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Section 3

Chapter 13 - Assesment In Videogames And Educational Apps Based Learning In Tertiary Education

Theoretical Framework

13.1: Higher Education Competencies and Computer Based Learning

Higher education focuses on preparing the graduate as a whole who would act competently and be flexible in the current work environment and in the future context which is not yet defined. In this higher education setting cognitive attributes such as critical analysis, problem solving, communication skills become important competencies as well as personality attributes and development. However despite the importance of these skills they are difficult to describe precisely and link with concrete metrics to measure the level of competence during the learning process (Blömeke, Zlatkin-Troitchanskaia, Kuhn and Fege 2013).

Higher education competencies are usually identified in collaboration with representatives from crafts, arts, trades, industry and labor unions to make sure that the skills taught at higher level studies are relevant to the current work context. Also such consultation and detailed descriptions of the competencies provide targets for teachers and students for the level of proficiency that has to be achieved.

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In this situation teachers need to develop capability to design assessment tasks that clearly specify the requirements for a unique assignment, then keep the students accountable for meeting the specified criteria and to calibrate students excellence on how they exceed the minimal specification standards (Blömeke et al., 2013).

In classical higher education studies students learning happens during the lectures (passive learning setting) and individual studies between the lectures and exams (information gathering and analysis). However, little of the practical knowledge application is possible in those two learning situations. With the growing technology enhanced learning tools higher education is expanding the learning activities to include more and more interactive situations to allow students apply the theory in a real scenarios. In addition to various media as movies, virtual learning environments, online courses, computer games stand out as a media that offers opportunity to involve students in complex virtual worlds, where all graduate competencies have to be applied to succeed, and includes ingame assessment possibilities making the measurement of learning outcomes more streamlined and objective (Lameras et al., 2017; Herro and Clark, 2016).

Some of the higher education fields most open to game based learning are business administration (Loon, Evans and Kerridge, 2015; Salas, Wildman and Piccol, 2009), engineering (Coller and Shernoff, 2014) and life sciences (Bonde et al., 2014). All these fields require students to learn fundamental laws for the discipline in order to enable students to create successful actual applications. It means that students first have to learn the abstract mathematical, chemical equations and management frameworks before they get to try what these concepts do in action. This way of learning usually goes against students expectations and interest, and decrease their engagement and motivation to learn, as well as teach them skills and concepts as a separate items neglecting the complex problems that they are applied in reality (Coller and Shernoff, 2014). Computer games on the other hand creates an immersive environment where the complex

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problem is presented first and then students have to get additional knowledge and apply it to make things work in real life simulations (Coller and Shernoff, 2014).

Computer games are also beneficial for the development of generic graduate skills and cognitive abilities. Such skills as problem solving, persistence, communication and collaboration were proven to be strengthened after playing specific video games (Shute, Ventura and Ke, 2015). One of the examples is logical puzzle game Portal 2. The goal of the game is to escape the laboratory setting, controlled by supercomputer, while going through many rooms. Every room is a logical puzzle that requires player to come up with the sequence of actions that open the door to escape the room. Player has to figure out how the tools provided to them are working. Some have explicit explanation and some don't. This game setting creates a complex problem solving situation which includes all problem solving components: rule application, problem decomposition, flexibility and resource management (Shute et al., 2015). For example, people with greater cognitive flexibility are more observant of features of an object or a problem situation, and may consider more alternatives in solving problems, than those with less cognitive flexibility (Bransford and Stein, 1984). Portal 2 require player creatively apply newly learned rules and tools in ever changing levels in order to reach the goal. Students who learn to solve problems this way are more likely to apply the same strategies in real life (Shute et al., 2015).

As the competencies developed in higher education are more complex and broader that lower levels of education, more creative, complex and interdisciplinary learning methods for representing world problems have to be used. Computer games is a media that allows to create immersive environment to simulate ubiquitous situations common in real life and develop student's cognitive skills and personality traits that define a successful graduate.

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13.2: Videogames Types And Qualities That Fit The Higher Education Profile

Computer games for higher education may be grouped into two categories based on what competencies they are most capable to develop. Some games are specifically designed to give students field or topic specific knowledge on engineering, data manipulation or business plan development and allow to practice required skills, so could be grouped under subject or competency specific computer games. The other games are more abstract regarding the direct application, and are more suitable to develop generic graduate competencies like problem solving, communication or critical thinking.

Subject or competency specific games are most used in science and engineering studies. For example, computer game that simulates protein folding is used in chemistry and biology studies to teach students the core information about proteins and rules that the folding algorithm has to follow. The game environment does not limit students to specific examples and allows them to experiment and test their hypothesis. Also, this massive multiplayer game allows collaboration and knowledge sharing among the players. Sometimes such freeplay and collaborative environment results in scientifically relevant discoveries (Khatib et al., 2011). Also similar example could be a online gaming platform for learning programming - CodeinGame. Player can build their skills by solving challenges that develops or helps to repair, complete or upgrade a videogame in their preferred programming language. In addition to that all the players are competing between each other to produce optimal solution to the problem. The platform also comes with the assessment possibility, that allows to use challenges as an assessment activity, that shows what skills the player has ad where their lack knowledge or skills. Both computer games are explorative environments that do not have predefined correct scenarios and allow students to explore and come up with creative ideas while practicing their technical skills. However, such games ensures that the competence that students develop is formed through solving complex and application based problems, and not only classroom exercises (Coller and Shernoff, 2014).

