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Gamification in Education through Stealth Assessments

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Abstract

Games play a very important role in promoting incidental learning and help in exploring both the conscious and subconscious processes such as insight of a learner. Digital Game-Based Learning and assessments are now an integral part of educational practices. When designed effectively digital games can take the learners from the stage of improvisation to a meta-reflection where they can apply the gained competencies/skills to real life situations. Increasing penetration of ICT into education and the disruptive educational technologies are making it possible not only to innovate but also to implement more and more exemplar teaching-learning pedagogies and assessment tools. Such innovations will shift the teaching-learning process from a rote learning process to an inclusive and individualized/personalized process. When developed properly, digital games can assess both procedural knowledge and declarative knowledge of the learners. One such technique of using digital games for assessment is stealth assessment (SA). They help in helps in assessing higher order thinking skills of students accurately and efficiently. SA adopts the approach of competency-based learning, where on the basis of performance of learners in the game their

competencies are easily identified and are provided further tasks accordingly. The paper also discusses the challenges in development and implementation of SAs.

Keywords: Teaching-learning, Digital Games, Assessment, Artificial intelligence, multi-disciplinary approach

Introduction

An industrial revolution is always characterized by a paradigm shift in hitherto routine tasks and creates a turning point in various aspects of life, whether in society, economy or philosophy. The 3IR (Industrial Revolution) known as digital revolution played a vital role in the emergence of 4IR which is characterized by artificial intelligence and Machine Learning. Thus, 4IR believes in the philosophy of integration of machines and processes amicably into the digital, physical and biological worlds. As with many other fields, the 4IR is also going to show tremendous and powerful impact on education. New technologies involving artificial intelligence, machine learning, block chains, smart boards, handheld computing devices etc. are already gaining importance in education. The impact of all these disruptive technologies is visible in the topmost agendas of the first Education Policy of the 21st Century of India (MHRD, 2020). The policy stresses the core principles that education must develop and, reiterates that education should develop foundational, higher order thinking, social and emotional skills among students. It lays emphasis that educational practices should nurture the unique qualities of each student by providing them flexibility in the paths of learning as per their talents and interests.

One of the critical criticisms on education system all over the world is that it is preparing the students for survival in a system that will die before they get into it. Our education system, which has not yet fully adapted to earlier generations of industrial revolution has already entered into IR 4.0. 4IR is characterized by features where the machines will perform almost all the routine

tasks and individual are meant only for intellectual and creative tasks. In such a world, we require individuals capable of exercising critical judgment and navigating unfamiliar environments adeptly and "have the future in their bones" (Snow, 1959). Thus, educational practices for Education 4.0 should make students "cope-able" to adapt at a faster rate to the continual changes happening around them. They should be able to project the "assumed future".

Moving towards education 4.0 Advancing into Education 4.0 entails reshaping organizational structures, overhauling curricula, and fostering a heightened focus on the future. Education 4.0 indicates that it is time to bring enormous changes in classroom pedagogies. Toffler (1970) said "experiential programming methods, drawn from recreation, entertainment and industry, developed by the psych-corps of tomorrow, will supplant the familiar, frequently brain-draining lecture" which is clearly visible in the present education system. The five building blocks on which the Education 4.0 would build upon are "curriculum, content, capacity, community and digital interventions" (Gupta, 2022). To take advantage of this, teaching-learning must shift from rote learning to inclusive, individualized/personalized. The assessments must shift from memory based to skill based. Therefore, it is high time to introduce new pedagogies which can guide the students to learn, unlearn and relearn. Going in tune with 4IR, the National Education Policy (NEP), 2020 (MHRD, 2020) recommends the use of games and gamification as an innovative pedagogical approach in teaching-learning and assessment. Games play an important role in promoting incidental learning and help in exploring both the conscious elements (ex:- processing information, constructing metal models) and subconscious processes such as insight of a learner. Gamification can be a very useful tool for teaching-learning, can increase learners' motivation and turn learning into an enjoyable process (Bose, Philip, Joseph & Abraham, 2024).

