Criteria for developing smart Learning Environment according to the theory of emotion-based learning

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Abstract:

Smart learning environments are revolutionizing the field of education, seeking to provide a personalized and effective learning experience for each learner. As our understanding of the role of emotions in the learning process has evolved, the theory of affective computing in learning has emerged as a fundamental pillar for designing these environments. Affective computing in learning (ACL) is an emerging field that focuses on the role of emotions in the learning process. This theory is based on the idea that emotions are not simply negative or positive reactions, but are an integral part of human cognition, significantly impacting attention, memory, motivation, and problem-solving. Designing a smart learning environment that responds to learners' emotions requires setting clear standards to ensure its effectiveness and quality. These standards go beyond technical aspects to encompass psychological and pedagogical aspects. The goal is to build a system capable of (detecting and understanding emotions, adapting and responding emotionally, and enhancing emotional support). These standards contribute to creating a learning environment that not only delivers knowledge but also considers the human side of the learner, leading to a more engaging, effective, and enjoyable learning experience.

Keywords:

Criteria - Smart Learning Environment - Emotion-Based Learning Theory

Introduction:

In the world of accelerated education, imparting knowledge is no longer enough. Science has proven that emotions are not just a side effect of the learning process, but rather its true fuel. Creating a smart learning environment that engages with learners' emotions requires more than a mere assembly of technologies. It calls for a deep understanding of how emotions influence cognition and how the system can adapt to these emotions to enhance the learning experience. These standards constitute a roadmap to ensure that these environments are not only technologically smart, but also emotionally intelligent, capable of delivering a learning experience that ignites curiosity, mitigates frustration, and boosts self-confidence, pushing learners to their full potential. This is the essence of a smart learning environment, based on the theory of emotion-based learning.

Modern learning environments are rapidly evolving toward artificial intelligence and advanced technology, with emotions playing a pivotal role in the learning process. The most challenging task during online learning is to be aware of and support students' emotions. (Myneni, 2022[1]) Contemporary smart learning environments require the integration of emotion recognition and analysis technologies to improve the quality and effectiveness of education. Smart learning environments combine technologies such as big data, cloud computing, and artificial intelligence to optimize and personalize the teaching and learning process, leading to improved efficiency and quality of education. (Zhao, W. & Qiu, L., 2025) In this context, achieving attention analysis and prediction and learning emotion recognition in adaptive teacher-student interactions in smart teaching environments is a key development need in the fields of intelligent guidance, teacher classroom assessment, and classroom stress analysis. (Lu, J.)

Learning theories and methods are diverse within e-learning environments, where many educational theories and methods can be presented and used in these environments. One of the learning theories that has achieved remarkable success in e-learning environments is the theory of emotion-based learning. In this context, the theory of emotion-based learning emerged, inherently compatible with the developmental nature of scientific advancements, in terms of the constant pursuit of unprecedented scientific additions. This theory focused on emotions, something that previous educational design theories overlooked. It therefore focused on presenting visual elements of learning content so that they

[1] The researcher followed the American Psychological Association (APA) 7th edition citation system. Citations in Arabic (full name, year of publication, page) – Citations in English (family name, year of publication, page)

are visually appealing and well-designed, with the aim of eliciting positive emotions such as satisfaction, interest, and enjoyment in students, with the aim of achieving the desired educational goals. (Simionescu, 2020).

Heidig (2015) indicates that emotionally based design in learning environments involves the use of visual design elements that can induce positive emotions and thus facilitate learning. It can also include additional or different substantive elements, such as sound and movement. Plass & Kaplan (2016) defined it as the use of different design features to evoke positive emotions in students to enhance learning and develop students' cognitive skills. Simionescu (2020) defined it as the use of design features that aim to stimulate the emotional dimension in students without having any specific informational or educational function.

