11. Outputs and Insights From 12 Years of Game-Based Learning Research at the Danube-University Krems' Center for Applied Game Studies

NIKOLAUS KOENIG AND ALEXANDER PFEIFFER

Abstract: For almost 12 years, the Center for Applied Game Studies at the Danube-University Krems, Austria, has conducted game-based learning (GBL) research. Guided by the aim to enable classroom integration of game-based learning on a broad scale, this research has centered on the development of a GBL toolkit for (and in cooperation with) teachers, enabling them to use GBL strategies within the context of current educational practice, while at the same time expanding their own knowledge and skills as GBL experts. The toolkit contains tools to evaluate the pedagogical potential of digital games, to plan and conduct GBL projects, and to exchange with other teachers and form an active GBL community. The current step consists of the development of an educational game-design tool and the first in a series of educational game editors for teachers. The talk will present these tools and discuss lessons learned from their development.

Overview

Since its foundation in 2006, the Danube-University Krems' Center for Applied Game Studies has examined, argued for, and put to the test the pedagogical potential of digital gaming media and their value for educational practice.

One of the center's earliest master's courses ("Media & Game Pedagogy" or–due to the Austrian weakness for compound nouns–"MedienSpielPädagogik") was one of the first academic training opportunities worldwide centered on the theory and practice of game-based learning (GBL) and (with regular updates to its curriculum) persists until today.

At the same time, some of the center's major research projects have been focused on the conditions under which game-based learning can be successful in educational practice, guided by the idea that the potential of digital games to enable meaningful learning experiences can only unfold in an adequate educational environment, and that it is dependent on skilled teachers and their ability to facilitate connected learning experiences through digital games. This research has laid the foundation for the center's teaching activities, but at the same time, the involvement of its students in these research projects has greatly contributed to the center's research profile. In the following, an overview will be given of the center's major GBL-related research projects and their relation to educational practice in Austria, with an emphasis on the ongoing effort of developing a game-based learning toolkit for teachers.

Background: Didactic Scenarios of Digital Game–Based Learning (2007–2010)

Starting in 2007, the center's first major research project in the field of digital game–based learning was focused on using digital games to close the gap between school life and the daily (media) experiences of children and youth–and by

finding out *how* digital games might be used in the classroom in order to achieve this. At the center of this investigation were questions regarding the feasibility of game-based learning approaches in educational practice, especially within the Austrian school system (and even more specifically, within the Austriawide educational concept of the new middle school/"Neue Mittelschule"/(NMS).

As the aim of this project–the first in a series of investigations funded by the Austrian Ministry of Education–was to harvest the potential of digital games to close the gap between school life and students' daily (media) experiences, the project used a series of commercial off-the-shelf games that enjoyed a certain popularity among students; on the other hand, most of these games had been used in the educational context before, so it would be possible to distinguish whether specific problems were caused by the game products themselves, or by the ways they were applied in the context of the project.

Over the course of the project, Austrian teachers worked closely with experts from the fields of game studies and media pedagogy to (a) develop a basic understanding of the medium-specific properties of digital games and their educational potential, (b) develop didactic concepts for using specific games in their own classrooms and to make their own decisions regarding game choice and didactic goals, and (c) apply the concepts in their classroom, reflect on their success, and involve their students in a discussion of the pros and cons of digital game–based learning, based on the shared experience of using a game in their classroom. The project was accompanied by a qualitative as well as quantitative evaluation as a basis for future strategic decisions regarding the use of digital game–based learning in Austrian schools.

Not only did the project establish the pragmatic perspective that would determine the center's research activities until today; it also led to the formulation of 12 "Theses regarding the use of computer games in the classroom" (Mitgutsch & Wagner, 2008).

The Game-Based Learning Toolkit (2013/2014)

At the beginning of the 2010s, there already was wide academic consensus that digital games have the potential to enable meaningful learning experiences (e.g., Annetta 2010; Gee 2009). But attempts to actually use game-based learning in educational practice were still rare, and if they were made (e.g., Salen 2011), they were designed as more or less radical alternatives to traditional education and, even more important, accessible only to a selected few.

