

Section 3

Chapter 12 - Assessment In Videogames And Educational Apps Based Learning In Upper Secondary And Post Secondary Non-Tertiary Education

Theoretical Framework

12.1: Upper Secondary And Vocational Education Competencies And Computer Based Learning

Vocational and technical education focuses on developing skills of mainly physical, practical and concrete kind. These skills differ from the competencies in higher education in the way that they are related to specific object, rather than situation or problem. The learning context includes routine and repetitive practice for mastering the skill. Because of the clear distinction between skills and precise definition of how good looks like each skill can be measured separately with very focused assessment tasks (Blömeke, Zlatkin-Troitchanskaia, Kuhn and Fege, 2013).

Competencies in vocational education varies depending on the field. The training programmes are usually designed in close cooperation with business representatives. The programmes are linked to occupational profiles for those qualifications that are outside higher education (Ulicna, Messerer and Auringer, 2016). Programmes are evolving based on the specific skill demand in the marked. For example, with growing field of technologies the demand for professionals that are not only engineers and architects designing the new technologies but also the ones who could support and maintain the new technologies is growing. The need is reflected in growing number of vocational programs in technologies and interest from business to collaborate in preparation of the program and definition of required competencies.



Business schools that fall under vocational training umbrella represents another field of competencies taught in vocational schools. These are the skills related to marketing, costs planning, international communication, customer relationship management. (Loon, Evans, Kerridge, 2015).

One more growing field in vocational education is health care. With aging society in Europe and other countries like Japan the need for elderly care helpers and nursing assistants is growing. However, competencies expected from the graduate care helper are mainly interpersonal, based on communication and skills and focus on human wellbeing (Oeseburg, Hilberts, Roodbod, 2015). Because of the variety of the competencies developed in vocational training the learning methods and nature differs. When computer based and virtual learning becomes the everyday of technology students it is hardly applied to fields like health care which requires in person training. However, every vocational program still keeps the aspect of practical skill development. These competencies are well developed practicing them in a situational environment. Let it be a training for operating crane or making decisions in business case or patient treatment, similar type or situational computer based learning activities could be used for practicing the skills. Depending on the field of study only the amount of time dedicated for computer based learning differs, while each program may contain some learning activities carried through technologies.

12.2: Videogames Types And Qualities That Fit The Vocational Education Profile

Vocational education develops competencies that require students to demonstrate their knowledge through action or performance and create this knowledge through experience. Videogames can simulate the practical tasks and actions that students have to master as part of their education. Simulation especially using virtual or augmented reality is one of the most applicable type of computer games in respect to vocational education. (Tang, 2016).

Simulation is simplified model of reality that maintains the authenticity of real situation while minimising complexity of it (Loon et al., 2015). Simulation games opposite from traditional learning change student's role in learning from passive information consumer to more active knowledge constructor (Chen, Cheng & Huang, 2011). They learn while experimenting with simulation game, changing values, parameters, constraints and observing the outcome. In contrast to the usual computer games simulations do not include competition aspect. However, recently the hybrid of simulation and games are emerging, where simulation is enhanced by the immersive experience of the game, allowing players to make a series of decisions and experience the consequences of their choices within the realistic game story (Loon et al., 2015).

Augmented reality (AR) that blends real world and digital information can be used to create ubiquitous game-based learning environment for engineering educational such as industrial and building services engineering. For example, Building Information Modeling (BIM) software with the AR application would allow construction activities to be visualized in real time (Wang, Schyndel, Wainer, Rajus, Woodbury, 2012).

Virtual reality systems like CAVE (CAVE Automatic Virtual Environment) or Powerwall are expensive and requires a lot of physical space to be installed. Also they are limited in scalability considering the number of students that can use them at the same time. However portable solutions could be developed using Virtual reality head mounted display like Oculus rift and real time 3D rendering engine integrated into BIM software (Tang, 2016).

12.3: Game-Based Learning Assessment And Design In Upper Secondary And Vocational Education

12.3.1: Computer Game Based Learning Assessment Model

Any computer game could be classified as educational if learning assessment is incorporated into game design or game application in the classroom. Learning assessment captures the outcomes of learning process and shows to what extent student has learned content presented during the educational activity. Assessment is usually organised in two ways: as summative or formative assessment. While summative assessment provides judgement on how well student did in the end of all learning activities sequence, formative assessment focuses on the student performance in the given learning activity and provides feedback through the learning process, not only in the end of it (Spector et al., 2016).