This theory focuses on answering the question: How can we design educational materials that are both attractive and effective? (Heidig et al,2015) and providing a general framework for designing and evaluating content in learning environments. (Norman, 2004) (PP417-407 & Malik, Tayal, Vij, 2019) confirms the emergence of many smart educational applications and environments, which represents the backbone of all smart learning environments. These environments give the teacher a clear picture of the topics that must be re-learned. This analysis - through analyzing the needs of each individual student - allows for the development of the best educational program for students. Therefore, teachers can - considering the results of the automated analysis of the learning process - modify their courses to address the learner's shortcomings. There are many artificial intelligence platforms that are concerned with machines executing tasks in a manner similar to what humans do; whether in terms of response, interaction with problems, or even from the most common and widely used artificial intelligence platforms, the platform (Microsoft Azure Machine Learning is an artificial intelligence platform provided by Microsoft, used through a cloud storage service, and enables its users to analyze data to facilitate machine learning for businesses. The Claned LMS is part of the Microsoft Azure cloud service based on artificial intelligence. TensorFlow is an open-source library developed by the Google Brain team, in which information is represented in graphs, each part of which represents a specific piece of information. Many cognitive computing services are available for developing machines such as robots and drones. Other platforms for artificial intelligence include API.AI, Premonition, Rainbird, Ayasdi, Mind Meld, Wit, Vital Adl, KAI, and Receptiviti. (Smith, Samuel & Robinson, 2021, p. 2) (Meya) sig

Feeling the problem:

With the rapid development of educational technologies, there is an urgent need to design learning environments that go beyond simply delivering content, but also intelligently engage with the learner's human side. With our growing understanding of the role of emotions in the learning process, the theory of emotion-based learning has become a fundamental pillar for enhancing educational effectiveness. This theory asserts that positive emotions enhance engagement and information retention, while negative emotions such as boredom and frustration hinder learning.

Despite the great promise of emotion-based smart learning environments, there is a clear gap in defining and formulating comprehensive and clear standards for developing these environments. The absence of such standards could lead to the design of ineffective systems that fail to respond intelligently and accurately to the learner's changing emotions, thus failing to achieve their desired educational goals. By reviewing the studies and research that have addressed this issue, the researcher addresses the challenge of translating the theoretical principles of emotion-based learning into applicable design and development practices, focusing on the practical, technical, and psychological aspects that ensure the effectiveness of these environments.

Research questions:

After formulating the problem, the researcher formulated the main research question as follows: What are the basic and effective criteria that must be considered when developing smart learning environments based on the theory of emotion-based learning to ensure maximum emotional and cognitive engagement among learners, and thus improve their learning outcomes؟

The following sub-questions branch out from the main question:

- What are the sources of educational design criteria that should be considered when designing smart learning environments according to emotion-based learning theory?
- What are the technical design criteria that should be considered when designing smart learning environments according to emotion-based learning theory?
- What are the technical criteria that should be considered when designing smart learning environments according to emotion-based learning theory?

Research objective: -

This research aims to identify and develop the criteria necessary for designing a smart learning environment based on emotion-based learning theory. The main objectives of the research are as follows:

- **Identify the importance of emotions in the learning process:** Explore the vital role emotions (positive and negative) play in knowledge acquisition, retention, and learner motivation.
- **Analyze emotion-based learning theory:** Delve deeper into the principles of this theory and its potential applications in smart learning contexts.
- **Develop a conceptual framework for criteria for developing a smart learning environment:** Identify the essential components and elements that a smart environment should include to promote emotional learning.
- **Identify technical and technological criteria:** Identify the tools and technologies necessary to integrate emotional aspects into smart learning environments (e.g., artificial intelligence, machine learning, sentiment analysis).
- **Develop educational content design criteria:** Establish guidelines for designing educational content to elicit positive emotions, address negative emotions, and support learner emotional regulation.
- **Identify interaction and assessment criteria:** Establish the foundations for designing interactions within a smart environment to be emotionally supportive and for assessing learning in ways that take emotional aspects into account.
- **Study the impact of the developed smart environment on learners:** Evaluate the effectiveness of the smart environment in enhancing academic achievement, engagement, satisfaction, and emotional regulation among learners.
- **Provide practical recommendations:** Develop actionable recommendations for developers, designers, and educators to design and implement smart learning environments that take emotional aspects into account.