In Austria, there was high demand for game-based learning strategies because of the reorganization of the school curricula and the introduction of the educational concept of the new middle school (NMS) with its core principles of *differentiation*, *individualization*, and *personalization*. However, the needs of the New Middle School could not be met with exceptional pilot projects alone but required strategies to consolidate game-based learning approaches with existing educational practice, and to facilitate the best possible application of game-based learning within the restrictions of the (Austrian) educational system; the goal was enabling the use of digital games as catalysts for connected learning experiences, not as an alternative to, but as a part of, the existing school model. A second project (Gaming Media and Their Application in Educational Practice) was therefore initiated (once again funded by the Austrian Ministry of Education).

Building on the earlier project's theses as well as the demands of the Austrian educational system, the project's aims were to consolidate game-based learning with contemporary models of educational practice, while at the same time facilitating the building of teachers' competencies on a broad scale (Koenig, Pfeiffer, & Wernbacher, 2014). The goal of the project was to cooperate with game experts as well as with educators in the development of a series of tools that teachers could use to:

1. Identify the educational potential of any given digital game, while at the same time developing their own understanding of the medium-specific properties of digital games (the Analysis Tool);
2. Develop suitable didactic scenarios to use these games in their educational practice, accounting for the specific needs of their respective students as well as the possibilities and obstacles at their own school location (the Application Tool);
3. Form and participate in a game-based learning community, while at the same time making game suggestions, discussing game-based learning scenarios, and assisting each other with their projects (the Online Platform);
4. Develop their own game projects using an easy-to-use game editor, systematically translating their pedagogical and didactical needs into game-design choices (the Game Design Tool and Editor).

The guiding idea behind these tools' development was that the integration of game-based learning into educational practice must be addressed in a sufficiently pragmatic manner: Game-based learning cannot be regarded as a fixed procedure that can be imposed on all educational settings alike but is a contingent set of principles that need to be adapted for every particular school, classroom, and even student. While rooted in sound educational and game theoretical concepts, the iterative development process involving experts from both areas was aimed at creating tools that were flexible enough to be adapted by teachers for their own students' needs and classroom situations.

The Analysis Tool

For the development of the Analysis Tool, game experts (graduates in game studies and professionals in various game-related fields) as well as experts in education (teachers holding a master's degree in media and game pedagogy) were put together in teams. These teams were presented with a preliminary questionnaire based on a structured translation of game-theoretical concepts into pedagogic and didactic principles, complete with detailed comments on the concepts and principles used (this outline would later be adapted, refined, streamlined, and reformulated according to the teams' findings in the subsequent project steps). Additionally, each team picked a specific game, which would later serve as a testing ground for the development and refinement of the Analysis Tool. In the following weeks each of the teams assessed the preliminary questionnaire, based on their professional experience and the analyses of the example games in order to assess what adaptations they deemed necessary to help teachers (a) identify a game's pedagogical potential and (b) gain an understanding of the distinct qualities of the medium. Based on the thorough feedback of the teams, the questionnaire and comments were then restructured, adapted, and refined.

The final version of this Analysis Tool consists of six basic categories that are further divided into subcategories to enable a more detailed insight into the respective category. The questions constituting these categories/subcategories are separated into general questions, which highlight the most important aspects of the respective category, and advanced questions, which either help to examine a category more closely or help to get a better grasp on those categories that are more difficult to use.

The first category—*General Information*—assesses the game's basic production data, gaming platform, and operating system. It is asked whether the game has been designed for educational or entertainment purposes, or whether it is a game-related software product rather than an actual game. While this first category is very general, it encourages us to perceive games as embedded in a broader technological, economic, and creative context.

The second category—*Form and Technology (Game Product)*—includes *technological requirements*, the game's purported *theme*, and its *presentation*. All in all, this category presents a soft entry to the analysis by restricting itself to aspects that can easily be assessed, even before the game is actually played.

The third category—*Content (Game World)*—requires a closer look into the game but deals with aspects that computer games share with more traditional media such as film or literature: What is the *setting* of the game, what are the *data and facts* it contains, and what kinds of *narratives* (if any) does it rely on?

The remaining three categories finally take the specific qualities of digital games into account. These game-specific categories of the Analysis Tool are closely related to the mechanics, dynamics, and aesthetics (MDA) framework for computer game analysis (Hunicke, LeBlanc, & Zubek, 2003).

The fourth category—*Mechanics (Game System)*—examines the game's *core mechanics* as well as the *flexibility* of the game system (room for errors/alternative solutions), as well as the relation between *game system and learning experiences*.

The fifth category—*Dynamics (Player Actions)*—deals with game verbs and complexity (player actions and depth of cognitive involvement; see Webb, 2002), with matters of roles and identity, and with player interactions (cooperation vs. competition).