Games, when designed effectively can take the learners from the stage of improvisation to a meta-reflective stage where they can apply the gained competencies/skills to real life situations. They can inform about students' attributes, their on-task or off-task behaviors, competency development related to the targeted subject matter etc. and thus can help in developing customized learning support systems (Ke & Shute, 2015). In the era of ICT, the use of games especially Digital Games (DG) in teaching-learning and assessment is increasing.

Digital Games in Teaching-Learning

The use of digital games in education will help in adopting competency-based teaching learning approaches and can develop both cognitive and non-cognitive skills of students. Usually when someone plays a game, loses self-consciousness, sense of time, and engage in complex, goal-directed activity not for external rewards, but simply to satisfy intrinsic desires and hence use of digital games can increase the learning of the learners. Digital games can make learning meaningful and joyful; they can help in acquisition of concepts in an engaging way and make it possible to provide immersive learning experiences to the learners. Thus, gamification or gamified learning as an educational pedagogy can make it possible to include game elements in the learning environment. Games in general and digital games in particular have various elements like conflict/challenge; rules, goals/outcomes to achieve, continuous and immediate feedback, intra and inter interactions, multiple solutions etc. which almost match with good instructional design and hence they can be used effectively in teaching learning and assessment process. Digital games used in education can be of various forms like role-playing, puzzles, simulations, quizzes, and massively multiplayer online games (CBSE, 2019). However, one should keep in mind that the digital games created for learning are different from those created for commercial purposes.

Presently two approaches are being adopted in integrating the DGBL (Digital Game Based Learning) in education. One is to use the existing commercial games and the other is to design customized games as per the learning outcomes to be achieved (Homer et al., 2018; Huang, 2011; Kebritchi et al., 2010; Yang, 2012). The games customized as per the learning outcomes can better satisfy the course needs and such games can also be used for assessment purposes. DGBL makes it possible to build multimodal environment in teaching, learning and assessment where the learners can be exposed to the content using various media like text, pictures, music, animation, audio, writing etc. and such environment can reduce the extraneous cognitive loads (Khalil et al., 2005). Digital games have been found beneficial for both students and teachers. Its Integration makes learning easy, attractive, interesting, challenging, flexible, effective, and enjoyable (NCERT, 2021). Different types of digital games influence students' learning in different areas (Jan & Gaydos, 2016). Positive gaming encounters are correlated with elevated self-concept among students (Jain, Kumar, Rajput, 2024). Many experimental studies conducted using various digital games concluded that DGBL influences the academic achievement and motivation of the learners (Woo, 2014). Digital games not only help in reducing the abstractness of the concepts but also have fun elements in them. The majority of the millennial learners prefer to play digital games than outdoor games (Khakhariya, 2023) and are skillful in operating devices like tablets, computers, mobile phones, PlayStation, etc. This makes it feasible to consider DGBL as an effective pedagogical approach to make teaching learning process attractive and effective. DGBL integrates games with educational practices and provides opportunities to the learners to solve problems, take decisions, and tackle challenges to acquire higher-order skills. DG's are now being used as accurate behavioral assessment tools to measure a person's behavior directly and objectively (Marder & Polli, 2016). They help in adopting learner-centered assessment strategies

which are learning goals oriented, personalized, multimodal and include individual or group elements. Many of the games require players to use and exhibit skills like strategic and analytical thinking, problem identification and solving, decision making, adaptation to change, meaning generation, risk taking, critical judgment, nonlinear navigation etc. that are in demand in today's workforce.

Digital Games in Assessment

Quality education is the topmost agenda of almost all the educational policies of India. Education committees, commissions and policies since independence of India have recognized assessment as an ongoing process and called for fundamental reforms in the purpose, design and implementation of student's assessment (eGyanKosh, 2017). The traditional assessment practices adopted in education are often considered as detached events rarely influencing the learning of a learner and face many validity issues and need lot of improvement (Santiago et al., 2011; Shute & Ventura, 2013). Therefore, it becomes inevitable to explore and implement various alternative approaches of assessments. With decreased cost and increased portability, digital technologies and especially DGs are being considered as assessment tools for creating adaptive testing systems.

