Improving Digital Game-based Learning Assessment to Acquire High-Order Thinking Skills Using Bloom's Taxonomy

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Abstract

The 21st century skills require learners to master high-order thinking skills (HOTS). High-order thinking is a cognitive process that involves a complex understanding of information beyond just memorizing and recalling. It covers complex problem-solving, critical thinking, generating new information, and synthesizing it. Traditional methods are known to induce test anxiety and ignore the learner's thinking processes. This low-order process of memorizing and understanding information is decontextualized and does not lead to deep knowledge. Student assessment should not only be concerned with what students know but rather what they can do with the knowledge they have acquired. These needed skills can be developed and improved through practical models such as game-based learning. Games can ensure HOTS; however, it is uncertain how they assess and evaluate learner performance. Initially, students were given a test before and after game play to gauge how much they knew before and after learning. To assess HOTS we need robust assessment mechanisms embedded within game applications to measure performance throughout gameplay. Therefore, research needs to explore how HOTS is measured in pedagogical games. The ability of games to quantify data for scoring cannot be doubted, however little is known particularly in the context of grading, results analysis, and implementing assessment strategies. Empirical studies are still lacking. We reviewed digital game-based learning assessment's (DGBLA) capacity to evaluate and improve high-order thinking. Authoritative databases were analyzed and compared, Web of Science and Scopus emerged best, giving 32 literature sources. The study found that game assessment structured through Bloom's Taxonomy improves HOTS.

Keywords: game-based learning assessment, high-order thinking, bloom's taxonomy

1. Introduction

Traditional teaching assessment is centered around the use of tests and standardized examinations that encourage low-order thinking. They are criticized for causing test anxiety and ignoring the learner's thinking process. In the context of education, the cognitive process can be at a high or lower level depending on the severity of mental engagement and complexity throughout the learning. At the lower level, learners just memorize and simply recall and comprehend information while the elevated level goes beyond that to include complex problem-solving, critical thinking, and creative analysis. A combination of the two forms effective learning as the second one builds on top of the first one. There are several types of learning, and some require more cognitive processes than others [15]. As a result, traditional methods are subject to biases. Researchers are working hard to incorporate games into education as they are known to address shortcomings of traditional style, however, there is little systematic review in terms of student assessment. Adaptive contemporary game-based learning came in to encourage high-order thinking [22], however, it remains a challenge as to how game-based assessment is done. DGBLA is an evaluative process of measuring how much a learner has acquired from playing a pedagogical game. We aim to systematically review the literature on Digital game-based assessment with the following research questions:

- Are educational games effective for teaching desired course content?
- Can they assess students and assist struggling ones?
- Can they improve learners' high-order thinking skills?

Despite the numerous forms of assessing DGBL, pretest and post-test assessment were commonly used, where a player was given a test before and after playing an educational game to assess how much they have learned. Alternatively, assessment is embedded within an educational game itself, which saves time and other resources as evaluation occurs during learning. Embedded assessment therefore required game models to be capacitated enough to track and evaluate high-order thinking throughout gameplay. As a result, developers need to be aware of how to embed assessment mechanisms within the game to assess their mental engagement and it is for this reason that most educational learning models are

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struggling to achieve their mandate of teaching as they lack proper assessment from design to implementation.

2. Literature Review

In high order, a learner is assessed on their ability to apply the acquired knowledge, make relationships between ideas, and concepts and make informed decisions. This involves solving a problem, analyzing complex queries, and real-world problems, and justifying arguments. Cognitive mental engagement, which means processing a task at hand is a key component that guides success. It therefore calls for more than simple basic mental operations to complex knowledge comprehension [8]. In today's learning mode, promoting high-order thinking is mandatory as it ensures a deeper understanding of course materials and prepares learners for practical real-world issues. Traditionally, core strategies such as open-ended discussions, critical thinking exercises, and problem-based learning were used, however, enough literature review has not been covered in terms of learner assessment from a perspective of game-based learning. This learning paradigm has a positive connection with success in real-world life, academic success, or at the workplace. It is important to think at an elevated level to make informed decisions and provide innovative ideas. Learners show more interest when provided with interactive modes rather than just formative ones [10], [31]. Activities such as solving a puzzle, debating, conducting research, and narrative storytelling are some high-order thinking tasks. Therefore, playing educational games fosters strategizing, and problem-solving and encourages high-order thinking. Critical thinking is a core component of HOTS but nearly impossible to measure using paper-pencil tests [30].

