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Optimizing agile adoption in virtual learning environments : A framework for classification and prioritization

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Abstract

This research presents a classification and prioritization framework for agile methods in virtual learning environments. The framework uses adaptive agile modeling principles and machine learning techniques to categorize agile methods into three tiers: Essential Agile Methods, Desired Agile Methods, and Deferred Methods. This system aids in informed decision-making regarding adopting and implementing Agile practices, ensuring alignment with educational goals and learner preferences. Essential Agile Methods include core practices like iterative development, continuous feedback, and collaboration, which are prioritized for immediate adoption due to their significant impact on learner engagement. Desired Agile Methods are supplementary practices that enhance the effectiveness and efficiency of virtual learning environments, offering additional benefits like communication enhancement, adaptability, and stakeholder engagement. Deferred Methods are valuable but less immediately relevant or feasible for implementation. The framework helps educational stakeholders make informed decisions regarding resource allocation, curriculum development, and instructional design, enhancing the responsiveness, relevance, and effectiveness of virtual learning environments. The framework's efficacy is demonstrated through case studies and simulations across diverse educational contexts, showing improved learner satisfaction, engagement, and learning outcomes through strategic adoption of Essential and Desired Agile Methods. So, the framework provides a structured approach to agile adoption in virtual learning environments, ensuring optimal resource utilization and maximizing the benefits of agile practices. Future research may focus on refining the classification criteria, validating the framework across different settings, and exploring its scalability and generalizability.

Subject Classification: *03B52, 03B65.*

Keywords: *Agile virtual learning methods, Educational goals, Machine learning, Optimization.*

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Introduction

This research presents a framework for identifying and prioritizing agile methods in virtual learning environments. The framework categorizes agile methods into three tiers: Essential Agile Methods, Desired Agile Methods, and Deferred Methods. Essential Agile Methods include core practices like iterative development, continuous feedback, and collaboration, which are prioritized for immediate adoption due to their impact on learner engagement. Desired Agile Methods offer additional benefits like communication enhancement, adaptability, and stakeholder engagement. Deferred Methods are valuable but less immediate or feasible for implementation. The framework aids educational stakeholders in making informed decisions regarding resource allocation, curriculum development, and instructional design, enhancing the responsiveness, relevance, and effectiveness of virtual learning environments. The framework's efficacy is demonstrated through case studies and simulations across diverse educational contexts, showing improved learner satisfaction, engagement, and learning outcomes through strategic adoption of Essential and Desired Agile Methods.

Literature Review

The literature review helps to understand the framework and methodology adopted in existing research work. This also helped to trace the research gap to frame the unique problem and address the innovative solution to solve the identified problem.

Agile methods

The COVID-19 pandemic has accelerated digital technology adoption in education, improving academic support and performance, with educators and administrators playing a crucial role in e-learning success. The education sector has demonstrated agility in embracing digital technology, a trend that has significantly impacted academic support and performance. This agility is crucial for fostering change in various stakeholders, including university administrators and administrators [1]. Future research should compare Web-based courses across higher education institutions and analyze student perceptions in interaction-based courses, emphasizing the importance of learner-instructor and learner-learner interactions for successful learning outcomes [2]. The study found that despite the comfort and self-reliance of online learning, challenges like internet access and instability persisted, suggesting the need for blended learning [3]. The paper explores the use of education simulation technology in vocational education to balance high expectations with low general scores, focusing on product development, design, method, and application characteristics [4].

Virtual Learning Environments

This article explores the relationship between Educational Data Mining and Learning Analytics communities, their key methods, and their evolution as the field matures, highlighting the growing interest in big data for education and the science of learning [5]. The meta-analysis of 74 studies reveals that the strength of interaction treatments in distance education (DE) courses, particularly asynchronous ones, leads to increased achievement outcomes and cognitive engagement [6]. The article examines blended synchronous learning environments, emphasizing active learning design, technology use, co-presence, and cognitive load, and presents a framework for pedagogical, technological, and logistical implications [7]. Leadership educators should create developmental programs that focus on effective leadership competencies and student development, using Intentional Change Theory to inspire self-development in MBAs through the Leadership Assessment and Development Course [8]. A meta-analysis of 14 studies comparing K-12 distance education programs found that distance education significantly impacts student academic achievement, highlighting factors influencing learning and suggesting improvement recommendations [9]. The study examines the use of virtual learning environments (VLEs) in Advanced Technological Institutes during the pandemic, revealing students frequently download lesson content, and the influence of lecturers' performance [10]. The survey, involving 144 respondents, reveals the positive impact of Agile Management on the selection and implementation of technology for PES [11].

