of the 42 educational technology-specializing professors and associate professors from Saudi institutions who were chosen as a purposeful sample to answer the study's questionnaire.

Study Methodology
This study utilizes a mixed method approach, combining a questionnaire-based quantitative research method with a qualitative method (semi-structured interview).

Data Collection
The data were gathered in two ways, by questionnaire and interview, in order to address the study's questions.

Questionnaire
The questionnaire was developed with 34 statements in four sections about the future requirements of university learning environments to implement adaptive learning after reviewing the theoretical literature and prior studies pertinent to the topic of this study. In order to find the answer to the first question of the study, the first section contained 10 statements about the requirements for course design in academic settings. In order to answer the second question of the study questions, the second section contained eight statements about the needs for online learning management in academic settings. The third section contained eight statements about the requirements for learning flexibility in university learning environments, in order to find the answer to the third question. The fourth section, which contained eight statements about technology management requirements for university learning environments, was intended to provide the answer to the fourth study question.

Validity of the Questionnaire
Specialist Validity
After developing the questionnaire in its earliest form, it was resolved by being presented to a group of specialists in educational techniques, curricula, and teaching methods. Based on their observations, various modifications were made to the questionnaire, including the deletion, addition, and modification of certain statements, until it was in its final form.

Internal Consistency Validity
The 'Pearson Correlation' between individual item scores and total questionnaire scores is statistically significant and positive (0.05).

Reliability of the Questionnaire
The Alpha Cronbach coefficient was determined to confirm the instrument's reliability, and Table 1 demonstrates that the instrument has a high degree of reliabilit

Table 1: Cronbach's Alpha for All Tool Sections

Section	No. of Items	Cronbach's Alpha
Course design	10	0.86
Online learning management	8	0.86
Learning flexibility	8	0.88
Technology management	8	0.82

Analyzing the Questionnaire Data
The SPSS program was utilized to analyse the data.

Interview
After analysing the theoretical literature and prior studies relating to the topic of this study, the interview questions and instrument were developed. As the interview takes 45 to 60 minutes, we began with the basic questions, which included six questions about development suggestions to prepare university learning environments for adaptive learning, with the goal of obtaining the answer to the fifth question.

Validity and Reliability of the Interview Tool
After constructing the tool and preparing the basic interview questions in their final form, the tool was evaluated by presenting it to a group of specialists from the faculties of Saudi universities and modifying it by deleting, adding, and modifying questions based on their feedback. In addition, the researcher conducted a pilot study in which he applied the study instrument by conducting interviews with three faculty members in order to ensure

that the questions were clear, and to determine the time required for the interview, as the sub-questions could not be planned in advance, but appear based on the interviewees' answers and discussion.
To ensure impartiality and improve the reliability of the data, verbatim transcripts of the interviews with the study samples' members were written without the researcher's interpretations to ensure objectivity. The analysis results were presented to three professors with expertise in educational technologies and an interest in qualitative research to verify their accuracy.

Interview Analysis
The interviews were communicated through four stages, as set out below
First stage: Data Transcription
Following the completion of the data privacy, the participants agreed to the recording of their interviews, which were then transcribed and converted into a written text in which everything mentioned by the study participants was written, the main points were extracted, and a preliminary list of topics (themes) was prepared.
Second stage: Data Reduction
The interviews generated a large quantity of data that required multiple readings with care. To organise the data and extract relevant information.
Third stage: Thematic Analysis
The main topics and subtopics of the interviews were identified through thematic analysis in this study. The thematic analysis was related to the interview's structure, which consisted of a number of open-ended questions that adopted a semi-structured interviewing methodology. The primary method of linking the interview's structure to the faculty member interviews was used for the objective analysis.
Fourth stage: Constant Comparative Approach
The various perspectives of faculty members were compared using the static comparison method.

RESULT OF THE STUDY
DISCUSSION
The researcher determined the means and standard deviations for the selected respondents to the statements in the questionnaire that addressed the future needs of tertiary learning environments (course design, online learning management, learning flexibility, and technology management) for establishing adaptive learning technology in order to respond to the study's first four questions. Based on the relative importance of each statement from the sample's self-reported viewpoints, which is represented as the ratio of percent to the sample's total number, the statements in Tables 2, 3, 4, and 5 are ranked in descending order by mean.
The researcher examined the semi-structured interviews with the study sample in order to provide an answer to the fifth question.