The use of games as compared to lecture-based instruction significantly improves learners' high-order cognition and therefore games must be designed for high-order engagements that go beyond remembering and understanding [25]. The use of game-based elements to evaluate learner skills is more effective, more engaging, interactive provides timely feedback, and can handle many users. However, this comes alongside drawbacks such as difficulty in designing such models and lack of understanding of how to implement the model by developers. The cognitive process of producing, observing, and managing knowledge encompasses thinking skills. Therefore, thinking is a mental activity that makes decisions toward solving a problem with the acquired information and experiences. Games need to be embedded with engaging and challenging assessment mechanisms and this can be achieved through complex combat, where game models challenge the learner to solve a problem, or are requested to provide multiple solutions to problems, then creatively engage to a certain level, and provide feedback which can identify areas of weakness and strengths to aid high-level thinking or given collaborative games where there is combat against more than one player. Minecraft games support high-level thinking and challenge learners to design and build complex structures or challenges. Embedded with the right level of challenge, not too hard or low to avoid frustrating users, engagement at the right level, optimal feedback, and alignment to course content are key components to consider when assessing an educational game model's ability to train and assess. Modern learning requires interactive embedded and competitive performance evaluation measures accessible to both learners and instructors [7].

Since high-order thinking skills are the expanded use of the mind to think more deeply, productively, and effectively, it is a key goal to today’s learning style, serious games implementing it are the best tool to use [22]. Games are good for the development of thinking skills however some components need to be aligned with pedagogy. Balancing curriculum and game structures is vital. Students need high-order thinking to address complex and challenging tasks. Even though game-based learning continuously evolves, learning assessment within games has been neglected [17]. Scoring and measuring performance is a crucial part of most pedagogical games and such game models generating output that be used as assessment tools have been available but not used. These frameworks can provide a practical, cost-effective, and innovative assessment methodology but the reasons for their underutilization remain unknown. The most important aspect of game-based assessment is its ability to evaluate skills that are increasingly essential for complex learning beyond just memorizing. Some of these skills were impossible to measure without virtual models e.g., where there is cooperation, or communication of learning players, and actions needed to be coordinated were difficult to handle with traditional format [15]. Games bring together analysis skills, evaluation, creativity, problem-solving, and communication evaluated into one goal. With immediate reward mechanisms, this is an indispensable mode of assessment in the learning field. Assessing high-order thinking is an important task that remains a prominent challenge [29]. Traditionally assessment components comprised of multiple-choice questions, essays, or written and oral examinations which have been largely criticized for their inability to assess critical thinking, collaboration, and creativity therefore they remained controversial. Without proper assessment, these important skills were neglected, despite learning platforms being heavily reliant on quantifiable results. Simulated assessment and educational games

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demonstrated a much higher capacity to handle the pressure of evaluating high-order thinking. This is much more suitable as interactive models connected or embedded with assessment strategies can demonstrate, expand, and provide feedback in high-order thinking paradigms.[22] emphasize that DGBLA is still new but offers high rewards in terms of developing and measuring higher-order thinking skills. As a result, some critical areas need to be prioritized to increase the ability to evaluate, and such include data collection and analysis throughout gameplay. Algorithms must be coded such that they can personalize how performance evaluation is overseen. This means assessment components integrated within games must be adaptive [32]. It is hard to measure such skills with a pen and paper [30]. Even so, then, we need to find the right ways of effectively assessing learners' performance, therefore Bloom's Taxonomy explores the cognitive process involved in deep learning, as such diverting levels of taxonomies to technology-based learning models as it was done with the traditional form of pen and paper is mandatory [27]. Though there is enough literature supporting the value of formative assessment [1], we cannot say the same with game-based assessment. Implementing this idea is a complex task. In today's information age, dependency on technology is notable and influences the learning system [2], the 4th industrial revolution, past the COVID-19 era, remarkably transformed the way we live and learn. Game learning compels creative learning, motivates students, and provides opportunities to explore innovative content. As this improves high-order thinking, it can only be possible to gauge performance if there are some proper assessments in place. When learners are exposed to the engaging, motivating, and interactive high-order thinking skills of Bloom's, they grasp the content, understand it to a deeper level, and can apply learned concepts in the real world [12], [13], [20].

