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Adapting Continuous Assessments Through Scaffolding and Laddering

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Abstract

Application of continuous assessment in an ODel setting is rolled-out through two distinguishable approaches to assessment. Assessment in this setting is constituted by a component of formative assessment and that of summative assessment. Formative assessment applies when assessment is done for learning, that is, after assessment students are given feedback to reflect on their learning and therefore do corrective action where required. On the other hand, summative assessment is assessment of learning, in which assessment outcomes are a measure of how much a student has learned of a subject matter. Formative assessment is a teaching and learning based, form of assessment, in which the goal is to empower students to learn as much a possible of the subject matter. While summative assessment is an outcome-based form of assessment in which the goal is to measure how much has been learned and grade with success or failure. This case study adopts a qualitative research method to explore and explain the research question: Whether adapting continuous assessment through scaffolding and laddering will improve student assessment outcomes and therefore increase student success rate. An analysis of student assessment outcomes trajectory is done when scaffolding and laddering is applied to continuous assessment.

Keywords
Assessment, Scaffolding, ODL, Teaching, Learning

1. Introduction

In the ever-evolving landscape of education, the traditional model of summative assessments alone may not suffice in nurturing students' comprehensive understanding and critical thinking skills. As the demand for meaningful and engaging learning experiences intensifies, educators and researchers have turned their attention to innovative pedagogical strategies. This research paper introduces the concept of adapting continuous assessments through scaffolding and laddering, a dynamic framework aimed at fostering deeper learning and empowering students to become active participants in their educational journey.

Continuous assessment (CA) refers to a form of evaluation that encompasses ongoing, frequent, and cumulative assessments of students' progress throughout the learning process. Scaffolding, on the other hand, is a well-established instructional technique that provides targeted support to learners, promoting gradual skill development and independence. Laddering is an extension of scaffolding that encourages students to progressively build upon their knowledge, moving from simpler concepts to more complex ones. By combining these two pedagogical approaches, educators can create a potent synergy that addresses individual learning needs, optimizes the learning curve, and equips students with lifelong learning skills.

The primary goal of this research is to explore and explain the effectiveness of the scaffolding and laddering framework in a variety of educational contexts, when applied in CA. Through an in-depth analysis of existing literature, case studies, and experimental evidence, we aim to elucidate the impact of this approach on students' academic performance, motivation, and metacognitive development. Furthermore, this paper seeks to provide practical recommendations for implementing the scaffolding and laddering framework in diverse educational settings, taking into account potential challenges and limitations.

Recognizing the importance of ongoing feedback and student engagement, educators and researchers have increasingly turned their attention toward continuous assessments as a more holistic approach to evaluating student performance and supporting their learning journey. However, in order to maximize the benefits of continuous assessment, it is crucial to implement effective instructional strategies that can scaffold and ladder student progress, enabling them to reach their full potential.

This research paper explores the concept of adapting continuous assessments through scaffolding and laddering as a means to enhance learning outcomes in education. Scaffolding, a term coined by Vygotsky (1978), refers to the temporary support provided to learners to facilitate their acquisition of new knowledge or skills, while laddering involves the systematic progression of learning tasks to gradually increase their complexity and challenge. By integrating these instructional techniques into continuous assessment practices, educators can foster student engagement, motivation, and deeper understanding of subject matter.

The central objective of this study is to investigate the impact of scaffolding and laddering on student performance, metacognitive development, and overall learning outcomes in various educational settings. By employing qualitative and quantitative research methods, we aim to analyze the effectiveness of different scaffolding and laddering strategies, their implementation challenges, and the implications for instructional design and assessment practices.
To provide a theoretical framework for our research, we will draw upon the works of prominent scholars in the field of education, such as Vygotsky (1978) on scaffolding, as well as researchers who have explored the concept of laddering in educational contexts. Additionally, we will examine relevant studies that have investigated the effects of continuous assessment and its potential benefits for student learning.