When DGs are used for assessment, assessment becomes easy and flexible and decreases the load of the teacher as well as students. Use of DGs as assessment tools make it possible to include a combination of different media and activities like still and moving images, sound and music, and speech and writing, slingshots, puzzles, quiz, role-play, simulation, and massively multiplayer online games (Shute, 2011). Aspects like the tasks to be performed, structure of the game, scope for collecting observable performance indicators, and immediacy of feedback that is provided to learners make DGs an ideal tool of assessment. When developed properly, DGs can assess both procedural knowledge and declarative knowledge of the learners. One such technique

of using DGs for assessment purpose is known as stealth assessment (SA). Many games such as Portal2, TAALES, Use Your Brainz, Oblivion, Taiga Park, World of Goo, Physics Playground (Shute & Kim, 2014; Shute et al., 2016) are already in use to assess the learners with the help of their gameplay. Light Lanes, a game developed by the NYU CREATE lab; Newton's Playground, a video game that teaches physics to students (Homer et al., 2018) are some of the well-known DGs.

Stealth Assessments

Stealth Assessment (SA) is an assessment in disguise which can measure and enhance learning in real time. The main philosophy of SA is to maximize learning without sacrificing the fun. Thus, SA blurs the line between assessment and learning and reduces test anxiety of students without jeopardizing validity and consistency of assessment. It expands the capacity of educators and helps in assessing higher order thinking skills of students accurately and efficiently.

The term 'stealth assessment' was first used by Valerie S. (Shute & Underwood, 2006; Shute et. al, 2005) to describe the automated assessment process through digital games. In SA, the learners are assessed during their digital gameplay using the data originating from the digital traces in electronic learning environments. With the help of AI based Machine Learning (ML) algorithms, the continuous stream of data that is generated as the learner keeps interacting with the game (which includes various hidden aspects like problem-solving, creativity, attention, working memory, reading comprehension, persistence, reflection, exploration etc.) is supplied as evidence and is translated into statistical models that can be analyzed further to understand the learners' competencies and skills. Thus, the relationship between observables from the gameplay and performance of the learners on competency constructs is assessed continuously and accordingly

learners are provided with appropriate new challenges as per their competency. Hence, using SAs, teachers can get immediate and in-depth feedback about actions of students, and they can be exposed to tailor made learning support systems. This approach of continually tracking progress while providing immediate automated responses using digital games has been termed 'Stealth Assessment' and is being used in educational games and simulations. SA adopts the approach of competency-based learning, where on the basis of performance of learners in the game their competencies are easily identified and they are provided further tasks accordingly. Thus, SAs can be used effectively to assess both cognitive and non-cognitive skills of students (Shute, 2011).

The best advantage of using SA is that we can assess the learner without their knowledge when they are so engaged in the gameplay. Most of us play games not for external rewards but to satisfy intrinsic desires and SA takes advantage of this to make valid inferences about what learners know what they can do, and to what degree (usually referred to as "competencies). SA is a way of uniting the two worlds of a learner i.e., what they learn in college and what they like to do best at their own i.e., playing games. SA can prove to be a very good and effective tool to improve learning. Digital games have various elements which almost match with instructional design like rules, challenges, goals, time limit, various alternatives to solve etc. and through SA we can assess such elements easily.