When designing assessment for game-based learning we can think about three main assessment directions: (1) game end scoring, (2) game play process, (3) teacher observation and evaluation (Chen and Michael, 2005). Game end score represents how well a player completed the game and how many point they earned. Game scoring is a way of summative assessment that gives the end result of game - based learning activity, however it does not give information how learner earned these points. With the digital capacity of videogames to capture action logs and record player choices monitoring gameplay process becomes an insightful formative assessment tool. Visibility of learner thought process, choices allows teacher to manipulate the learning process, provide timely feedback and differentiate students abilities and needs (Delacruz, 2010). Designing game leveling and feedback loops is not an easy task, as it requires homogeneous representation of learning material, game activities and ingame feedback to lead learner through the game experience in a way that develops her knowledge and skills. In this learning process some insight about learner progress comes from teacher observation and out of game evaluation or dialogs. Simulations and ingame learning activities are most effective when teacher provides additional

materials, divide training into parts, provide feedback and coaching through the learning process (Aldrich, 2005).

Ifenthaler, Eseryel and Ge (2012) defined the Integrated assessment model that combines summative and formative assessment methods for computer games based learning. The model consist of three components: (1) External assessment, (2) Embedded assessment and (3) Game scoring.

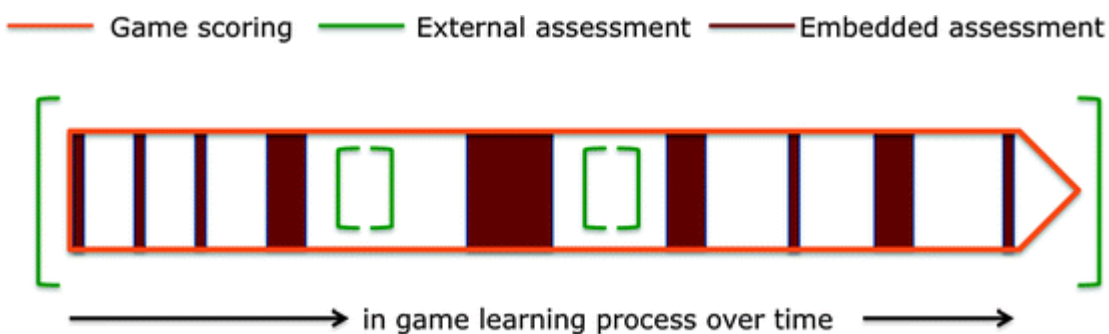


Figure 1 Integrated assessment model for computer game based learning (Ifenthaler et al., 2012)

External assessment is evaluation that happens outside the game. It would include tests after learning activity and after all learning process. This part of assessment could be performed using computer based test, paper-pencil assessment, presentation, essays or any other tool used to evaluate overall learner knowledge after the activity and held outside game environment.

Embedded assessment is integrated part of the game, through which player behavior is observed without interrupting the gameflow. Learner actions and choices are recorded through her clickstreams and event markers, and stored in game log-files. In the game context event markers capture player achievements and state at predefined time intervals. This method known as information trails allows to get deeper insights into the learner journey through the game and learning trajectory (Loh, 2008).

Game scoring is part of game logic and design and lasts through all the game accumulating as points or levels. Combined with the time spent in game scoring represents how well one is completing game challenges. Because scoring stimulates players to act, game designers frequently design scoring systems to guide players through the game. A good scoring system keeps balance between three aspects: perceivability, controllability and relation to achievement (Lee, Chen, Hsieh and Liao, 2017). Player has to understand the scoring system, what are the points given for, what do the levels mean and how to adjust the behavior to have impact to the score. Also the scoring relation to achievement in game should also be clear. It should be explained if higher score is important for overall game achievement or it is not related, e.g. resources score in strategy games like StartCraft does not have any impact to the game result, they only get value when transformed into other goods, that help you win the game.

In summary computer game based learning assessment strategy should aim to combine summative and formative assessment methods through integrated tools and the digital nature of computer games, allowing automated tracking of learner behaviour and decisions. However, to get the most from the computer based learning new feedback mechanisms and teacher coaching should become the main part of the learning experience.

12.3.2: Feedback Driven Learning Through Formative Assessment In Computer Games

The purpose of formative assessment in learning process is to help learner achieve intended goals encouraging strengths and identifying weaknesses. There are five formative assessment areas that enables student growth: (1) determine the level of learner current knowledge, (2) determine learner's strengths and weaknesses in relation to learning goals, (3) individually review learning progress, (4) set targets for future efforts, (5) guide learner through the learning process. In this setting teacher is empowered to set individual learning goals, change students' approaches to learning, engage, coach and motivate them to become independent learners (Spector et al., 2016).

Technologies enable to scale formative feedback, personalise it and evolve the formative assessment to support learning situations that previously required a lot of teacher effort and personal connection with the student. There are a few feedback mechanisms used in computer-based learning that support different learning scenarios (Spector et al., 2016).

- **Scaffolding in intelligent tutoring systems**

Learning systems that use scaffolding principle provide feedback based on learner performance on specific task. Computer game in this scenario would consist of a database that contain all learning activities and possible outcomes or most common mistakes. Based on students performance on a specific task they are given feedback that provides information about their response and what direction to go next. This type of scaffolding feedback is easy to implement however, it's applications are limited to very well defined learning domains and straightforward tasks. It is not flexible enough for more complex learning experiences.