Discussion of the Results Relating to the First Question
What are the future requirements of course design for university learning environments to implement adaptive learning technology?

Table 2: Sample self-reporting on the future requirements of university learning environments related to course design

	Totally disagree		Disagree		Neutral		Agree		Totally agree		Mean	Standard Deviation
	C.	%	C.	%	C.	%	C.	%	C.	%		
Content matches learning objectives	0	0.0%	0	0.0%	0	0.0%	3	7.1%	39	92.9%	4.93	0.26
The online course modules' structure should be carefully planned into logical and clear sections	0	0.0%	0	0.0%	0	0.0%	15	35.7%	27	64.3%	4.64	0.48
The online course contents should be engaging and encourage learning	0	0.0%	0	0.0%	0	0.0%	15	35.7%	27	64.3%	4.64	0.48
It is important to clarify online class policies explicitly	0	0.0%	0	0.0%	3	7.1%	15	35.7%	24	57.1%	4.50	0.63
Consider the application of adaptive content	0	0.0%	0	0.0%	0	0.0%	21	50.0%	21	50.0%	4.50	0.51
Course is tailored to	0	0.0%	0	0.0%	6	14.3%	12	28.6%	24	57.1%	4.43	0.74

students' skill levels												
Students receive the additional information they require	0	0.0%	0	0.0%	3	7.1%	18	42.9%	21	50.0%	4.43	0.63
Students process course information in a manner that they can comprehend	0	0.0%	0	0.0%	3	7.1%	21	50.0%	18	42.9%	4.36	0.62
The course is created specifically to assist learner-centred teaching methods	0	0.0%	0	0.0%	0	0.0%	27	64.3%	15	35.7%	4.36	0.48
Course design should stimulate interest and engagement	0	0.0%	0	0.0%	0	0.0%	30	71.4%	12	28.6%	4.29	0.46
All											4.51	0.36

The statement "Content matches learning objectives" was ranked first with a mean (4.93), and the statement "The online course modules' structure should be carefully planned into logical and clear sections" was ranked second with a mean (4.64). Table 2 displays the sample's opinions regarding the future requirements of university learning environments relating to course design for establishing adaptive learning technology.

The sample's overall mean is (4.51), which shows that it largely agrees with all of the future requirements statements pertaining to the course design. This might be because it's crucial for learning materials to achieve learning objectives, because online course materials must be organised logically and have distinct sections, and because they must be suitable for students' needs and at the appropriate level of skills and abilities. According to the research by Tenorio et al. (2022), adaptive learning environments should be created so that academic staff can assign learning objectives and tasks to students in accordance with their needs and capabilities. This will encourage student participation and help them reach their learning objectives. Additionally, according to Bayounes & Saadi's report on adopting adaptive learning, the main objective of e-learning management systems should be to assist learning resources, activities, and content that are customised to each learner's unique needs and influenced by their motivation.

Discussion of the Results Relating to the Second Question

What are the future requirements for online learning management for university learning environments to implement adaptive learning technology?

Table 3: Sample self-reporting on the future requirements for university learning environments relating to online learning management

	Totally disagree		Disagree		Neutral		Agree		Totally agree		Total Mean	Standard Deviation
	C.	%	C.	%	C.	%	C.	%	C.	%		
A system for managing learning should be straightforward to use	0	0.0%	0	0.0%	0	0.0%	9	21.4%	33	78.6%	4.79	0.42
Equip students with instructional materials that correspond to their individual learning styles	0	0.0%	0	0.0%	3	7.1%	12	28.6%	27	64.3%	4.57	0.63
Improve communication between learners	0	0.0%	0	0.0%	0	0.0%	18	42.9%	24	57.1%	4.57	0.50
Offer unrestricted access to all lecture materials	0	0.0%	0	0.0%	3	7.1%	12	28.6%	27	64.3%	4.57	0.63
Encourage the sharing of knowledge	0	0.0%	0	0.0%	0	0.0%	18	42.9%	24	57.1%	4.57	0.50
Encourage independent learning	0	0.0%	0	0.0%	3	7.1%	18	42.9%	21	50.0%	4.43	0.63
To enhance curricular sequencing, a balance between navigation freedom and direction	0	0.0%	0	0.0%	6	14.3%	12	28.6%	24	57.1%	4.43	0.74

should be in place												
Regulate how the system and learners share control	0	0.0%	0	0.0%	3	7.1%	24	57.1%	15	35.7%	4.29	0.60
											4.53	0.42