3. Game Assessment

Effectively assessing practical skills is a challenge, it is difficult to evaluate these skills without compromising the quality of the assessment strategy. In [6] research was performed comparing the traditional style against game-based learning, a group of 28 master students was randomly assigned into two groups. The results indicated that those in the game-based learning group significantly performed better than the ones with the traditional approach. The feedback mechanism, practicality, and oral defense were better achieved with technology-based teaching and assessment rather than non-technological approaches. Digital learning methods such as video games have a high potential to improve learners' cognitive skills [5], however, this brings psychosocial difficulties [11].

Embedded assessment within educational games is a complex task that needs careful consideration. The assessment metrics, instructions, or learning evaluation are woven into algorithms such that they can gather data, track changes, and measure performance without interrupting the gameplay. Several core components need to be included. Firstly, the learning outcomes must be identified properly for inclusion. Secondly, the relevant strategies should be carefully employed, they include an embedded quiz, essays, or open-ended questions simulated such that they can help aid learning. Then the alignment between game design and learning objectives should be challenging and still be achievable to enable practical demonstration. The data collected from embedded assessments will track, evaluate, and score learner's performance. That can also be used for feedback provision. Educational games with embedded assessment need engaging questions, multiple choice, or elements of competition simulated properly into a game model. These simulation games provide an incredibly effective way of practically demonstrating problem-solving and decision-making skills. Students' creativity and imagination will involve a situation where the latest information is produced such as narrating a story based on originality. Though game-based learning is not a replacement for traditional methods, it provides an alternative complementary mode of assessing. As a result, we need to make sure their assessment mechanisms are robust, authentic, and relevant, provide feedback properly, and where relevant, help improve the model themselves. Well-designed digital games promote and enhance constructive interplay through various forms of assessment and practical interaction inherent in pedagogy games. This may be through NPCs' behaviors, and challenging educational combats leading to a summative assessment to evaluate the player's performance. The collected data throughout the play is specifically used for measuring and certifying the capacity of the learners in harnessing HOTS. There is continuous feedback provision which is an exceptionally valuable tool for informing the player to adjust their attack response thereby enhancing their learning and thus the basis for assessment. Game elements and mechanics practically underpin DGBA, transforming the traditional style into a more adaptive practical playful learning experience [4].

3.1. High-Order Thinking Through Bloom's Taxonomy

Bloom's Taxonomy is a hierarchical order or classification of cognitive skills that is used to structure assessments, lessons, and learning outcomes. Bloom's Taxonomy as a teaching and assessment framework is an effective way of