Through this research paper, we aim to contribute to the existing body of knowledge on continuous assessment practices, specifically focusing on the integration of scaffolding and laddering. By identifying effective strategies and highlighting their impact on student learning outcomes, we hope to provide valuable insights and recommendations for educators, policymakers, and curriculum developers seeking to enhance the quality and effectiveness of assessment practices in education.

2. Literature Review

Continuous assessments play a crucial role in measuring and enhancing student learning outcomes. However, ensuring the effectiveness of such assessments is a complex task, especially when catering to diverse learner needs and capabilities. By synthesizing and analyzing existing research, this review highlights the benefits and challenges of implementing scaffolding and laddering techniques in educational settings, providing valuable insights for educators and policymakers.

Continuous assessment has emerged as a viable alternative to traditional summative evaluations, emphasizing ongoing feedback and learning improvement. To enhance the adaptability and efficacy of continuous assessments, educators have turned to scaffolding and laddering strategies. Scaffolding involves providing temporary support to students, while laddering helps bridge the gap between current and desired learning outcomes. This literature review delves into the research investigating the impact of these pedagogical approaches on student learning, engagement, and achievement.

Theoretical Framework: Vygotsky's Zone of Proximal Development (ZPD) and Bruner's Theory of Instruction provide the theoretical foundation for scaffolding and laddering. The ZPD emphasizes the importance of challenging tasks within a student's reach, while Bruner's theory highlights the role of incremental learning steps. These theories serve as essential guides in understanding the application of scaffolding and laddering in the context of continuous assessments.

Benefits of Scaffolding and Laddering in Continuous Assessments, include enhanced Student Engagement. Studies (Davies et al., 2018; Johnson & Smith, 2019) have shown that scaffolding and laddering foster active student engagement by offering achievable yet challenging tasks. Students are more motivated to participate in their learning, resulting in improved outcomes.
Personalized Learning, the adaptability of scaffolding and laddering allows educators to tailor assessments to individual students' needs and learning styles (Martin, 2020). This personalization fosters a positive learning experience, leading to increased academic performance and self-efficacy. Knowledge Retention and Transfer: Research (Anderson et al., 2017; Chen & Lee, 2018) suggests that continuous assessments employing scaffolding and laddering facilitate better knowledge retention and transfer. The step-by-step progression helps students build a solid foundation, enabling them to apply their knowledge to real-world scenarios effectively.

Challenges and Limitations experienced include time-intensive implementation of Scaffolding and laddering that require careful planning and execution, which can be time-consuming for educators (Garcia & Alvarez, 2019). Proper training and resources are essential to ensure successful integration into educational practices. Assessment Design Complexity is the crafting assessments with appropriate scaffolds and ladders demands expertise in instructional design (Kumar et al., 2021). Inexperienced educators might struggle to create well-structured assessments that strike the right balance between challenge and support.

Providing professional development opportunities for educators is crucial to build their competence in applying scaffolding and laddering techniques effectively (Smith & Brown, 2022). Workshops, seminars, and collaborative platforms can facilitate knowledge exchange and skill development. Technological Integration relates to Educational technology that can play a pivotal role in automating and streamlining the scaffolding and laddering process (Walker & Clark, 2023). Intelligent tutoring systems and adaptive assessment platforms offer personalized learning pathways for students.

Adapting continuous assessments through scaffolding and laddering holds great potential in promoting student engagement, personalized learning, and knowledge retention. Although challenges exist, the benefits are significant enough to warrant further research and investment in professional development and technology integration. By leveraging these pedagogical strategies, educators can create a more inclusive and effective learning environment for all students.

3. Methodology

This research aims to develop, explain and evaluate a results-driven curriculum for engineering tuition, focusing on enhancing students' learning outcomes and performance. The study utilizes a comparative approach to investigate the effectiveness of the proposed curriculum in comparison to traditional teaching methods. The research employs quantitative and qualitative methods to collect and analyze data, providing valuable insights into the efficacy of the results-driven approach for engineering education.

