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Research Article

Enhancing Adaptive Pedagogical Content Development with ADDIE and Scrum in Hypermedia Environments

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Abstract. This article explores an innovative approach that combines the ADDIE and Scrum methodologies to develop pedagogical objects in adaptive hypermedia systems. The aim is to address the evolving needs of learners in a constantly changing learning environment. This integration provides increased flexibility, allowing for quick adjustments based on learners' requirements. It also promotes multidisciplinary collaboration, enhances pedagogical quality through regular reviews, maintains alignment with educational objectives, and ensures transparent quality management. The article presents an architecture tailored to this approach, highlighting key components to promote adaptability. It discusses future prospects for the implementation of this approach, including automation and the integration of artificial intelligence, thus opening up new possibilities for continuous improvement in adaptive education and learning.

Keywords: Pedagogical objects, Adaptive hypermedia systems, Agile methodology, ADDIE, Scrum.

INTRODUCTION

Intelligent learning and adaptive hypermedia systems have revolutionized the way education is delivered and have opened up new possibilities for personalized learning. At the core of this revolution are pedagogical objects, educational resources that can take various forms, such as learning modules, interactive videos, quizzes, simulations, and more. These pedagogical objects play a central role in creating engaging, effective, and learner-specific learning experiences.

Pedagogical objects are at the heart of intelligent learning and adaptive hypermedia systems. They are designed to help learners acquire knowledge, develop skills, and achieve specific educational goals. They are essential components that facilitate individualized learning by enabling systems to adapt to the needs, preferences, and performance of each learner. As such, pedagogical objects have garnered significant international interest as drivers of educational innovation.

However, the creation of effective and adaptive pedagogical objects is a complex task that requires a robust methodological approach. Over the years, the focus on technical aspects, such as metadata standardization and software packaging, has diverted attention from central issues related to how to develop pedagogical learning objects of high pedagogical quality. It is in this context that agile approaches, notably the Scrum methodology, have gained importance in the field of education.

The agile approach, popularized in the software development field, has proven itself in managing complex projects characterized by changing requirements and rapid development cycles. It is characterized by its flexibility, interdisciplinary collaboration, and emphasis on the continuous delivery of high-quality products. The application of agile approaches in education and the creation of pedagogical objects provide a suitable response to the challenges of personalized learning, content customization, and responsiveness to the constantly evolving needs of learners.

The main objective of this article is to explore the integration of the ADDIE (Analysis, Design, Development, Implementation, Evaluation) and Scrum approaches in the production of pedagogical objects for adaptive hypermedia systems. We will demonstrate how this combination can harmonize the detailed planning of ADDIE with the agile flexibility of Scrum, thereby enabling the creation of high-quality educational resources tailored to the changing needs of learners. By examining the benefits of this approach, we will also provide concrete examples of application and practical recommendations for education and pedagogical development practitioners.

METHODOLOGY

The effectiveness of combining ADDIE (Analysis, Design, Development, Implementation, Evaluation) and Scrum lies in the synergy of two complementary approaches, each bringing unique benefits to the creation of pedagogical objects for adaptive hypermedia systems.

Presentation of the ADDIE Approach

The ADDIE model is a widely used framework in instructional design, particularly for creating online learning modules and various training materials. ADDIE is an acronym for Analyze, Design, Develop, Implement, and Evaluate,

reflecting the comprehensive approach of the model in the development of educational programs (Crompton et al., 2023; Drljača et al., 2017). This model was created in 1975 by the Center for Educational Technology at Florida State University for the U.S. military. It provides a structured methodology for designing any type of curriculum and is adaptable across different instructional design methods, whether for lectures or web-based training (Branch, 2009; Gamal, 2022; Spatioti et al.). The ADDIE approach is a pedagogical development model that serves as a methodological framework for creating high-quality pedagogical objects. This model, which has evolved over the decades, consists of five interdependent phases, each with a clearly defined role in the development process (Cotter et al., 2023; Shelton & Saltsman, 2011).