Adaptive Modeling and Machine Learning Techniques

Learning style-based adaptation impacts learning outcomes, but its impact on other populations remains unclear. Combining learning styles with prior knowledge and competence is crucial for effective learning [12]. Agile Product Development Management (APDM) is a method that integrates agile principles with product development, enhancing customer satisfaction, quality, cost reduction, and innovation [13]. The study employs eye-tracking technology to analyze virtual learning environments, revealing that live interpretations are more effective than AI interpretations, providing new ideas for teaching resource design [14]. The study explores the influence of adaptive e-learning on students' engagement, skills, participation, performance, and emotional development, highlighting the need for further research [15].

Proposed Research Solution Model/Business Model

A fuzzy-based technical solution for Agile Virtual Learning Management Systems (AVLMS) can be developed using fuzzy logic and machine learning techniques. Here are some possible steps that can be taken to develop such a solution:

1. Identify the key parameters and variables that affect the performance of AVLMS. These may include student engagement, course completion rates, course satisfaction, and teacher performance.
2. Develop a fuzzy logic model that captures the relationship between these parameters and the performance of the AVLMS. Fuzzy logic is a mathematical technique that can handle uncertainty and imprecision, which is important in a complex system like an AVLMS.
3. Collect data on the performance of the AVLMS over time. This can be done using surveys, interviews, and performance metrics such as completion rates and grades.
4. Use machine learning techniques to train the fuzzy logic model using the collected data. Machine learning algorithms can identify patterns and relationships in the data that can help improve the accuracy of the fuzzy logic model.
5. Use the trained fuzzy logic model to make predictions and recommendations for improving the performance of the AVLMS. The model can be used to identify areas of the system that are underperforming and suggest specific changes or improvements that can be made.

Figure 1 is showing Optimized Dynamic Agile Virtual Learning Management System.

R Tools Used for Analysis

The model is implemented using R- programming for fuzzy optimization initially.

- RStudio Version- 2023.06.1 Build 524
- R - 4.3.2

Steps

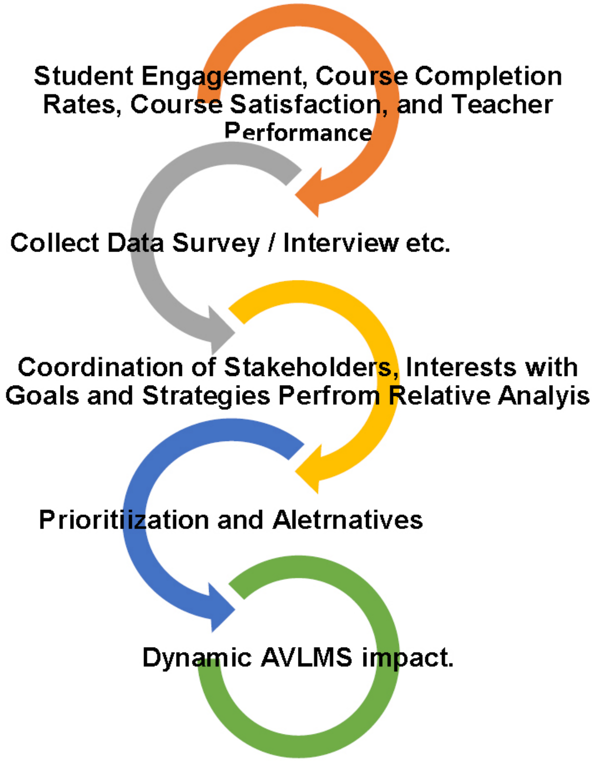


Figure 1

Optimized Dynamic Agile Virtual Learning Management System

Authors own diagram

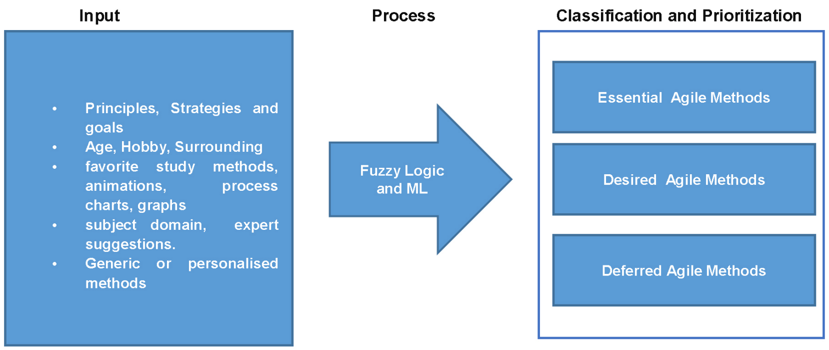
A fuzzy-based technical solution for AVLMS can help improve the performance and effectiveness of virtual learning environments, leading to better outcomes for students and teachers alike. There are several ways to measure student engagement, course completion rates, course satisfaction, and teacher performance in an AVLMS. So, measuring teamwork, student engagement, course completion rates, course satisfaction, and teacher performance in an AVLMS requires a combination of data collection, analysis, and reporting techniques that are integrated with the system itself. This can help ensure that the data is accurate, timely, and actionable, and can lead to continuous improvements in the learning environment.