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Subject specific game types usually are simulations and experimentation games, that allow students to practice the skill and apply knowledge needed for the task completion. Such games can also be used as assessment tools, as they allow to evaluate the player choices and achievements during the game. For example, business development simulations are common learning tool in the new business administration and marketing study programs (Loon et al., 2015; Salas et al., 2009). In addition to the usual practice of skills needed to prepare a good business plan or establish and run the business itself the simulation allows to set an assessment task, with the given goal in limited time to measure students level of business knowledge application (Teach and Patel, 2007). Business simulations may seem as a good tool for the generic graduate competency development, and they are, however, the main outcome and goal of the business game is successful business concepts and process application and outcomes measured by revenue, agreements, budget and other KPIs (Key Performance Indicators). Because of this focus business simulation fall more into specific skills development group, than generic competencies group, even though it serves both sides.

Generic graduate competencies such as problem solving, communication, critical thinking and collaboration are usually an indirect result of many complex learning activities that primary goal is to teach a specific topic or skill, rather than the cognitive competence itself (Blömeke et al., 2013). Computer games that work well for generic competencies development are of various types, some are focused on the competence itself through the engaging gameplay without extra learning content within the game, some tie the competencies to a subject related game. For example, Portal 2 is a first-person puzzle-platform video game which goal is to get to the exit door in multiple rooms using a series of tools (Shute et al., 2015). Any given problem in Portal 2 requires the application of either basic rules or rules that require cognitive flexibility that is the ability to adjust prior thoughts or beliefs in response to a change in goals (Shute et al., 2015). Even though the game story and content itself is no related to any higher education subject, its gameplay develops player ability to discover the rules and application of various tools and apply the

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knowledge in complex and changing situation. Such cognitive flexibility is required in many higher education disciplines and is crucial when university knowledge has to be applied in a workplace (Allen & van der Velden, 2011).

Also, as mentioned earlier, simulation games in business and management field or any other non technical higher education subject are proved to be beneficial for cognitive skills development (Loon et al., 2015). In this type of game students have to prioritize and organise their action to balance the long and short term goals, make trade-offs and evaluate consequences. Such dynamics of the game help to improve efficiency of information processing. As indicated by engagement scores and students feedback the blended approach where video game is combined with real life discussions and meetings gives the best results (Loon et al., 2015). It is important that students not only play and make decisions on their own in the simulation environment, but also discuss the complex examples with peers and teachers and have a chance to defend their strategy and choices. This way simulation experience is strengthen through communication and reasoning in a group. As well, overall course program and topic is perceived as more engaging when combined with the simulation experience (Loon et al., 2015; Salas et al., 2009).

All in all computer games in higher education should focus on the learning subject as well as generic graduate competencies. To develop these competencies the best type of games are the ones that require higher cognitive engagement, and complex problem solving. These skills could be developed through simulations, puzzle games or collaborative multiplayer online games. The best results from game based learning in this setting would be achieved blending game experience with the student and teacher interactions and group discussions.

13.3: Game-Based Learning Assessment And Design In Higher Education

Learning with computer games is different and the traditional assessment approach that assess knowledge and skills after the activity and move on with new content does not capture well the

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new learning nature and students needs. A new performance based assessment approach is needed to make the ingame learning experience meaningful. With the game-based learning and assessment approach we are taking a few assumptions: (1) that learning by doing improves learning processes and outcomes, (2) learner progress and competencies can be verified and measured during the gameplay, (3) learner strengths and weaknesses can be identified and addressed in the game to improve performance, (4) and feedback can be used to further support the learner (Shute, Ke and Wang, 2017).

When we compare the formative assessment practices performed by teachers and their computer game design analogs (Table 1) we see that most of the evaluation tasks could be integrated into gameplay opening more space for teacher to become coach for students rather than assessor (Bauer et al., 2017). For example, the second practice where teachers elicit relevant and quality evidence of student learning on an ongoing basis to inform instruction happens in forms of written assignments, students polls, estimating student's knowledge level from classroom discussion etc. Similarly computer games use telemetry and analytics to gather and analyse information about students performance through the patterns of their successes and failures and suggest new learning actions and adjust game difficulty (Bauer et al., 2017). In the learning process like that, where formative assessment is integrated within the game, teachers are encouraged to observe and couch students along the way, supporting their deeper understanding about the topic and helping to connect the learning goals with the gameplay as well as to practice argumentation for their choices and actions in relation to the subject.