Research methodology:

The current research follows the descriptive analytical research method for educational technology research, The research also relied on the experimental design.

Research Steps: Conducting the field study for the application as follows:

• **First:** Prepare the theoretical framework for the research by reviewing educational literature, including educational technology books and previous research related to the research topic.

• **Second:** Present the literature, studies, and previous research related to the criteria for designing smart learning environments according to the theory of emotion-based learning.

• **Third:** Conduct the field study, applying the following: Preparing a list of criteria for designing smart learning environments according to the theory of emotion-based learning by:

• Collecting the extracted criteria and classifying them logically.

• Establishing indicators for each criterion.

• Preparing the initial version of the list of criteria and presenting it to the referees as a pilot sample.

- Presenting the initial list to a sample of professors and educational technology and curriculum specialists.
- Adopting a ready environment that takes these standards into account. In this research, a (Claned) environment was used.

Significance of the research:

1. Opening the door for researchers to implement smart learning that takes emotions into account.
2. Directing the attention of researchers interested in the field of educational technology to conduct studies and research on the design of smart learning environments using educational, technical, and technological standards for smart learning environments in accordance with the theory of emotion-based learning.

Research Limits:

The current research is limited to extracting criteria and an evaluation tool from relevant studies, research, and literature that were available, and then presenting them to a sample of professors and specialists in the field.

Research terms:

Smart learning environment according to emotion-based learning theory:

It is an environment based on the application of artificial intelligence and the use of a variety of media to create an interactive learning environment for fourth-year students in the Educational Technology Department. Various design features are used to stimulate emotions in students, according to emotion-based learning theory, to enhance learning. This is intended to provide skills for producing augmented e-books.

Theoretical Framework and Previous Studies:

First: The Concept of a Smart Learning Environment:

Smart learning environments are defined as physical environments rich in digital resources, contextual awareness, and adaptive devices to promote better and faster learning (Koper, 2014).

Mikulecy (2016, p. 365) defines it as a system that applies new methods at the levels of teaching and learning design and organization, helping to provide an environment for learners.

Singh and Hassan (2017) define it as an adaptive system that improves learning experiences based on learning characteristics, preferences, progress, and features that increase engagement, access to knowledge, guidance, and feedback, the use of rich media with easy access to relevant information, and real-life and on-the-go monitoring, along with the use of technology to continuously enhance learning environments**.**

Smart learning environments can be considered a new level of technology-enhanced, learner-centered learning environments, consisting of tools, technology, media, textbooks, teachers, students, etc. that not only support learners' self-construction of learning but also provide just-in-time guidance for learning. It is a learner-centered environment based on the application of information and communication technology, characterized by adapting to different learning styles and learner abilities and providing support for their development. (Zhong G, et al. 2006) (Milulecky, P. 2012)

The International Association for Smart Learning Environments defines it as: "An effective learning environment with precise measurement of learning outcomes that facilitates learner engagement, flexibility, adaptability, personalization, openness, and creativity" (Spector, 2014)

Smart learning environments have several synonyms defined by Chen, Zou, Xie, and Wrang (2021, 94), including: smart classroom, smart learning process, smart device, mobile device, smart blended learning, Internet of Things, cloud computing, ambient intelligence, STEM education, and software engineering. Given the development of the Internet, cloud computing services, the Internet of Things, social media tools, innovations, information and communications as a new educational model, smart learning can be considered a pattern of learning in specially designed interactive and smart environments supported by advanced digital technology and services.