Pseudocode

Function classifies_and_prioritize_agile_methods (agile_methods_data):

1. Split data into features (X) and labels (Y).
2. Define and train a classification model using X and Y.
3. Classify agile methods using the trained model.
4. Prioritize agile methods based on their classifications.
5. Output the classified outcome and prioritized list of agile methods.

Early Phase Adaptive Agile Modeling Using AI and ML based Classification to decide to set of Generic and Personalized Virtual Learning



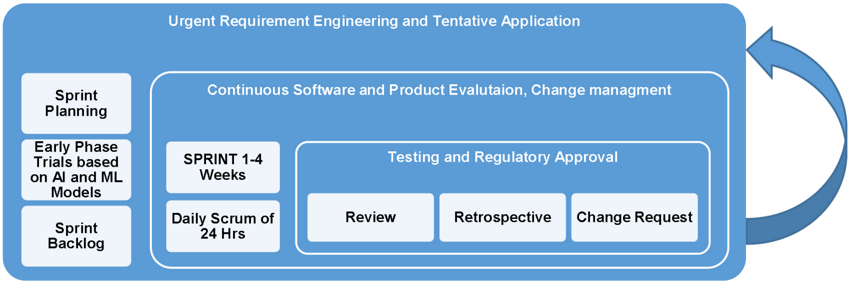


Figure 2

Proposed Agile Framework for virtual classroom learning

Author's own diagram

The Agile process involves several phases, including Requirement Engineering and Tentative Application, Sprint Planning, Early Phase Trials based on AI and ML Models, Sprint Backlog, Continuous Software and Product Evaluation, Change Management, Testing and Regulatory Approval, Review, Retrospective, and Change Request. The Requirement Engineering phase involves gathering and analyzing requirements for the software or product and outlining a tentative development plan. Sprint planning involves deciding which items from the product backlog will be worked on during each sprint. Early Phase Trials based on AI and ML Models are suggested. The Sprint Backlog lists tasks identified during sprint planning. Continuous Software and Product Evaluation and Change Management involves managing changes to requirements or features as necessary. Daily Scrum meetings are held at the same time each day. Change Requests are formal requests for changes based on stakeholder feedback or observations during development.

Implementation

Table 1

Agile Optimization Parameter Knowledge Base

In: Team Collaboration	In: Iteration Speed	In: Student Satisfaction	Out: Optimization Level	Membership Degree
MostPositive	VeryFast	VeryHigh	Must	100
Positive	Fast	High	Essential	80
Neutral	Moderate	Moderate	Desired	60
Negative	Slow	Low	Extra	40
MostNegative	VerySlow	VeryLow	Deferred	20

[Source: Compiled by Researcher]

The fuzzy model presented in table no.1 for Optimization of Agile Adoption in Virtual Learning Environments aims to optimize the adoption of agile methodologies within virtual learning environments (VLEs). Key components include team collaboration, iteration speed, and customer satisfaction. Team collaboration refers to the effectiveness of individuals working together in virtual settings, with higher levels indicating strong teamwork and communication. Iteration speed refers to the pace at which iterative development cycles or learning modules are completed. Faster iteration speeds suggest rapid iteration and adaptation to changing requirements, while slower iteration speeds may indicate bottlenecks or delays in the development process. Customer satisfaction represents the level of satisfaction among learners, instructors, and other stakeholders with the learning experience. High satisfaction levels suggest that the learning environment meets or exceeds user expectations, fostering engagement and motivation. Lower satisfaction levels may indicate issues such as poor user experience, ineffective content delivery, or lack of support, potentially impeding agile adoption and learning outcomes. The Optimization Level output variable determines the degree of optimization required to enhance agile adoption within VLEs, ranging from Must to Deferred. By considering these factors, educators and instructional designers can prioritize improvement efforts to enhance the effectiveness of agile methodologies in supporting online learning initiatives.