1) Analysis:

Analysis is the initial phase of the ADDIE process. It aims to deeply understand learners' learning needs, targeted educational objectives, usage context, and potential constraints. This often involves conducting a needs analysis, gathering learner data, and defining success indicators.

The primary goal of this phase is to establish a strong foundation for further development by identifying issues to address and setting clear objectives.

2) Design:

The design phase builds on the results of the analysis. It involves creating a detailed plan for pedagogical objects. This includes structuring content, designing learning activities, selecting media, defining interactions, and assessments.

Design focuses on creating an effective and engaging learning experience that aligns with educational objectives. It takes into account learners' needs and preferences, as well as pedagogical principles.

3) Development:

The development phase puts the design plan into action. It involves the actual creation of pedagogical objects, including the production of multimedia content, programming interactions, creating educational materials, and assembling all necessary resources.

This phase requires close collaboration between instructional designers, multimedia developers, and domain experts.

4) Implementation:

Once the pedagogical objects have been developed, they are integrated into the learning system or platform intended for learners. This phase ensures that resources are accessible, the learning environment is ready, and users can interact with the pedagogical objects.

Implementation often includes testing to verify that everything functions correctly and that users can access the content.

5) Evaluation:

The evaluation phase is essential for measuring the effectiveness of pedagogical

objects. It includes both formative assessments, which track learners' progress and allow for adjustments along the way, and summative assessments, which measure final learning outcomes. Data collected during this phase serves to identify the strengths and weaknesses of pedagogical objects, determine if educational objectives have been achieved, and guide future improvements.

The ADDIE approach offers a structured methodology that ensures pedagogical objects are developed with careful attention to needs analysis, thoughtful design, production quality, effective implementation, and ongoing evaluation. However, it can sometimes be perceived as rigid, necessitating integration with agile methodologies like Scrum to address the changing needs of learners.

Presentation of the Scrum Methodology

Scrum is an agile methodology widely used in the software development field, but it also finds successful applications in other domains, including education (Sutherland and Schwaber, 2017). This methodology is characterized by its flexibility, iterative and incremental approach, and its focus on interdisciplinary collaboration (Wonohardjo et al., 2019).

Scrum is structured around self-organizing teams working in fixed-duration sprints, typically two to four weeks long. Each sprint is a development period during which the team commits to producing a set of features, components, or finished products (Nyembe et al., 2023; Prasetya et al., 2021).

A central aspect of Scrum is the role of the Scrum Master, who facilitates the process, removes obstacles, and supports the team in achieving its goals (Scrum, 2020). Furthermore, the Scrum team includes multidisciplinary members, such as developers, testers, designers, and other experts necessary to complete the project (Morandini et al., 2021 ; Rahmadi & Lavicza, 2021).

The Scrum board is a visual tool used to track work progress. It includes elements such as the product backlog, the list of tasks to be completed (sprint backlog), and items currently in development (Adi, 2015; Garzaniti et al., 2019).

Scrum promotes constant collaboration and transparent communication within the team. Daily stand-up meetings allow team members to synchronize, resolve issues, and adjust the plan as needed (Schwaber, 1997; Melillán et al., 2023). At the end of each sprint, a review is conducted to examine the sprint's outcomes, gather stakeholder feedback, and plan the next sprint.

Scrum offers a dynamic and iterative approach to managing complex projects while allowing responsiveness to changing project needs. This methodology has been successfully adopted in the field of education to enhance the management of educational projects and the creation of adaptive pedagogical objects (Brock et al., 2016; Sassa et al., 2023).