The aim of the sixth category—*Aesthetics (Player Experience)*—is to make the volatile field of gameplay/learning *experience* tangible by highlighting possible fields of experience, asking teachers to reflect on their own gameplay experiences by encouraging the observation and discussion of other players' gameplay experiences.

As is obvious in the description of the various categories, the goal of the Analysis Tool is not to conduct a thorough and authoritative analysis of a game, but to guide teachers in approaching digital games from a sound perspective, getting a grasp on their medium-specific qualities while at the same time developing the skills necessary to assess the pedagogical potential of a specific game on various levels of the medium.

The Application Tool

The goal of the second project phase was to design a tool that assists teachers to apply the pedagogical potential of a specific game to their own classrooms by enabling the design of classroom-specific game-based learning scenarios. In this phase, it was crucial to reconcile the pedagogical potential of the medium with the strict limitations of educational reality. The teams were expanded by teachers who had no prior experience with digital games to ensure that the tools were accessible even without a prior understanding of game-based learning principles.

The Application Tool was designed to be used as a flexible supporting tool for the development and application of game-based learning scenarios in the teachers' own educational settings. As a result of workshop discussion and subsequent testing of the tool during the pilot projects, four key areas have proven relevant for a pragmatic, yet meaningful implementation of game-based learning strategies in educational practice: (a) the *educational objectives* that can be pursued based on the game; (b) the *added value and limitations* of employing a game-based learning strategy to reach these objectives; (c) the *methods* required to tap the pedagogical potential of the game in the classroom; and (d) the *problems* that must be solved before game-based learning strategies can be successfully employed in a specific educational setting.

1. *Educational Objectives*—The definition of educational objectives forms the starting point of meaningful learning design (Westfall-Greiter & Hofbauer, 2010). What are the *core questions* that define how these concepts are approached? What are common *misunderstandings* in regard to these concepts, and how are they addressed by the game? And finally, how can the game help to enable meaningful learning and understanding (Schratz & Weiser, 2002)?
2. *Added Value and Limitations*—Game-based learning is not an end in itself. What can the game add to a meaningful learning process? Can the objectives be reached in alternative ways, and what are the upsides and downsides of

these approaches? Which aspects of the educational goals are not sufficiently addressed by the game, and what complementary strategies are required?

3. *Methods*—The success of game-based learning is dependent on how they are integrated in the learning situation: What preparations are necessary for a specific game-based learning project, and how must the gameplay be hosted to be meaningful and effective? How does the transition from playing a game back to the educational setting take place, and what will students need in order to benefit from the game?

4. *Problems*—The integration of a new medium into educational practice is not without problems. It is important to be aware of these problems in order to counter or minimize them early enough. Will expert help be needed, or is it necessary to adapt the scenario in order to minimize these problems? Is it possible to conduct the game-based learning project within the class schedule? Can the schedule be adjusted, or does the project itself need to be adapted? What support will students need to comprehend the game's topic and achieve the educational goals? Are colleagues, parents or even student skeptical toward the use of computer games in the classroom? How can this skepticism be reduced in order to create a cooperative educational environment?

The Online Platform

In the final phase of the project, the basic demands of the Online Platform (whose actual development would take place in another project) were defined. While it was clear that the Online Platform would also provide access to the previously developed tools, its main function was to provide adaptable entry points depending on the user's expertise and previous experience with computer games and game-based learning strategies. The basic goal was to enable dynamic and discursive competence building within the teaching community by fostering a "choose what to use" approach; according to their respective demands and competencies, teachers were to be able to choose different ways to use the platform.

The First Application: Game-Based Learning to Alleviate Early School Leaving in Malta (EU)

Contrary to the first two tools (the Analysis Tool and the Application Tool), which were developed, tested, and refined in the context of the Austrian education system, the development of the Online Platform was conducted as part of an Erasmus Plus Strategic Partnership between five partners: the Malta Information Technology Agency (MITA), the University of Malta, St. Margaret's College Malta, Nyströmska School Sweden, and Danube University Krems, Austria. While the development of the online tool was only one segment of this partnership, whose main goal was to explore the potential of game-based learning to alleviate early school leaving, this embedded approach enabled us to develop and test the platform on a broader scale than a national project would have allowed us to, while at the same time providing a first application for the previously developed tools.