Second: Advantages of Smart Learning Environments

Ashfaque et al. (2014), Hwang, Chu, Yin, and Ogata (320, Hwang, Chu, Yin) (127, Ogata, 2015, p. 733), and Spector (2016, p. 733) indicate that the most important advantages of smart learning environments are:

1. Digital technology is used to support learning, teaching, and training.
2. It is a means and method that helps improve learning and promote better and faster learning.
3. The primary goal of these environments is to transform learning and teaching into more useful methods and approaches, make learners more engaged in learning, more productive, and increase their desire to learn.
4. It helps achieve learning motivation and increase effectiveness and impact. Therefore, the continued development of technology ensures the continued development of smart learning environments and their increased effectiveness in attracting and developing learners' attention.
5. Teachers can immediately assess the learning achieved by their students, if not Once the concept being taught is understood, it can be repeated with greater clarity and focus.
6. Identify the student's strengths and weaknesses, which ultimately helps the student achieve a better understanding.

Requirements for Smart Learning Environments

Designing smart learning environments requires identifying a set of prerequisites before, during, and after learning (Koper, 2014, p. 5).

Before learning

1. Providing one or more digital devices that can identify learners' location, context, and culture.
2. Creating learning content, which includes defining general objectives, then behavioral objectives; activating the learner's prior knowledge; generating questions; and predicting hypotheses.

During learning

1- Information processing, including reading and thinking.
2- Adding applications to digital devices that offer a variety of learning functions, such as providing (augmented) information, assessments and remote collaboration, and concise and concise feedback.

After learning

1. Transferring information, including defining visual representations of tasks. The smart learning environment consists primarily of modules that are easy to understand and implement.
2. Reflecting knowledge, including finding evidence to meet personal goals for achieving a specific task.
3. Digital devices monitor learners' progress, identify personal strengths, and provide appropriate information; these then set goals for future endeavors.

The Concept of Emotion-Based Learning Theory

Emotion-based learning theory emerged in its nature as a developmental theory, always striving to achieve unprecedented scientific advancements. This theory focused on emotions, something that previous educational design theories overlooked. It therefore focused on presenting visual elements of learning content in a visually appealing and well-designed manner, with the goal of eliciting positive emotions such as satisfaction, belonging, and enjoyment in students, with the goal of achieving the intended educational goals.

Heidig (2015) points out that emotion-based design in learning environments involves the use of visual design elements that can induce positive emotions and thus facilitate learning. It can also include additional or different substantive elements, such as sound and movement.

Plass and Kaplan (2016) defined it as the use of various design features to evoke positive emotions in students to enhance learning and develop students' cognitive skills.

Simionescu (2020) defined it as the use of design features aimed at stimulating the emotional dimension in students without having any specific informational or educational function.

Benefits of Effective Design Based on Emotion Sensing Technology for Educational Materials:

1. Acquisition of Empathy, which refers to quickly generating a sense of identity and familiarity between students and the design.
2. Access to a Sense of Participation: Anthropomorphisms are objects without innate human characteristics that are redesigned by applying human characteristics and traits. These features often include human body parts such as eyes, noses, and mouths (2015; Um et al., 2012; Park et al.). Participation: which refers to

supporting students' sense of participation and belonging, given their important role in meeting their needs.

3. Acquisition of Controllable Sense: Students' sense of control over the learning environment brings them positive feelings in the learning process. Therefore, educational designers must accommodate students' psychological characteristics to implement appropriate blank spaces that give them a sense of imagination and creativity (Chen et al., 2020).

Research Procedures

Preparing a list of criteria for developing a smart learning environment based on emotion-based learning theory, through the following steps:

Defining the objective of the criteria list:

The general objective was determined, which was to develop a list of educational and technological criteria.

Defining the sources for deriving the criteria list:

Several sources were consulted when constructing the list, including:

- Analysis of the literature and previous studies that addressed the effectiveness of smart environments in the teaching and learning processes, and examining and analyzing the criteria included in these studies. The researcher relied on these studies to construct a list of criteria for developing a smart learning environment based on emotion-based learning theory. This was in addition to the opinions of experts and specialists in the field of educational technology regarding the criteria for developing (designing and producing) smart learning environments, and the results of recommendations from previous research, studies, and relevant conferences, such as studies by Ismail (2015); Fagels (2019); Ali Saud (2017); Al-Dahshan (2020); Mujahid (2020); and Mahmoud (2020). (2020) Shin & Shin In light of this, the list was built, based on the opinions of some professors in the field of educational technology.