- **Formative feedback for eportfolios**

Eportfolios are getting more common and popular in technology based learning. They allow to collect student achievements into one place and showcase if needed, adding examples of the work. As eportfolios are being integrated into learning management systems it becomes a great tool to provide formative feedback for learners reflecting his achievements through all learning process.

In computer game based learning eportfolio does not need to be a separate platform, usually the game design itself has player achievement section that is a representation of learner portfolio: showing levels, accumulated points, achievements, badges, time spent in game etc. However in the setting where assessment happens in game and outside the game, external eportfolio would enable teacher to leverage peer assessment more effectively, making the evaluation and feedback process part of learning and collective effort.

- **Adaptive formative assessment**

Previously mentioned intelligent tutoring systems leveraged the branching and customised feedback based on learner choices, however, these systems at some point provides same direction and feedback to everyone because of their static design, that allows only limited number of learning scenarios. An adaptive learning system creates personalised learning experience through data-driven, usually non-linear instruction that adjusts to a learner's interactions and performance level as well as anticipates the content and support that may be needed for learner to progress at specific point in time (Ifenthaler et al., 2015; Spector et al., 2016). The most beneficial game based learning setting in this case is and adaptive game combined with additional feedback sources and game scoring explanation. Delacruz (2010) conducted an experiment measuring what type of feedback and incentives for searching feedback leads to the best student performance. Students were playing MathBlaster game, which goal is to help game character to jump through blocks and successfully reach the X block while calculating the distance, between blocks and trampolines and estimating jump height, length etc. Three feedback situations were examined: points-only feedback, scoring explanation and scoring explanation with incentive. Students in all conditions showed slightly better learning results compared to control group who did not play the game, however, there were no significant difference on learning outcomes in group who received only points and the group with points and scoring explanation. The only group who received feedback and incentives for seeking it showed improved performance. However, the most interesting finding is that students who performed poorly in pretest improved their knowledge significantly in the coring and feedback condition, then students scored higher in pretest did well in the scores only condition too. These results support the idea, that feedback in game helps to differentiated learning process based on students abilities and improve their results.

Even though the adaptive feedback might require more resources to be implemented in the classroom, it is a great assessment and learning differentiation tool, that is getting more attention in the area recently.

12.4. Teacher Role In Computer Game Based Learning Assessment

Teacher is essential part of learning experience. However, with technologies entering the learning environment and emerging game based learning approach teacher role is shifting from the one-way instructor, to collaborative coach enabling students to learn independently. In game learning teacher guides students through the process explaining game rules and learning objectives. However, the balance between active student guidance and more observational approach that preserves player unique experience should be kept.

Lameras et al. (2016) described the possible teacher roles in game based learning. It may vary from the designer of the game itself to motivator and learning facilitator. However, overall teacher goal is to ensure a smooth learning experience, guiding students through the obstacles, motivating, providing feedback and designing the assessment process, let it be in game formative evaluation, pre and post game assessments, peer assessment etc. What could be less familiar and new to the changing teacher role is becoming an expert player going through the game together with students. This requires teacher be part of the gameplay, and feel comfortable doing that. In addition playing together with students allows teacher to interact with them through the game and build trust as well as strengthen students engagement with the learning process.

Table 1: Types of teacher role in designing and playing games (Lameras et al., 2016).

Type of role	Example
Designer	<ul style="list-style-type: none"> Genre of game and difficulty should be aligned with the specific role permeated to the teacher spanning from an active to a more passive role. Designing experiences, materials and sources of information in conjunction to game-play and methods of conveying content via the game. Designing in-game tutorials on how the learning content, virtual instruments and overall game play including rules, dynamics and mechanics are instantiated within the game context. Design for collaborative opportunities and dialogic game-play
Player	<ul style="list-style-type: none"> Engage in actual playing individually or collaboratively with the students the game for scaffolding students' efforts to play and learn. To act as a best practice example in terms of what is the optimal way to play and learn via the game.
Facilitator	<ul style="list-style-type: none"> Asking questions that encourage students to transfer learning originated from the game to learning applied in real-world situations. Engaging students via in-game discussion mechanics or in-game hints on how to evidence their ideas or answer their questions through game play evidence or curated content in the game (i.e. content mashed-in from external resources) Provide guidance and support for solving learning problems and progress to next game levels.
Motivator	<ul style="list-style-type: none"> Use KPIs (Key Performance Indicators) as means to motivate and reward students to learn existing knowledge and transfer knowledge to new game or non-game settings.
Evaluator	<ul style="list-style-type: none"> Asking pre- and post- gaming questions to elicit understandings on what students do during the game (role of the evaluator with focus on formative assessment) Including measurable and quantifiable metrics for assessing students' performance in the game (role of the evaluator with focus on summative assessment).

With the rapid change in computer games world and new technologies in learning it is not possible to train teachers to apply specific games or technologies in the classroom. What should rather be taught is the open mindset and creative thinking, enabling one to be ready for the change and excited to try new approaches together with the students.