As it was one of the main aims of the project to enable teachers to become "agents of change" within their schools by expanding, practicing, and sharing their expertise in game-based learning, the platform needed to provide entry points for teachers of all skill levels regarding game-based learning, varying from game-based learning experts to novices and even sceptics. Based on the previous project's output, the following ways to engage with the game-based learning community via the platform become the guiding principles of its development and refinement.

1. *Scuttle*—The platform contains a database with existing game-based learning scenarios and game analyses, as well as commentated documentations from game-based learning projects that have already been used in the classroom. Furthermore, the platform contains background material on digital games and game-based learning.

Looking through the material on the platform, teachers are able to gain first insights into the use of computer games in educational practice and get familiar with the work of colleagues and the theoretical foundations of game-based learning.

2. *Dabble*—It is not necessary to have experience with game-based learning to engage in the game-based learning discourse. In the discussion forums, teachers without prior knowledge about game-based learning can be assisted by more experienced colleagues, but they can also contribute insights from their own teaching experience. The discussion forums help teachers get familiar with the topic and—most important—become part of the game-based learning community.

3. *Sample*—While the design of the Analysis Tool and Application Tool aims to enable classroom-specific game-based learning scenarios, it is possible and valid to draw on existing scenarios and use them in one's own classroom. While these scenarios have not been adapted to the specific educational setting, they will still provide an opportunity to gain firsthand experiences with game-based learning and highlight the demands and opportunities of the specific classroom, thereby inspiring the development of more specific scenarios.

4. *Grapple*—Teachers feeling sufficiently familiar with the basic principles of game-based learning can decide to use the Analysis Tool to identify the pedagogical potential of a particular game. The tool may lay the foundation for designing a game-based learning scenario, or it may simply be used to gain insight into a game that the teacher's students keep bringing up in the classroom. In any case, using the Analysis Tool is the first step of developing an autonomous approach toward game-based learning.

5. *Embrace*—As soon as teachers feel ready, they can develop their own game-based learning scenarios using the Application Tool. In addition to using the tool, teachers can discuss problems and ideas with colleagues in the discussion forums, or in the comments section of a project they have shared on the platform.

6. *Lead*—Using the platform, teachers increasingly gain experience and confidence as game-based learning experts. As their own competencies continue to grow, they might choose to actively engage in supporting their colleagues in getting hold of game-based learning and its application to the classroom. As "teachers' leaders," they become an integral part of the game-based learning community, helping others in becoming familiar with the pedagogical potential of digital games and their application in educational practice.

Outlook

The next tools in the game-based learning toolkit are now being developed in the form of an Educational Game Design Tool and an Educational Game Editor (EGE-1) that enable teachers to design and create their own games for/with their students. The development of these tools is again embedded in an Erasmus Plus Strategic Partnership, in cooperation with the Malta Information Technology Agency (MITA), the University of Luxembourg, the Science Centre Malta, the game-development company waza! UG, Germany, and the Research and Innovation Management GmbH, Austria.

The Game Design Tool is based on the research conducted for the development of the Analysis Tool. However, the creation of the new tool requires a basic redesign of the questionnaire and its structure, as well as the comments on the underlying concepts and principles. The goal behind this tool's development is to provide easily accessible guidelines for teachers without a background in game design and development that will enable them to:

1. Assess whether specific educational goals can benefit from a game-based learning approach using a self-made game;
2. Define a realistic scope for the project and translate the educational topic into a game concept;
3. Decide which game form best supports the educational goals and choose an appropriate game editor;
4. Implement their game concept step-by-step using a game editor.

Mirroring the insights from the creation of the Analysis Tool, the finished Game-Design Tool will translate game-design principles into educational concepts to enable teachers to base game-design decisions on their own skill set as educators. (However, insights from the development process will be used to assess how adaptations for a similar tool might look, allowing game designers to base the pedagogic/didactic decisions in the development of educational games on their existing expertise in game design).

The Game Editor (EGE-1) is the first in a series of low-threshold educational game editors. Each of these editors will highlight another primary mechanic, so that teachers have appropriate editors available depending on the choices made using the Educational Game Design Tool. EGE-1 uses a dual decision–tree mechanic that makes action-consequence relations tangible by means of simple interactive narration. This and later editors will be developed in cooperation with teachers and education experts, the goal being to employ interface conventions, design strategies, and vocabulary stemming from the educational context in order to enable easy translation of educational aims into game-design decisions.

The first Game Editor (EGE-1) is in its testing phase and will be ready for presentation for the Connected Learning Summit 2019.

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