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structuring lesson plans, curricula, or educational processes [26]. It indicates areas of assessment to content-based learning, however diverting all these benefits to game-based learning means developing algorithms such that they can evaluate and measure conceptual knowledge, and factual and procedural knowledge as per the 6 core levels of taxonomy. This means being able to gauge how much acquired knowledge is relevant to complete a particular task by mapping that to the taxonomy. Conceptual knowledge involves theorems, structures, and models, while factual deals with core facts and procedural knowledge handles understanding interrelationships, applying the learned information, and producing innovative ideas. Developing and embedding intelligent algorithms that can track performance within an educational game is a big breakthrough in the learning sector. Additionally, the learner needs to understand their cognitive capabilities and how to improve, that is thinking about how to think in learning. A robust model with features of assessments embedded within will be able to assess HOTS. Thinking levels differ according to various course types [28], assessment is an important performance measure that student can use to explore their thinking skills. The quality of assessment systems fills the gap between learning and achieving outcomes. Students learn in numerous ways, and they understand the concepts better when they can connect to learning on a deeper level. HOTS is an advanced level of cognitive thinking that pushes learners beyond just memorizing information. When learners understand at an elevated level, they can evaluate, critique, and use the learned information to develop innovative ideas, building on previous knowledge from low-level thinking. Academic success is dependent on high-order thinking and there is a strong connection to Bloom's Taxonomy. It covers the assessment strategy in terms of memorizing, understanding, applying, and creating. Therefore, it can be the perfect tool to aid content creation, assessment, and addition of cognitive activities to pedagogy, and as a result tracking and scoring this process is an advantage to assessing. Teachers create better assessment materials using Bloom's Taxonomy which leads to the acquisition of higher thinking skills. The failure of students has been attributed to their inability to cognitively process the curriculum as expected by their trainers. The cognitive functional category of Bloom's taxonomy encompasses knowledge, application, comprehension, evaluation, analysis, and synthesis. These are the basic cognitive areas of concern leading towards understanding to a deeper level. Practically applying them to the game-based learning paradigm is a big breakthrough for skills in both teaching and assessment [17], [20], [26]. Bloom's Taxonomy is a classification framework by Benjamin Bloom, it plays a vital role in learner assessment. It helps design learning materials and challenging assessments at all levels of thinking. A very robust tool for improving HOTS, incorporated within game learning will ensure a powerful assessment mechanism. It can be used in a variety of areas such as multiple choice, short answer questions, essays and projects therefore aligning digital assessment to this framework carries more benefits. To apply it to game-based learning we must ensure the following are kept in consideration:

- **Alignment:** game mechanisms, and assessment must align with learning outcomes
- **Clarity:** DGBA should be understandable and clear
- **Authentic:** practical, relevant components
- **Diverse:** should cover taxonomy levels

The entire DGBA must be able to assess the ability to understand, remember, analyze, apply, evaluate, and create the latest content. Assessment should assess all levels of thinking. To avoid any learners thinking at a lower level, Bloom's taxonomy should be incorporated into the assessment. The purpose of game-based learning is to encourage the adoption of new skills and build knowledge to achieve HOTS [19].

Conceptualizing gamification through Bloom's taxonomy encourages learners to apply a deeper level of cognitive thinking. By applying it in DGBA we can measure the complete thinking capacity of learners and help them where necessary. Game-based learning is a practical mode of learning therefore embedding this taxonomy in a game is an indispensable tool in the learning field. This is the best strategy to use. Gamifying curriculum through this taxonomy positively connects to both high and low-level thinking at various levels. Based on this approach all the affected stakeholders will benefit; be it students, trainers, game developers, or course developers. Mostly non-player characters (NPCs) are responsible for managing the logic behind the game models and if professionally trained this can bring the best in a student’s performance. It is on this premise that we argue that incorporating these three concepts; game learning, Bloom's taxonomy, and high-order thinking far outweighs the benefits of the traditional style in assessing learner performance. This is because technology-based models are adaptive, fast, secure, and available throughout which in turn benefits all users at any time. The application of assessment in game contexts encompasses embedding evaluation metrics into the game setting [17], [29], this should easily evaluate learner performance from a pedagogical point of view.

In the gaming design, the objective as well as the Outcomes play a significant role because this is what

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learners/players must do. As such knowledge is acquired through the process and outcome. This further means the process of playing a game, reflecting on the play, and the outcome the learner gets are mandatory. From a perspective of pedagogy, that means instructors concentrate mainly on what happened which forms the process of gameplay, while the learner's interest centers around winning (the outcome) In between the two it is critical to ensure reflection to help aid the player learner to understand the main purpose of the game combat as instructional teaching models. The question to be answered is "Can the game mechanic that promotes such learning be cataloged"[18]. This is because teachers do not only depend on 1 type of teaching but a combination of many [23], [24]. As a result, a successful model must be interoperable. In Bloom's Taxonomy skills are categorized from low to high order and adapting them to game mechanics means fitting the game design context to education through levels of taxonomy. According to [21] cognitive process development is enhanced by learning activities that are designed based on Bloom's taxonomy, learning must be measurable [16], and practical skills are important. For example, the remembering taxonomy be adapted to the game rules, recalling, and memorizing the game information or description. Understanding taxonomy: adapted to game mechanics operates, comprehends, and interacts. The: Apply: taxonomy be adapted to strategy, challenges, and making decisions. The Analysis: taxonomy to game statistics, optimization, and approximation techniques. The evaluation component is the core of the assessment. The creating level of taxonomy goes to the generation of game content, feedback, and levels. The cause-and-effect relationship helps game developers to produce a game that motivates, engages, and challenges the learner's minds at various levels.