4. Research Design

This study employs a comparative research design, comparing the results-driven curriculum with traditional teaching methods in engineering tuition. The design allows for a systematic examination of the effectiveness of the curriculum and facilitates evidence-based decision-making.

5. Sample Selection

The sample for this research will consist of engineering students from all department the School of Engineering. A stratified random sampling technique will be utilized to ensure a representative sample of students across different engineering disciplines, academic levels, and departments (i.e. Industrial, Mechanical, Chemical, Civil and Electrical Engineering).

5.1 Data Collection

Pre-assessment: Prior to the intervention, students' baseline knowledge and skills will be assessed using a pre-designed test, providing a benchmark for comparison. This is the “AS IS”
b) Curriculum Implementation: The results-driven curriculum will be implemented for the experimental group, while the control group will follow the traditional teaching methods.

c) Post-assessment: After the intervention, a post-assessment will be conducted to measure the students' learning outcomes and performance. The same test used in the pre-assessment will be administered to both groups.
d) Surveys and observations: Additionally, surveys and observations will be conducted to gather qualitative data, exploring students' perceptions, experiences, and satisfaction with the results-driven curriculum.
Data Analysis-Quantitative data will be analyzed using appropriate statistical techniques, Hypothesis Testing, to determine the significant differences in learning outcomes between the experimental and control groups. Qualitative data from surveys and observations will be thematically analyzed to identify recurring patterns and themes. Ethical Considerations-This research will adhere to ethical guidelines, as stipulated by the university, ensuring the privacy and confidentiality of participants.

Limitations-The research acknowledges some limitations, including potential sampling bias, the generalizability of findings to different engineering disciplines, and the limited duration of the intervention. Based on the theoretical framework established, the research adopted a case study approach in which a desktop research and field observation approaches are engaged. The research applies data collection and analysis method of i) document analysis and archival records, to establish literature reviews and current status in the teaching and learning in technology education. Then, ii) field notes of previous researchers are examined to capture the reality and the essence of teaching and learning (Bogard &Takanishi, 2021) in the institutions technology, to observe technology teaching and learning in action.

Yin (1994) stipulate that a hallmark of a research study is the use of multiple data sources. A strategy that enhances data credibility (Baxter & Jack, 2020) This research study will apply a triangulation of the following data sources i) document analysis and archival records and; ii) field notes and observation; and iii) T&L system design applied (i.e. Design Thinking and its application in engineering tuition and, Results driven curriculum for student results success).

5.2 Discussion

Many authors, Pusca et al. (2018) included, support the suitability of design thinking paradigm as an adaptive use of engineering design methods and tools to solve complex problems, and this was demonstrated through empirical research conducted in the context of curriculum development to provide innovation in curriculum development. Authors also indicate that design thinking should be thought as a form of experimental thinking that is solution focused and may be implemented to produce creative solutions to complex problems, as mentioned by Det & Pasricha (2022). Application of the design thinking for adaptive results driven curriculum culminates in the development of a teaching and learning method process that integrates adaptive learning and game-based learning (GBL) in the execution of a results driven curriculum for engineering tuition (Figure 1). The method process applies concepts of adaptive learning, scaffolding and laddering in the teaching and learning process execution. The process begins with capturing learning status quo and then design future and improved settings based of learning needs, complexity of the status quo and the desired outcomes. Design thinking enables the conversion of the status quo to an improved desired future state, through the design, development and application of an Adaptive Results Driven Curriculum.