A system for managing learning should be easy to use came in first with a mean of 4.79, and the statement "Provide students with instructional materials that correspond to their individual learning styles" came in second with a mean of 4.57. Table No. 3 shows the sample's opinions on the future requirements for university learning environments relating to online learning management for establishing adaptive learning technology.
The sample's overall mean is (4.53), which shows that it largely agrees with all statements about future demands for online learning management. The philosophy of adaptive learning, which emphasises the value of adapting learning to the level of the learner, focusing on individual learning and the role of the learner so that the learner's role is active in achieving learning, communication, and knowledge sharing, may be the reason for this. According to Zhao et al. (2022), the adaptive learning system gives students the chance to pursue personalised learning in accordance with their unique personal characteristics while also giving them access to a supportive environment that offers dynamic services that satisfy them to a high degree. Additionally, Vincent-Ruz & Boase (2022) pointed out that adaptive learning environments powered by digital technologies are the only way to fully personalise learning in the context of higher education courses. The findings of their study demonstrated that adaptive learning can meet the needs of all students fairly and can enhance pedagogical behaviour.

Discussion of the Results Relating to the Third Question:
What are the future requirements for learning flexibility in university learning environments to implement adaptive learning technology?

Table 4: Sample self-reporting on future requirements of university learning environments relating to learning flexibility

	Totally disagree		Disagree		Neutral		Agree		Totally agree		Mean	Standard Deviation
	C.	%	C.	%	C.	%	C.	%	C.	%		
Based on the student's performance, offer specific feedback and review resources	0	0.0%	0	0.0%	3	7.1%	12	28.6%	27	64.3%	4.57	0.63
Choose between various techniques of presenting the same topic	0	0.0%	0	0.0%	6	14.3%	18	42.9%	18	42.9%	4.29	0.71
Allow the learner to select their own appropriate learning time	0	0.0%	0	0.0%	6	14.3%	12	28.6%	24	57.1%	4.43	0.74
The instructor serves as facilitator and coach	0	0.0%	0	0.0%	0	0.0%	24	57.1%	18	42.9%	4.43	0.50
Take individual characteristics into account	0	0.0%	0	0.0%	3	7.1%	21	50.0%	18	42.9%	4.36	0.62
Allow the learner to select their own appropriate learning level	0	0.0%	6	14.3%	0	0.0%	21	50.0%	15	35.7%	4.07	0.97

Topics should be presented in a different order	0	0.0%	3	7.1%	9	21.4%	18	42.9%	12	28.6%	3.93	0.89
Allow the learner to select their own appropriate content	0	0.0%	6	14.3%	6	14.3%	15	35.7%	15	35.7%	3.93	1.05
											4.25	0.58

The samples' opinions regarding the future requirements of university learning environments pertaining to learning flexibility for establishing adaptive learning technology is displayed in Table No. 4, where the comment 'Based on the student's performance, offer specific feedback and review resources' ranked first with a mean of 4.57. The statement 'Choose between various techniques of presenting the same topic' ranked second, with a mean of 4.29.The sample's sample agreement on all statements of future requirements linked to learning flexibility being quite high, as shown by the overall mean of (4.25). This could be as a result of the fact that one of the most crucial requirements for adaptive learning is flexibility, which includes flexibility for students to select the time, method, and method of learning according to their individual skills and abilities, to meet their individual needs, and to provide tailored feedback for each student.

One of the most significant advantages and benefits of technology, according to Sridharan et al. (2021), is the availability of a wide range of resources available via the internet for gaining the necessary knowledge level on any subject. However, this makes it more difficult to choose the most useful resource. Each student has a unique learning rate, efficiency, and favored learning technique. Consequently, the significance and utility of adaptive learning depends in overcoming this obstacle. It assists in delivering information to each student according to their level of expertise and preferred learning technique, constantly adapts to their specific learning speed, and offers each student with personalised feedback.