Advantages of Combining ADDIE and Scrum

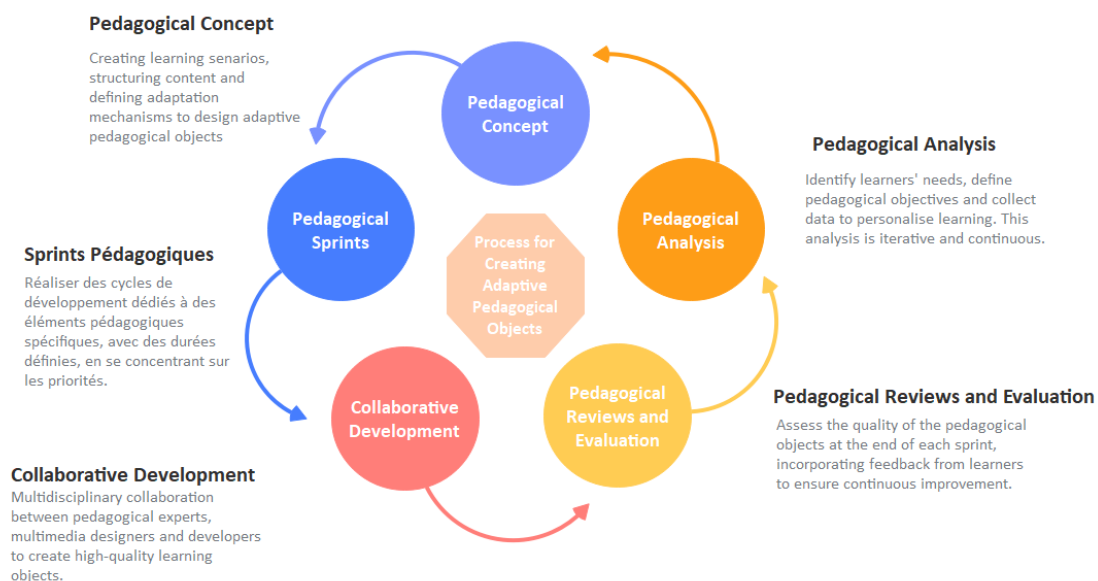
The combination of the ADDIE (Analysis, Design, Development, Implementation, Evaluation) and Scrum approaches brings numerous significant advantages to the process of creating pedagogical objects, especially in an adaptive context for hypermedia systems.

- **Structure and Flexibility:** The ADDIE approach provides a clear structure for the analysis, design, development, implementation, and evaluation of pedagogical objects. Scrum, on the other hand, brings the flexibility needed to adapt to changing project needs. Combining these two methodologies allows for both structure and adaptability.
- **Agile Project Management:** Scrum introduces agile project management based on iterative sprints and frequent reviews. This enables development teams to quickly respond to feedback and make adjustments, ultimately improving the quality of pedagogical objects.
- **Responsiveness to Learner Needs:** Using Scrum in the process allows for increased responsiveness to the changing needs of learners. Adjustments can be made swiftly to ensure that pedagogical objects remain relevant and effective.
- **Interdisciplinary Collaboration:** Scrum encourages interdisciplinary collaboration by bringing together experts in pedagogy, multimedia designers, developers, and other professionals within the team. This ensures a seamless integration of pedagogical and technical aspects in the creation of pedagogical objects.
- **Continuous Improvement:** The combination of ADDIE and Scrum promotes the continuous improvement of pedagogical objects. Ongoing evaluations and revisions help identify strengths and weaknesses, leading to constant improvements in pedagogical quality.
- **Alignment with Educational Objectives:** The ADDIE methodology ensures that pedagogical objects are aligned with educational objectives, while Scrum ensures that these objectives are maintained throughout the development process.
- **Quality Management:** Both approaches emphasize quality management from both technical and pedagogical perspectives. This ensures that pedagogical objects are not only functional but also effective for learning.

The combination of ADDIE and Scrum offers a comprehensive approach to creating adaptive pedagogical objects in hypermedia systems. It combines the structure of ADDIE's analysis, design, development, and evaluation with the flexibility, responsiveness, and continuous improvement of Scrum, making it a powerful approach to address the evolving needs of adaptive education.