High-order thinking involves critical, analytical, and creative thinking, it goes beyond the low-order approach of just memorizing and recalling information. It can be developed through practice, and it helps one to learn new things, make informed decisions, produce arguments, and defend one's position. Criteria-based criticism which calls for differentiating simple theorems, and fiction, improved to more complex synthesized, evaluated, and communicated facts makes it more possible to reach an informed decision. It is the backbone of strong education. So well-designed game models must conform to learning objectives, assessments, and content as outlined in the structure shown below in Figure 1. The application of Bloom's educational model for learning, which illustrates the incorporation of the instructional process of DGBA and how it leads to deep learning is the best solution.

The learning objectives encompass the number of skills, knowledge, and abilities to be demonstrated by the students after learning, then how that amount of learning will be measured refers to assessment while content is the tasks or activities that helped sharpen those learner skills. Figure 2 below denotes the relation between these core concepts.

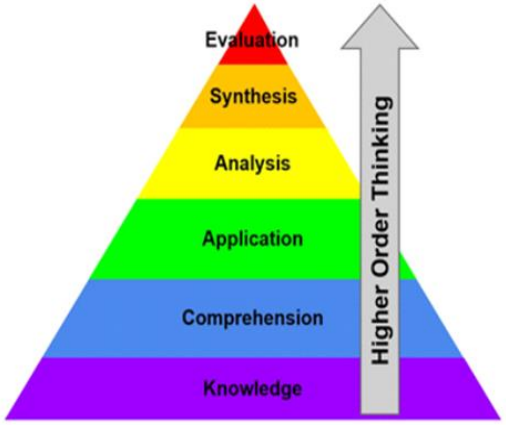

Figure 1. Bloom's Taxonomy [33]

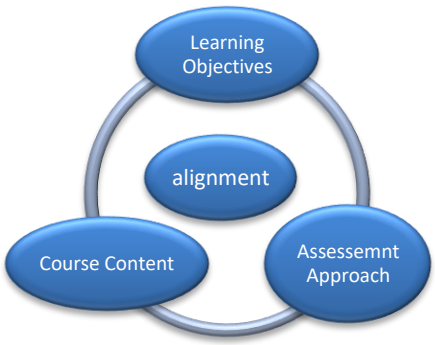

Figure 2. Learning Assessment Structure

Tremendous improvement has been recorded in education concerning the adoption of pedagogical mediums that nurture deep learning. The importance of deep learning in education does not need to be overemphasized and its close connection to high-order thinking is vital. Activities that bring critical thinking, and rational decision-making are powerful learning environments, they simulate real-world issues and new ways of disseminating constructive knowledge. As a result, connecting this constructive paradigm of learning and assessment to Bloom's Taxonomy carries immersive benefits. According to [14], there is a lack of framework for designing real-world models such as serious games that support and enhance deep learning. Additionally, finding a way to evaluate that same framework is an indispensable benefit. Assessment approaches as indicated above must align with content and objectives. A simulated assessment provides authentic and valid performance evaluation; therefore, they are better than traditional pencil and paper [9], [17], and digital game-based

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assessment solves several problems of the traditional style which includes test anxiety and rigging [3]. There is a correlation between Bloom's Taxonomy, difficulty of assessment, and the pass rate, therefore a game-based assessment framework that guides institutions on how to evaluate the learner's cognitive levels at different stages is needed [7].