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Table 1. Formative Assessment Practices And Their Game Design Analogs (Bauer et al., 2017)

Formative Assessment Practice	**Video Game Analog**	**Connecting the Game to the Broader Learning Context**
Teachers identify and share learning expectations with the students (learning goals and progressions)	Games provide explicit challenges and goals	Game goals and challenges are connected to larger unit learning goals
Teachers elicit relevant and quality evidence of student learning on an ongoing basis to inform instruction	Games collect telemetry and use analytics to understand player behavior and structure the game experience	Evidence collected and identified in game informs instruction outside the game, and is integrated with other evidence about student learning
Teachers structure opportunities for students to take ownership of their own learning	Games create a sense of agency by providing choice and flexible pacing	Students have opportunities to reflect on their own learning both within the game and as part of the larger instructional unit
Teachers structure opportunities to activate students as instructional resources for one another	Games provide structured contexts for collaboration and sharing– multiplayer platforms	Students have opportunities to reflect with peers about their learning within the game, and to provide feedback to peers on their learning
Teachers provide feedback to move learning forward and create a structure for students to act on it	Games provide just in time feedback linked to rewards that guide players' actions	The teacher is able to provide feedback that helps students connect learning within the game to the broader instructional unit

When thinking how to integrate the assessment into the game design Stealth assessment comes as an emerging approach for seamless learner performance evaluation through the gameplay (Shute et al., 2017). Stealth assessment uses evidence based evaluation models coded into the game to gather evidence about player current level of skill or competence through their actions and choices in any given situation within the game task. As this type of assessment is invisible for

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the player it eliminates the test anxiety induced by traditional exams and evaluations. Using this method students progress could be monitored through a long time, and results have a greater reliability and validity of the assessment (Shute et al., 2017).

Stealth assessment uses an assessment design framework known as 'evidence-centered design' (Bauer et al., 2017). Assessment based on this framework support arguments about personal competencies via an evidence chain that connects the arguments with task performance (Shute et al., 2017). Teacher is an active creator of such assessment as it requires assessment designer or teacher to define inputs for three main models of evidence-centered design framework. Competency model defines what knowledge, skills and other attributes should be assessed in the game. Evidence model defines the behaviours that reveal targeted competencies and thus have to be observed; and the statistical connections between behaviours and competency model variables. Task model defines the activities and situations that would elicit the behaviours demonstrating the evidence for the proficiency on target competence. Once assessment is designed based on the three models it could be reused in multiple subjects and games. However, it is important to understand that such innovative learning and assessment approach requires interdisciplinary collaboration among teachers to develop and adapt computer games and assessments for the classroom, as it contains great amount of engineering work.

In brief, computer games bring new approach on learning assessment proposing technological tools to take manual assessment over from teacher shoulders. Stealth assessment is the most growing framework that structures the learning goals, target competencies and learning actions, then allows to embed the assessment within the game creating seamless experience for student. Teachers are key developers of the assessment structure, thus their role shifts from assessor to designer and student coach.

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13.4. Teacher Role In Computer Based Learning In Higher Education Setting

Even though technologies are entering the learning and assessment process teacher remains the key asset in learning design and execution. Assessment of higher education competencies is usually complex and subjective. In order to create an effective assessment system it requires either to train the assessors to be able to notice differences and calibrate consistently the representation of competency of a student; or educators to design assessment tasks that specify the required higher-order cognitive outcomes as well as specifications for a particular student learning product. The specifications would draw the base line that has to be met to show the required level of competence and allow the differentiation of results above the baseline (Blömeke, 2013). Once the learning behaviours and outcomes are specified the assessment could be transferred to technological solution, however, first teachers have to define the target competencies, behaviours and learning activities to demonstrate the competencies.

In the given emerging technologies environment in higher education teachers often feel the lack of time to learn new skills, research and solve technological challenges and solve logistics problems when implementing games and digital learning tools in the classroom (Bennett, Dawson, Bearman, Molloy and Boud, 2017). Education institution leadership requires to adapt efficient solutions to optimise assessment for growing number of students. Such pressure results in many pilots abandoned after the first attempt as not enough time was given for preparation and assessment design. As teachers spend a lot of time preparing the learning content there is not enough time to innovate the assessment process (Bennet et al., 2017).

However, with the games as a learning media the content design and assessment design intertwine. The only prerequisite for the integration of the game based assessment is to start planning technologies implementation early in the course design process (Bennett et al., 2017; Bauer et al., 2017). The teacher role here is to design the course content, materials and

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assessment through the game framework so that all the learning experience would be cohesive. This way it is more likely that the integrated technology will last and be accepted by students and teachers community, than adding technology on top of the traditional course structure.

Therefore teacher role in higher education could be identified as innovator and learning designer, with the flexibility and adaptation to change being the most important professional traits (Englund, Olofsson and Price, 2016). Taking time to redesign courses focusing on the technology integration may take more time in the beginning but will pay off once the manual work is taken away and more quality student coaching and meaningful support will fill the teacher everyday work.

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