RESULTS

When creating adaptive pedagogical objects within the context of an adaptive hypermedia system, a well-designed architecture is essential to ensure the effectiveness of the entire process. The proposed architecture combines the best practices of the ADDIE approach and the agile principles of Scrum to provide a robust and flexible structure.



1. **Pedagogical Analysis:** This phase corresponds to the Analysis phase of ADDIE. It involves identifying learners' needs, defining pedagogical objectives, and collecting the necessary data for personalized learning. This analysis is iterative and continuous throughout the process.
2. **Pedagogical Design:** Pedagogical design, also inspired by the Design phase of ADDIE, involves creating learning scenarios, structuring content, and defining adaptation mechanisms. This phase is crucial for designing effective adaptive pedagogical objects.
3. **Pedagogical Sprints:** This component is borrowed from Scrum and consists of development cycles dedicated to creating specific pedagogical objects. Each sprint has a defined duration and focuses on the creation of priority pedagogical elements.
4. **Collaborative Development:** The development phase is a multidisciplinary collaboration, integrating pedagogy experts, multimedia designers, and developers. Team members work together to create high-quality pedagogical objects that meet the objectives.
5. **Pedagogical Reviews and Evaluation:** At the end of each sprint, pedagogical reviews are conducted to assess the quality of the produced pedagogical objects. Evaluation also includes feedback from learners, contributing to continuous improvement.

One of the main achievements of this combined methodology is a significant increase in flexibility and responsiveness throughout the development process. Through the integration of Scrum, teams were able to quickly adapt to the changing needs of learners. Iterative sprints allowed real-time adjustments to pedagogical resources, whether by modifying content, adapting learning scenarios, or adjusting adaptation mechanisms. This responsiveness greatly improved the relevance of pedagogical objects and contributed to delivering a more personalized learning

experience.

The combined methodology also placed a strong emphasis on pedagogical quality management. Regular evaluations within Scrum and pedagogical reviews ensured that pedagogical objects were not only functional but also effective in terms of learning. Learner feedback was taken into account for continuous improvements. This approach ensured that educational resources remained aligned with educational objectives and met high pedagogical standards.

The application of the ADDIE-Scrum integration yielded significant benefits compared to other pedagogical development approaches. Unlike linear methods, the ADDIE-Scrum approach provides increased flexibility to adapt to changing learner needs. Furthermore, it promotes closer multidisciplinary collaboration, enhancing the overall quality of pedagogical objects. Compared to purely agile approaches, it incorporates a thorough analysis phase to ensure clear definition of pedagogical objectives.

However, the integration of ADDIE and Scrum is not without challenges. The main difficulty lies in managing the complexity of this combined approach, requiring careful planning to harmonize Scrum's iterative cycles with ADDIE's sequential phases. Effective communication within the multidisciplinary team can also be challenging to establish. Additionally, evaluating and measuring pedagogical quality remain challenges, as they must be integrated into every phase of the process.

For a successful implementation of ADDIE-Scrum integration, it is recommended to:

- Plan the sequence carefully: Clearly define how ADDIE phases integrate into Scrum sprints to avoid overlap or inconsistency.
- Foster communication and collaboration: Encourage open and regular communication within the multidisciplinary team to ensure mutual understanding of pedagogical and technical objectives.
- Establish pedagogical quality criteria: Define specific pedagogical quality indicators for regular evaluation of pedagogical objects and improving their effectiveness.
- Train the staff: Ensure that team members understand both ADDIE and Scrum principles for a harmonious implementation.
- Adopt an iterative approach: Understand that optimizing this combined approach may require adjustments over time and be prepared to iterate and continuously improve.

The integration of ADDIE and Scrum provides a robust framework for developing adaptive pedagogical objects but requires careful planning, effective communication, and proactive management of challenges. With proper implementation and ongoing adaptation, this approach can significantly contribute to creating more personalized and high-quality learning experiences.