Preparing the initial draft of the criteria list:

From the previous sources, the criteria were formulated in their initial form as statements, each representing a basic condition that must be met when selecting a smart learning environment.

Verifying the validity of the criteria: To verify the validity of the criteria list, the method of arbitrator validity was followed. The initial version of the

criteria list was presented to the arbitrators (who are educational technology experts, instructional designers, and AI specialists). Their input was used to modify the initial version and ensure the indicators' suitability for the respective criteria. A five-point Likert scale was used.

Table (1) Model of the arbitration form for the list of smart learning environment criteria according to the theory of emotion-based learning according to the five-point Likert scale

M	Criteria	Strongly agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly disagree (1)	Comments

They agreed on the importance of the proposed criteria, and the required amendments were made. These included consensus on the main criteria, deleting some unnecessary indicators, combining indicators with similar meanings, and adding others.

Based on the opinions of the arbitrators regarding the initial list of criteria for designing a smart learning environment based on emotion-based learning theory, the required amendments were made, and the final list of criteria was reached (Appendix (2)). It consisted of (9) main criteria and (65) indicators, as follows:

- **Criterion One:** Educational objectives in terms of clarity, specificity, and measurability.
- **Criterion Two:** Characteristics of the target group and needs, in terms of the suitability of the smart learning environment for learners, according to emotion-based learning theory.
- **Criterion Three:** Educational content and multimedia in terms of compatibility with scientific and theoretical foundations, and its ability to achieve educational objectives and be presented objectively, organized, and accurately.
- **Criterion Four:** Educational activities in terms of clarity, gradual progression, and relevance to objectives, content, and learners.
- **Criteria Five:** User interface and intelligent interaction in a smart learning environment, based on the theory of emotion-based learning, regarding

teacher-learner interaction, its role in achieving learning objectives, and its relevance to the characteristics of the target group.

- **Standard Six:** Monitoring and Encouraging Learners in a Smart Learning Environment According to Their Emotions
- **Standard Seven:** Feedback, Assistance, and Guidance in a Smart Learning Environment
- **Standard Eight**: Considering Emotions in a Smart Learning Environment
- **Standard Nine:** Evaluation in a Smart Learning Environment

Reaching the Final Image: The final list consisted of (9) main themes and (65) indicators. Table (2) shows the criteria for a smart learning environment according to the theory of emotion-based learning.

Table (2) Total number of indicators in the list of standards

Name of the standard	Number of indicators	Percentage of accuracy of the system's achievement of the standard
1- Educational Objectives	7	100%
2- Target Audience Characteristics and Needs	3	≥90%
3- Educational Content and Multimedia	14	≥ 85%
4- Educational Activities	7	≥ 85%
5- User Interface and Smart Interaction	14	≥ 85%
6- Learner Monitoring and Reinforcement	4	≥ 85%
7- Feedback, Assistance, and Guidance	6	≥ 85%
8- Considering Learners' Feelings	6	≥ 85%
9- Evaluation	4	≥%90
Total	Total 65	

List of criteria for building a smart learning environment based on emotion-based learning theory

m	Criteria and their indicators
	Standard 1: Educational Objectives
1	Objectives should be appropriate to the content.
2	They should be presented to the learner at the beginning of their learning.
3	They should be formulated in a behavioral, procedural manner.
4	They should help develop the learner's interactive element.
5	They should cover all required cognitive and performance levels.
6	They should focus on the learning outcome, not the learning process itself.
7	They should aim to stimulate positive feelings toward learning.
	Criterion 2: Target group
8	The environment should be appropriate to the characteristics of the class.
9	The environment should present the content in a manner appropriate to the characteristics of the students.
10	The environment should provide a logical sequence of content that motivates students.
	Criterion 3: Educational Content and Multimedia
11	The information must be appropriate to the subject matter in the smart environment.
12	The content must meet the educational objectives.
13	The content must be accurate and up-to-date.
14	The content must be presented in a way that takes individual