Game-based learning ensures high-order thinking through numerous ways such as collaboration, active learning, problem-solving, critical analysis, and creative thinking. These strategies foster learning mechanisms that benefit learners by reflecting on the processes, making a connection between various concepts, and applying the learned knowledge as outlined below:

Problem-Solving: Games present educational combats through non-player characters, which trigger learners to solve a problem before progressing to the next level of play, thus improving their high-order problem-solving skills.

Creative Thinking: Encourages thinking outside the box as it provides learners with the opportunity to explore multiple solutions to challenges and come up with new ideas that bring innovation.

Teamwork: It ensures collaboration, where learners work together towards a common solution or against each other, this can be between learners and NPCs. Teamwork and communication skills improve as well.

Critical Thinking: Complex decision-making requires informed knowledge to succeed, this means the need to evaluate large volumes of data and discern the most appropriate. It is a critical aspect of game-based learning.

All this enables deeper understanding, as learner knowledge is applied, helps identify learners' weaknesses and strengths, and evaluates and compares concepts thus improving cognitive skills.

4. Methodology

Authoritative databases such as Scopus, web of Science, IEEE Xplore, Science Direct, JSTOR, ACM Digital Library, and ERIC were systematically evaluated for selection.

Table 1. Database Comparison

	Authoritative with relevant citation	**Multidisciplinary**	**Index citation**	**Powerful search**	**Coverage**
Scopus	Exceptionally good	Exceptionally good	Good Journal citation	Good search mechanism	Large coverage
Web of Science	Very Good	Exceptionally good	Reputable citation and indexing	Good search mechanisms	Large coverage but not more than Scopus
IEEE Xplore	Authoritative in Technology	Engineering, technology, computer science	engineering and technology	searchable	Wide coverage in computers
Computers and Education	Reputable in technology, Games	Technology education, games	Computer education	Good in computer education	New Findings on Computer educations
Science Direct	Incredibly good	physical, health science	Good indexing	good search filter	Highly cited articles
JSTOR	social sciences	Humanities, natural science	Not primarily a citation database	Advanced search	Multidisciplinary

It is noted that different databases have their fields, the Web of Science and Scopus emerged as the most authoritative ones, with multidisciplinary coverage and Google Scholar search as the best search engine. They provide citation indexing better as compared to others and offer comprehensive coverage, varying content, and several search options and features. They offer more advantages as outlined in the above table. In terms of content and coverage, they reach a wide spectrum. Scopus provides more intuitive search interfaces while Web of Science has simple straightforward search mechanisms with filters. Search with keywords or authors is simple and citations can be exported. They both met the required systematic literature requirements for retrieving data, but the Web of Science is preferred as it offers additional easy-to-use features.

4.1. Literature Search: Database

A total of over 4100 sources were retrieved from the Web of Science and Scopus database, screened using a selection process for the most applicable, and the number then went down to 2200.

1. Search Terms related to Digital Game-based Learning Assessment - Used search terms: “pedagogical game-based assessment” OR” game-based learning assessment” OR “digital game-based learning assessment” OR “game

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learning assessment" OR "educational game-based learning assessment" OR "In some situations, assessment and evaluation were used interchangeably to mean the same thing or combined using the "AND" operator.

2. Search Terms related to High Order Thinking - High-order thinking search terms used in isolation or combined with Bloom's Technology were used. Additionally, the two phrases were interconnected using the logical And, OR.
3. Search Terms 1 and Search Term 2 - Concatenating the first search term and the second search term using the "AND" operator returned only twenty results. For example: "educational game-based learning assessment and High order thinking" Sources reviewed by titles, abstract, keywords, relevance, citation, and references shortlisted down to 13. This is an indication that little has been done in terms of the two concepts jointly.

Table 2. Selection Criteria: Inclusion and Exclusion

Inclusion criteria	**Exclusion Criteria**
Literature sources in the fields of game-based learning assessment, HOTS, and Bloom taxonomy	general sources on game-based learning, HOTS, or Bloom's Taxonomy in isolation, with no relationship between concepts
Empirical study /Literature review papers specifically in improving assessment in digital games	sources not specifically to improve assessment e.g., game-based learning appreciated but not how they assess
search retrieval in alignment with keywords/ search terms	Web of Science selects matching terms leaving irrelevant ones.
Highly cited papers., peer-reviewed, sorted by relevance, filtered	Despite meeting the criteria, were not highly cited or peer-reviewed

The search terms were aligned to search results, the research targeted mainly recent publications. The target was that 80% should have been published within the past 5 years, the other 15% at least the past 10 years, and the remaining 5% over 10 years or more. This is to ensure more current, recent findings and theories. It has been noted that especially from a technological perspective, the information changes at a very fast rate, there are new findings, and some problems might already have been answered and published in other databases.