CONCLUSION AND DISCUSSION

The integration of ADDIE and Scrum in the process of creating adaptive pedagogical objects opens up exciting new possibilities for the field of intelligent

learning and adaptive hypermedia systems. This methodological combination offers significant advantages that have been demonstrated in various educational contexts.

At the core of this integration lies improved flexibility and adaptability. Development teams can quickly adjust their resources to meet the changing needs of learners, thereby ensuring a more personalized learning experience. This responsiveness to the evolving needs of learners is essential to maintain the relevance and effectiveness of pedagogical objects in a constantly evolving educational landscape.

Multidisciplinary collaboration is another cornerstone of this combined approach. Within the Scrum team, there are pedagogy experts, multimedia designers, developers, and other professionals, all working together to create high-quality pedagogical objects. This diversity of skills allows for a seamless integration of pedagogical and technical aspects, ensuring that pedagogical objects are both educational and technically robust.

Pedagogical reviews specific to pedagogical aspects play a crucial role in this approach. They lead to continuous revision of pedagogical objects, enabling ongoing improvements. Furthermore, learner feedback is carefully considered, contributing to the constant improvement of pedagogical efficiency. This real-time feedback loop promotes pedagogical development that is more focused on learners' actual needs.

Alignment with educational objectives remains a constant priority of this integrated methodology. Despite flexibility and adaptability, educational resources remain true to their primary goal: supporting learning. This coherence ensures that pedagogical objectives are consistently at the center of the development process, ensuring maximum efficiency.

Finally, the management of pedagogical quality is seamlessly integrated into the overall development process. High standards in pedagogy are rigorously maintained, ensuring that pedagogical objects are not only technically effective but also compliant with the highest educational standards.

Overall, the integration of ADDIE and Scrum offers a holistic and powerful approach to the development of adaptive pedagogical objects. It combines rigor and flexibility, creativity and coherence, creating an environment conducive to continuous improvement in education and learning.

As learning needs evolve and technology continues to advance, the integration of ADDIE and Scrum paves the way for new perspectives in the creation of adaptive pedagogical objects. Future developments could include increased automation of certain phases, the integration of artificial intelligence for even more extensive personalization, and the exploration of similar methodologies in other areas of education.

Ultimately, the primary goal of this combined approach is to create more flexible, personalized, and effective learning environments for learners while maintaining high standards of pedagogical quality. With thoughtful implementation and ongoing adaptation, this methodology can significantly contribute to the improvement of education and adaptive learning in the future.