	differences into account.
15	The content must achieve sufficient integration to enable students to construct knowledge in an interactive, intelligent manner.
16	The content must be presented in a way that facilitates discussion.
17	The use of positive text, i.e., dark colors on a light background.
18	The titles must be standardized in terms of font type, color, and size.
19	The colors in images and graphics must be consistent.
20	The texts must be free of spelling errors.
21	The writing must be clear and legible.
22	Appropriate fonts must be chosen.
23	The learner must be able to control the video using the control bar.
24	The learner must be able to download the video to watch at any time.
Criterion 4: Educational Activities	
25	Help develop students' thinking.
26	The activities are used functionally.
27	They are clear and understandable.
28	They are appropriate for the characteristics of the learners
29	They contain learning tasks and applications that encourage students to work.
30	They provide textual instructions on how to run the activities.
31	They are derived from the educational objectives and content.
Standard 5: User Interface and Smart Interaction	
32	Navigating the environment should be easy, allowing students

	to access information with ease.
33	The design of the environment's interface should be clear and of high quality.
34	It should encourage interaction and collaboration among students
35	The interface should be stable, with buttons remaining in place across all pages.
36	It should contain appropriate tools that enable communication between the teacher and students.
37	Each tool in the environment should be used for learning purposes according to the learning objective.
38	The environment should handle each student's login account
39	Colors should be harmonious and pleasing to the eye.
40	The environment should allow the uploading of images and files.
41	Students should be able to watch videos and listen to audio files.
42	Students should be able to engage in text and voice chat.
43	It should include a notification button that notifies learners and the environment's facilitator of any new developments.
44	It should include a chat button between learners and the environment facilitator to interact and submit questions.
45	It should include a smart button to create AI-powered tests.
Standard 6: Follow up and reinforce learners	
46	The environment should display the percentage of each student's progress.
47	It should show learners what they have and have not accomplished.

48	The environment should provide a certificate to each student upon completion of each level of the course.
49	It should provide reinforcement to build motivation and encourage learning.
Standard 7: Feedback, Assistance, and Guidance	
50	Specific mechanisms should be in place to inform students when homework is due.
51	Feedback should encourage students to build their own knowledge.
52	Feedback should be appropriate to students' responses and age.
53	Support should be provided in areas the learner needs.
54	Support phrases should be specific and simple.
55	Methods for direct communication with the teacher should be provided.
Standard 8: Considering learners' feelings	
56	Use various design features to evoke positive emotions.
57	Analyze every interaction a learner has with the learning environment.
58	Monitor all interactions as the learner reads, writes, shares, organizes, and plans.
59	Give a comprehensive view of a learner's academic performance.
60	Improve and analyze learning outcomes for each student.
61	Keep countless data on learners' abilities, such as their response speed, academic and personal preferences, cognitive backgrounds, and feelings about learning.
Standard 9: Evaluation	
62	The assessment questions should be varied to cover the entire

	content.
63	The test should measure the intended objectives.
64	The learner should be given an online test remotely.
65	Each question should have a designated score.

Research Recommendations:

- Adopt the criteria indicators used in the current research as a guided model for designing smart learning environments based on emotion-based learning theory.
- Further revisions of these criteria should be undertaken to keep pace with recent technological developments in the field.
- Deepen the theoretical and applied understanding of emotion-based learning theory by decision makers.
- Organize training courses for university faculty members to train them on using emotion-sensitive smart learning to develop successful curricula.
- Include detailed topics on emotion-sensitive smart learning in curricula at colleges of education and train students on its use, so they can benefit from it during practical education and upon their appointment to schools.

Suggested Research:

- Conduct studies on the criteria for designing and publishing courses in smart learning environments, based on emotion-based learning theory.
- Study the impact of different tools and activities used within smart learning environments, based on emotion-based learning theory, on learning outcomes and academic achievement.

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