Elements of SA

The essence of SA as an assessment tool depends on key elements like Evidence Centered Design (ECD), machine learning (ML) algorithms (Georgiadis et al., 2019), formative assessment and feedback to support learning (Shute & Ventura, 2013; Shute, 2011). Its success lies in the extent of concrete evidence it can collect regarding the achievement of competencies of the

learners during the gameplay. For this, it is essential to have strong evidence centered designs. Development of ECD needs a multi-disciplinary approach. ECD makes use of technology, computer programming, education, and psychology to enlist the competencies needed to be developed and assessed in the learners. It applies competency learning pedagogy where a learner can be assessed continually during digital gameplay through evidence-based results. Hence, SA should be designed in such a way that it not only helps in assessment of competencies but also provides evidence based supporting claims regarding it. When developing the algorithms, ECD should consider aspects like "what competencies should be measured? How they should be measured? When they should be measured? And to what extent they should be measured". When a learner plays a game, it creates huge traces of digital data. However, the ECD used for SA should be designed in such a way that it collects only those traces which can be counted as evidence for students competency/skills learnt (Steinberg & Gitomer, 2019) and it should include about how the collected evidences should be statistically linked to variables in the competency model (Mislevy, 1994). Thus, ECD should identify the game indicators which are also known as real-world competencies that would provide evidence about students' learning in various aspects like critical thinking, problem solving, persistence, goal sustenance etc. and should also determine the kind of tasks or situations (quiz, puzzle, simulation, video etc.) that will elicit the evidence. It should engage the learners in iterative processes of the game so that meaningful evidence of learning can be collected with reliability in an objective way. The ECD with the help of ML based algorithms collects the performance data of a learner automatically and statistically gives out the findings regarding the relevant competencies developed in a learner. The data thus obtained can be used effectively for formative assessment, giving proper feedback, designing tailor made

instructional designs etc. The ECD should consider learning mechanics, game mechanics and assessment mechanics while integrating DGs in teaching, learning or assessment processes.

Basically, there are two approaches for integrating DGs as assessment tools. One is to build assessment activities into the games itself and record the actions as and when evoked by the players, and the other approach is to collect the game log files of the knowledge, skills, etc. that are being assessed and then analyze them using the ML and statistics. DGs when used for assessment should be designed based on both evidence and competencies. When a player does not achieve the pre desired achievement goals i.e., the learning outcomes, it should allow the learner to continue by replaying segments that caused a discrepancy between their performance and mastery.

Thus, determining the type of games to be used for SA, listing the competencies to be assessed, designing the activities for the same, analyzing the results given by the ML based algorithms and giving feedback and develop customized learning support systems is the task of pedagogy. On the other hand, collecting the evidence created during the game play, linking them and analyzing them using the statistics, giving the results in terms of human understandable language is the task of ML based algorithms. Hence, it is rightly said that development and use of DG's in teaching-learning and assessment requires a multidisciplinary approach.

Challenges in integrating DGBL in teaching-learning

Despite an increase in research in DGBL, due to constant questions about its efficiency, DGBL still remains less used among teachers. Development of customized digital games which can be used especially for teaching learning and assessment demands a multi-disciplinary approach. It needs the integration of knowledge from various disciplines like Education, Psychology, Technology, Neuroscience etc. and hence it becomes tough to develop such games.

Few scientists claim that video games stimulate only that regions of brain that control vision and movement and other important parts of the brain which are related to aspects like behavior, emotions etc. remain untouched and studies also experimentally proved that those who spend more time online in playing games have less gray matter (thinking part of the brain) than those who spend less time (Paturel, 2014). Hence, integration of DGBL should be preceded with strong research evidence. When the learners play digital games, it requires considerable cognitive investment from them, and they have to demonstrate many higher order thinking skills and other skills. Such an investment can cause cognitive load on them, and it can lead to early interruption or termination from the task and thus DGBL may not yield proper outcomes (Keller, 2008). If the difficulty level of digital games is not determined properly, learners may stop playing games when they are overly easy tasks and on the other hand they may get discouraged if the tasks are excessively difficult. Hence, a strong strategy to enable learners to exhibit superior performances should always be the objective of the digital games (Wang & Chen, 2010). Establishing the validity and reliability of contribution of DBGL is still in infancy stage and hence requires extensive research both on the technological as well as educational fronts.

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