Moreover, Kotsyuba et al. (2022) show that in adaptive learning, the emphasis is on active self-learning, in which the student's strengths and limitations are analysed, as well as his interests and experiences and individualised learning based on individual educational routes is offered.

Discussion of the Results Relating to the Fourth Question:

What are the future requirements of technology management in university learning environments for implementing adaptive learning technology?

Table 5: Sample self-reporting on the future requirements of university learning environments relating to technology management

	Totally disagree		Disagree		Neutral		Agree		Totally agree		Mean	Standard Deviation
	C.	%	C.	%	C.	%	C.	%	C.	%		
Providing the required technical assistance	0	0.0%	0	0.0%	3	7.1%	3	7.1%	36	85.7%	4.79	0.56
Providing suitable technical curricula for a variety of courses	0	0.0%	0	0.0%	0	0.0%	18	42.9%	24	57.1%	4.57	0.50
Implement appropriate security provisions for scientific content	0	0.0%	0	0.0%	0	0.0%	27	64.3%	15	35.7%	4.36	0.48
Provide appropriate data security for students	0	0.0%	0	0.0%	6	14.3%	15	35.7%	21	50.0%	4.36	0.73
The technology is easy to understand and performs reliably and quickly	0	0.0%	3	7.1%	3	7.1%	15	35.7%	21	50.0%	4.29	0.89
The user develops	0	0.0%	0	0.0%	3	7.1%	27	64.3%	12	28.6%	4.21	0.56

an activity profile and chooses the content of interest												
Based on the appropriate ontology of the user's interest profile, the server retrieves knowledge ontologies that are suitable for the user	0	0.0%	3	7.1%	6	14.3%	24	57.1%	9	21.4%	3.93	0.81
The content for individualised web-based learning is generated by the server	0	0.0%	12	28.6%	0	0.0%	15	35.7%	15	35.7%	3.79	1.22
											4.29	0.50

The statement "Providing the required technical assistance" was ranked first with a mean of 4.79, and the statement "Providing suitable technical curricula for a variety of courses" was ranked second with a mean of 4.57. Table 5 shows the sample's opinion regarding the future requirements of university learning environments relating to technology management for establishing adaptive learning technology. The sample's overall mean is 4.29, which shows that it largely agrees with all statements regarding future technology management requirements. This may be due to the necessity and significance of providing the technical infrastructure that ensures the adoption of adaptive learning, as well as the activation of AI applications and other programmes and technology infrastructure that make a significant contribution to providing adaptive learning requirements relating to course design, online learning management, and learning flexibility on one hand, and retains the privacy and security of data learners and content on the other, in addition to providing the technical infrastructure necessary to achieve the success of adopting adaptive learning.

Kochetkov (2022) suggested that colleges offer the curricula, technical tools, and technical infrastructure necessary for the success of adaptive learning. Noting that the dominating framework for future education will be adaptive learning. Moreover, Minn (2022) suggested utilising AI technologies in adaptive learning settings to supply learners with educational content.

Discussion of the Results Relating to the Fifth Question

What are the suggestions for developing university learning environments for implementing adaptive learning technology?

Electronic learning management system development for adaptive learning management was suggested by the majority of study participants, and one of them mentioned the following as one of the suggestions for creating university learning environments for the implement of adaptive learning technology:

Special e-learning management systems, with additional features and services are available that are consistent with the requirements of adaptive learning, in order to guarantee that adaptive learning is adopted accurately.

In order to create university learning environments that meet the needs of adaptive learning, a number of survey participants proposed investing significantly in AI applications. Several participants suggested particularly using the virtual tutor programme. One participant suggested the following:

I advise using artificial intelligence (AI) virtual tutoring programmes like Queirum AI software to enhance student learning efficiency, quality, and analysis.

A portion of survey participants also recommended creating future AI-based formative evaluation systems. One suggested the following:

Future classroom assessment systems that use AI tools should be built for students since they not only allow students to find gaps between their present and required knowledge, but they also assist academic staff in improving their teaching techniques and monitoring students' development.