Results and Discussion

The fuzzy system consists of four variables implemented as depicted in figure no.2, with input variables team collaboration, student satisfaction, and iteration speed. The output variable optimization level gives classified agile virtual learning methods ranging as Must, Essential, Desired, Extra, and Deferred with rank prioritization of importance. These variables are crucial in assessing and optimizing agile adoption within virtual learning environments (VLEs). The fuzzy inference and optimization models are shown in figure 3 and 4

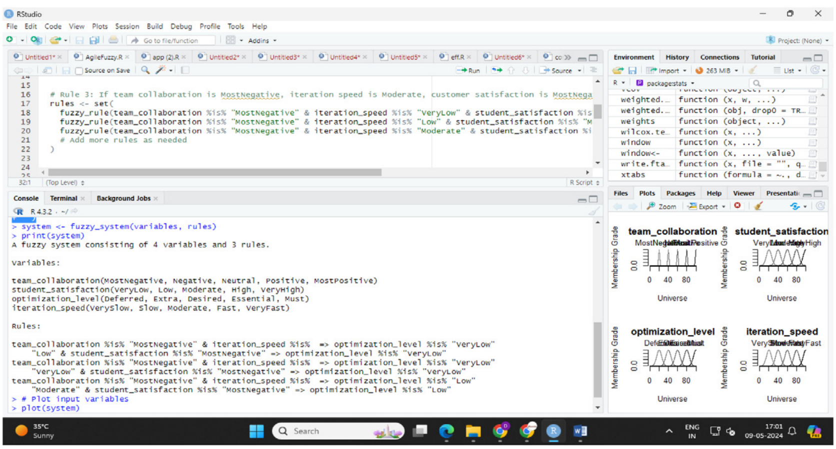


Figure 3

Fuzzy Inference System

Author's own compilation

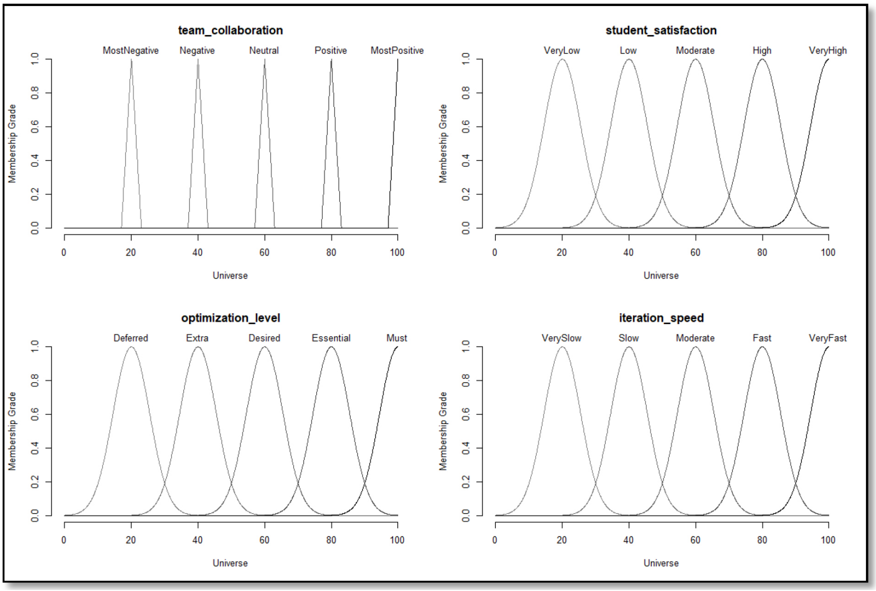


Figure 4

Fuzzy Model for Optimization

Author's own data compilation diagram

Conclusion

The research aims to create an Agile Virtual Learning Model for educational institutions, based on Adaptive Emergency Initial NEP (NEP). This model can help plan classrooms, faculty, study methods, IT and HR resources, and experts, providing a technological advantage in the educational field. It can be implemented at micro-level units for day-to-day institute setup design, enhancing instruction delivery, assessment, curriculum design, and resource management. The study on Agile Virtual Learning Management Systems (AVLMS) for Higher Management Institutes has the potential to contribute to the development and advancement of online learning in business and management education. The model can deal with systematically fuzzified immediate needs and continuous iterative developments. Researchers will explore the design and build comparative grouping and dominant parameter behavior study for virtual classroom learning using fuzzy and ML techniques to generate implementation scenarios and improve the design.

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