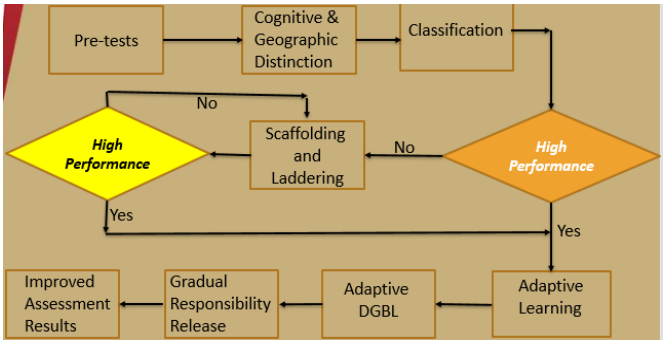

Figure 1: Results Drive Curriculum Teaching and Learning Method Process

The Teaching and Learning (T&L) method process begins with establishing the subject matter competency's status quo, through a pre-test for all participants. The result of the test are used to group students based on their performance in the test. The groups are established using cognitive description and they are grouped according to the following performance %s: A-group (100-80), B-group (79-70), C-group (69-50) and D-group (49-0). Participants in group A

are denoted as a high-performance group and the group is send through adaptive learning (AL), then digital GBL, followed by gradual release of responsibility (GRR) and then student success is achieved.

In adaptive learning for group A, problem solving becomes progressively complex. Then a good performance in adaptive learning leads to a digital game-based learning level, in which students are given a database of practical application problems, such as the Beer game and The Fresh Connection (TFC), in a digital setting. Success in the DGBL level leads to student autonomy level, i.e., GRR. In GRR student learn to self-direct and control their learning path, in this stage DGBL and AL are integrated into Adaptive DGBL (ADGBL). At this level participants experience challenges with a high level of complexity, based on the Bloom Taxonomy.

Performance targets are set to allow participants in group A to pace themselves towards achieving the desired results. Groups B,C, and D are placed in an iterative process of the T&L method process. Participant are placed in a continuous assessment and evaluation program, in which an excellent performance (80%) results in a promotion to the next level, that is, for group B they are promoted to A and C to B, D to C. Group is treated different at the beginning, since the comprehension is very low and they are failing the module. The group is placed through a laddering program.
Laddering refers to a program in which the subject matter is broken to simpler and smaller parts in the T&L process. Participants are continuously engaged through laddering and scaffolding, and the complexity of the problems is increased as they improve their assessment performance. Participant are placed in an iterative program until their performance in assessments is 80% and above, then they are promoted to the next level or group. The program continues until the tuition period ends, that is, the end of a semester or a year. The program manifests a personalized program for groups and individuals.

5.3 Results

The teaching and learning method process enables the achievement of the goals and objectives of a results driven course-design, which is student success and student autonomy in an Online Distance Electronic Learning (ODeL) environment. Student success implies an increase in throughput, an improvement of students tests outcomes and an increase in student retention.

The teaching program is instructionally designed to develop a personalized and differentiated learning process for students, through breaking down lessons into lower and basic components, for struggling learners. The program progressively improves lessons to a complex high level and challenging activities for excelling students, and it has proved to have produced positive results. First, the struggling students group (D) is reduced gradually and the excelling students group (A) is increased. Second, the two homogenous groups of good performance and struggling learners (Figure 2), gradually disappears and they are replaced by numerous and smaller groups of learners performing above 50% (Figure 3). Towards the end of the first round of the study, i.e. 2017/2018, it becomes apparent that the group of excelling students (A) increases and that of struggling students (D) decrease significantly.

It is also clear that more learners have improved their performance above 50% and a large group is in the category of excellent performing students (group A). A result driven curriculum execution T&L method process developed has improved student performance gradually and increased the number of excelling students. In general the student success rates has been increased and performance improved for a large number of learners for about +25% (Figure 4).