REFERENCES

- Adi, P. (2015). Scrum Method Implementation in a Software Development Project Management. *International Journal of Advanced Computer Science and Applications*, 6(9). <https://doi.org/10.14569/ijacsa.2015.060927>.
- Branch, R. M. (2009). *Instructional Design: The ADDIE Approach*. Springer US. <https://doi.org/10.1007/978-0-387-09506-6>.
- Brock, D., Brodie, P., McIntyre, D., & Dobbyn, C. (2016). Agile Methodologies and Instructional Design. In *Handbook of Research on Cross-Disciplinary Perspectives on Contemporary Research in Education* (pp. 83-102). IGI Global.
- Cotter, S., Yamamoto, J., & Stevenson, C. (2023). A systematic characterization of food safety training interventions using the analyze, design, develop, implement, evaluate (ADDIE) instructional design framework. *Food Control*, 145, 109415. <https://doi.org/10.1016/j.foodcont.2022.109415>.
- Crompton, H., Jones, M. V., Sendi, Y., Aizaz, M., Nako, K., Randall, R., & Weisel, E. (2023). Examining technology use within the ADDIE framework to develop professional training. *European Journal of Training and Development*. <https://doi.org/10.1108/ejtd-12-2022-0137>.
- Drljača, D., Latinović, B., Stanković, Ž., & Cvetković, D. (2017). ADDIE Model for Development of E-Courses. Dans *Sinteza 2017*. Singidunum University. <https://doi.org/10.15308/sinteza-2017-242-247>.
- Gamal, A. H. (2022). DEVELOPING MULTIMEDIA TECHNOLOGY FOR EFL CLASSROOMS IN INDONESIA USING ADDIE MODEL: A LITERATURE REVIEW. *ELTR Journal*, 7(1), 14–22. <https://doi.org/10.37147/eltr.v7i1.162>.
- Garzaniti, N., Briatore, S., Fortin, C., & Golkar, A. (2019). Effectiveness of the Scrum Methodology for Agile Development of Space Hardware. Dans 2019 IEEE Aerospace Conference. IEEE. <https://doi.org/10.1109/aero.2019.8741892>.
- Melillán, A., Cravero, A., & Sepúlveda, S. (2023). Software Development and Tool Support for Curriculum Design: A Systematic Mapping Study. *Applied Sciences*, 13(13), 7711. <https://doi.org/10.3390/app13137711>.
- Morandini, M., Coleti, T. A., Oliveira, E., & Corrêa, P. L. P. (2021). Considerations about the efficiency and sufficiency of the utilization of the Scrum methodology : A survey for analyzing results for development teams. *Computer Science Review*, 39, 100314. <https://doi.org/10.1016/j.cosrev.2020.100314>.
- Nyembe, F. H., van der Poll, J. A., & Lotriet, H. H. (2023). Formal Methods for an Agile Scrum Software Development Methodology. *Proceedings of the International Conference on Advanced Technologies*. <https://doi.org/10.58190/icat.2023.35>.
- Prasetya, K. D., Suharjo & Pratama, D. (2021). Effectiveness Analysis of Distributed Scrum Model Compared to Waterfall approach in Third-Party Application Development. *Procedia Computer Science*, 179, 103–111. <https://doi.org/10.1016/j.procs.2020.12.014>.
- Rahmadi, I. F., & Lavicza, Z. (2021). Pedagogical Innovations in Elementary Mathematics Instructions : Future Learning and Research Directions. *International Journal on Social and Education Sciences*, 3(2), 360–378. <https://doi.org/10.46328/ijonses.110>.

- Sassa, A. C., Almeida, I. A. d., Pereira, T. N. F., & Oliveira, M. S. d. (2023). Scrum : A Systematic Literature Review. *International Journal of Advanced Computer Science and Applications*, 14(4). <https://doi.org/10.14569/ijacsa.2023.0140420>.
- Schwaber, K., & Sutherland, J. (2017). *Scrum Guide: The Definitive Guide to Scrum: The Rules of the Game*. Scrum.Org. <https://www.scrum.org/resources/scrum-guide>.
- Scrum, J. (2020). *Agile Project Management Guide : The Simplified Beginners to Deeply Understand Agile Principles from Beginning to End, Developing Agile Leadership and Improving Soft Skills, Scrum and Lean Thinking*. Charlie Creative Lab.
- Shelton, K., & Saltsman, G. (2011). Applying the ADDIE Model to Online Instruction. *Dans Instructional Design* (p. 566–582). IGI Global. <https://doi.org/10.4018/978-1-60960-503-2.ch305>.
- Spatioti, A., Kazanidis, I., & Pange, J. (2022). A Comparative Study of the ADDIE Instructional Design Model in Distance Education. *Information*, 13(9), 402. <https://doi.org/10.3390/info13090402>.
- Sutherland, J., & Schwaber, K. (2017). *The Scrum Guide*. Scrum.Org. <https://www.scrum.org/resources/scrum-guide>.
- Wonohardjo, E. P., Sunaryo, R. F., & Sudiyono, Y. (2019). A Systematic Review of SCRUM in Software Development. *JOIV : International Journal on Informatics Visualization*, 3(2), 108. <https://doi.org/10.30630/joiv.3.2.167>.