Advance Search with a Query Builder

This is a powerful search utility that enables complex and precise processes. It allowed the use of Boolean Operators; **OR**-returned the results where any of the searches is true, **AND**-where all search words are true while **NOT**-returned those without the search term. Additionally, the search for early access and enriched cited references narrowed down the outcomes.

5. Findings

In the case where concatenation used the two search terms "DGBA" and "HOTS", the returned results narrowed down to only thirty-two sources, which when screened through the inclusions and exclusion criteria the number went down to less than 50% of the initial sources. Additionally, from the remaining almost half of them did not specifically talk about assessment, and as a result, only less than 8 remained from at least fifteen. The study found that there was enough literature related to digital game-based assessment, as searched through keywords such as pedagogical game-based assessment or game learning assessment. However, the number goes down when soliciting those who relate game assessment to the evaluation of high-order thinking. The results further indicate that when applying the concepts of Bloom's Taxonomy as a way of aiding the game mechanics to ensure HOTS, there were very few data sources.

Less entertaining educational games are frequently used while too challenging ones leave learners less interested and less motivated which means mainly users are looking for learning models with balanced challenges. Though traditional assessments are controversial and difficult to quantify critical areas such as collaboration, and communication, educational games are not yet fit to replace traditional learning. As such game learning is better used as a complementary mode of learning. Digital game-based learning assessment is still at its infant stage, it has the potential to measure high-order thinking skills.

6. Discussion

The analysis of the literature contents revealed that the application of Bloom's Taxonomy led to a high-order structure. This is because taxonomy helps structure the development life cycle of game design

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from inception to deployment. There is a relationship between various levels of taxonomy to the game levels which in turn aid assessment towards ensuring effective teaching and assessment and improve high order thinking. Effectively assessing HOTS through game learning is achievable when the cognitive skills assessment is rooted in Bloom's Taxonomy. There must be a balanced relationship between these three concepts: HOTS, game assessment, and Bloom's Taxonomy. This is made possible by ensuring that there is alignment, clarity, authenticity, and diversity. Conceptualizing Bloom's Taxonomy through game simulation brings alongside the automatic adoption of HOTS. NPCs designed and woven into Bloom's framework effectively gauge learners' attainment at various levels. From the various levels of Taxonomy arranged in order, the remembering levels can be mapped to rules, understanding mapped to how game mechanics operate, the application level be aligned to game challenges and strategies, analysis be mapped to game statistics, evaluation to assessment as the core component.

7. Conclusion

The assessment component in educational games has been neglected, yet they can collect and quantify data. Throughout game learning the output retrieved can be used to assess learner skills and knowledge. At the core of the learning paradigm is Bloom's taxonomy, a framework that denotes a classification of cognitive abilities necessary for studying pedagogical concepts such that they can reach high-order thinking. HOTS involves deep understanding, beyond just memorizing and recalling, it goes to problem-solving, critical thinking, and creating the latest information. Therefore, aligning the performance collection and scoring by game mechanics to levels of taxonomies is an indispensable mode of assessment in game-based learning. This positively connects with learners' practical skills and reduces the need to rely on traditional platforms as they are too laborious, error-prone, and ineffective despite today's technological advancement. Therefore, pedagogical assessment for order thinking can be revolutionized through Bloom's Taxonomy. This eliminates the drawbacks of low-order thinking as they are prone to cause test anxiety, ignore key components to be assessed, and are ineffective. Finally, we can confidently say Improving Digital Game-based Learning Assessment to Acquire High-Order Thinking Skills Using Bloom's Taxonomy is the best solution.

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