Furthermore, some of the survey participants proposed extending the adaptive learning culture in academic circles at universities. One of them, for example, mentioned the following:

I believe that in order to develop university learning environments that meet the criteria of adopting adaptive learning, it is critical to spread the adaptive learning culture with its advantages and benefits, as well as its applicability for the future in view of technological advancement and the needs of the next generation.

Due to the significant expense of adaptive learning software, one of the significant ideas given by study participants is the creation of special financial resources for the construction of university learning environments consistent with the criteria of adaptive learning. One participant mentioned the following:

The financial considerations are one of the most significant factors to consider when developing university educational experiences to meet the objectives of adaptive learning. It is well known that the rising costs of technology devices and adaptive learning software, as well as necessary technical support, necessitates the creation of separate budgets for them.

Overall, it is evident that the findings of the study have given a number of development proposals for implementing adaptive learning technologies in university learning settings. The most important of these suggestions are as follows: developing special learning management systems for adaptive learning, investing in AI applications and implementing the virtual tutor programme, developing future formative assessment systems based on AI tools, extending the culture of adaptive learning, and providing special budgets for the development of university learning environments in accordance with the requirements of adaptive learning technology.

It is recognised that the majority of suggestions focus on leveraging AI applications; this can be attributed to the benefits and services provided by AI applications to fulfill the needs of incorporating adaptive learning, in accordance with its objectives, strategies, and philosophical underpinnings.

This agrees with the results of earlier research. AI applications, with their traits and benefits that enable them to offer distinctive educational content and adapt to the individual needs of students, have been demonstrated by Kabudi et al. (2021) to be one of the most significant technical tools to aid in the creation of adaptive learning environments.

In order to address a variety of learning issues and enhance users' learning experiences, AI applications can also be used to develop adaptive learning environments. Moreover, Minn (2022) advocated funding the use of AI technologies in flexible learning environments.

CONCLUSION

In conclusion, it became apparent that the sample's agreement on the future requirements of academic learning environments for the implementation of adaptive learning technology was substantial because it covered four different types of contexts (course design, online learning management, learning flexibility, and technology management).

The study's findings also resulted in a number of recommendations for developing university learning environments in order to implement adaptive learning technology, the most significant of which are the following: developing specialised learning management systems for adaptive learning, investing in AI and incorporating the virtual tutor programme, developing future classroom assessment systems based on AI tools, and spreading the culture of adaptive learning.

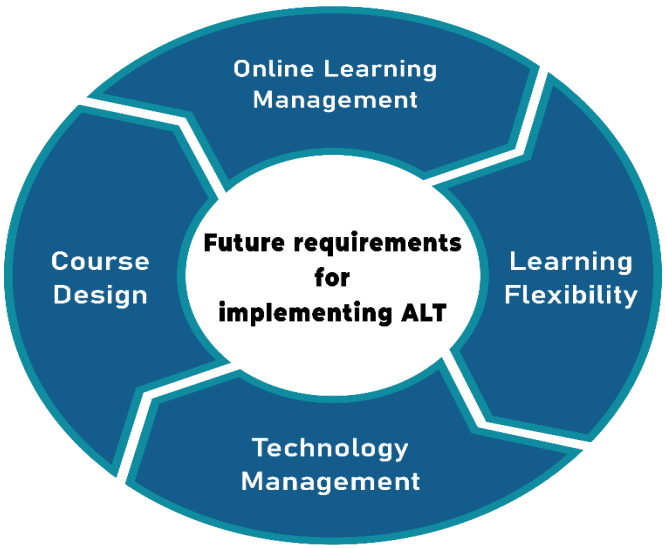

Figure 1: Future requirements of university learning environments to implement adaptive learning technology

RECOMMENDATIONS

Based on the study's findings, the researcher suggests the following:

1. Create strategic strategies to meet the application requirements for adaptive learning technology in university learning settings, including course design, online learning management, learning flexibility, and technology management.
2. Investing in AI applications for the development of adaptable university learning environments.

3. Delivering the infrastructure required for adaptive learning technologies.
4. Promoting an adaptive learning culture at universities.
5. Designing specialised e-learning management systems for adaptive learning management.

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