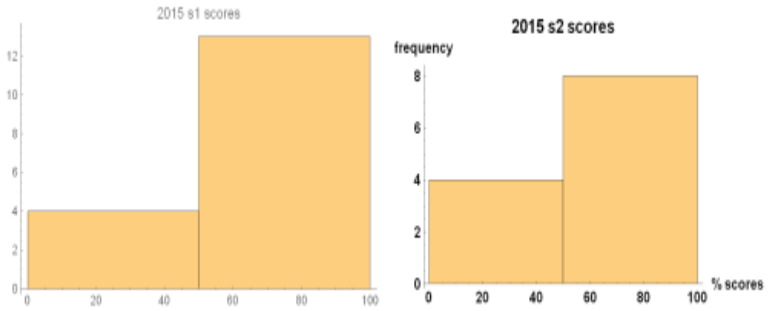

Figure 2: Assessment Performance results at the beginning of the Program

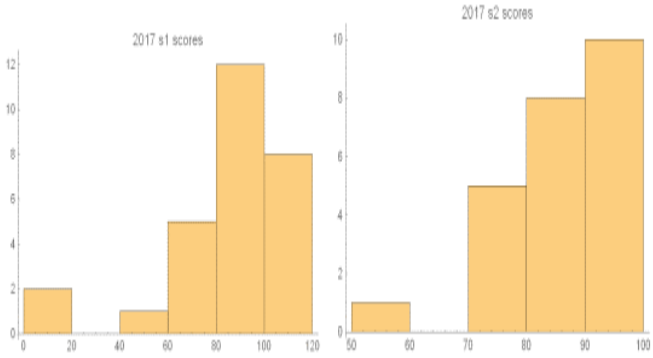

Figure 3: Assessment Performance Improvement in second year of the program

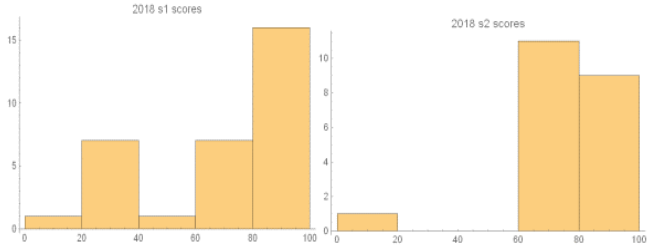

Figure 4: Assessment Performance Improvement in the 4th year of the program

Some of the key aspects of learning emanating from the implementation of a results driven curriculum are:
Learning can be seen to occur in four domains (eg. Bloom et al, 1956 and others): cognitive (knowledge and intellectual skills), affective (feelings and attitudes), interpersonal (behavior and relationships with others) and psychomotor (physical skills). Individuals can be seen to have different learning styles and so courses should be designed with a variety of learning (and teaching) methods.

Learners need to be treated as people and there should be opportunities for them to make contributions which are valued by teachers. Effective learning is active – people learn best when they are engaged in an active process and learning has to be relevant to learners' own experience and needs and to be set within a clear context or framework. Relevance applies at a variety of levels: to the overall structure of the course or subject or to the use of particular technology. Learning outcomes or objectives help learners to learn because they define what the learner has to do, the outcomes should be explicit and clearly linked to delivery and assessment. Effective learning needs to be done in a safe environment. Learning is not always easy and learners must feel comfortable and able to make mistakes. Feedback should be constructive and timely.

6. Conclusion

One of the most influential approaches to engineering education has been problem-based learning (PBL) as developed by Barrows, Harden and others. PBL aims to stimulate students to observe, think, define, study, analyze, synthesize and evaluate a problem. The problems or cases are written to simulate real life engineering problems which are multidimensional, and which encourage students to think as they would in real life industry situations. Digital game-based learning and Robotics and AI strategies have so far produced good results, thus should be part of EE programs in Universities of Technology. Therefore, the results driven curriculum execution process of teaching and learning is different from the common and general method because it focuses on helping students to develop a higher level of comprehension of subject matter content. Thus, it remedies T&L problems and responds to the questions, where do most curriculum programs fall short? Therefore, the innovation implemented confirms that it is no more possible to

treat all students in the proliferating range of e-learning users with very different prior knowledge, backgrounds, learning styles, interests and preferences, with the one-size-fits-all approach.

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