

PhD-candidate	
Name	Noémi Bernadett Agócs
University	Eötvös Loránd University
Institute	Department of Media and Educational Informatics
Doctoral studies	Informatics Doctoral School – Doctoral Program of Informatics teaching methodology
Motivation, relevant background	
<p>As a teacher of Informatics and English, teaching information technology (IT) part-time at the Eötvös Loránd University (ELTE) in Budapest, I am committed to help students unlock their full potential through the use of technology. I love to incorporate larger, project-based learning opportunities in my lessons aiming to provide students with both individual and collaborative work modes. These situations mirror real-world environments and allow students to build on their own strengths and experiences.</p> <p>Game development, animation, digital drawing, and 3D modelling are at the core of my interests and professional focus as with these fields, technology and creativity intersects to unlock new possibilities.</p> <p>As I am at the beginning of my academic journey, I am grateful for the opportunity to share my ideas and preliminary findings with experts and fellow students. I look forward to broadening my perspective by receiving feedback and digging deeper into my research on creative problem solving through game development in IT education.</p>	
Supervisor	
Name, title	Ágnes Erdősné Németh, PhD
University	Eötvös Loránd University
Institute	Department of Media and Educational Informatics
Role in project	Supervisor
Description of research project	
<p><b>Title:</b></p> <p>The possibilities of game development in IT education</p>	
<p><b>Problem statement:</b></p> <p>The research problem I aim to address is the challenge of creating an effective, comprehensive methodology for teaching game development, because I see this as an untapped opportunity, especially in the Hungarian education system.</p> <p>I believe it is essential for IT classes to equip students with crucial skills such as problem-solving and computational thinking, but it is equally important to engage student motivation, spark interest and build on creativity. There is a gap in current teaching practices when it comes to integrating these skills through game development education, therefore my goal is to create a teaching approach that better prepares students for the demands of both the digital age and the evolving job market with the help of games.</p>	
<p><b>Aims and objectives:</b></p> <p>My primary objective is to develop and collect easily applicable principles, methods and ideas suited for the introduction of game development in secondary schools.</p> <p>I aim to fill the gap of current teaching practices in IT education by combining the technical aspects of game development, such as programming and tool use, and the creative aspects, such as game design and narrative. This approach will offer students an interdisciplinary understanding, showing them that the subjects they learn in school and the skills they gain are interconnected and relevant in real life, and hopefully it will encourage a deeper engagement with the subject.</p>	
<p><b>Research Questions:</b></p> <ol style="list-style-type: none"> <li>1. Which skills are essential in the labour market and in students' private life? Can these be linked to game development? If yes, how?</li> <li>2. Is there a relation between learning game development and being a successful and mindful user of technology?</li> </ol>	

3. Should game development be a mandatory part of the IT curriculum? How can the curriculum be structured so game development can also play a role?
4. What method can be used to introduce new knowledge? What should be introduced to everyone? What should be taught to only students learning it specialised schools?
5. How can we build on students' previous knowledge and experiences? What examples should be used?
6. How can students be motivated to learn about game development? Do they need external motivation?
7. How much and what kind of practice is needed to acquire knowledge? What specific tasks can students do to practice?
8. What assessment can be used to check the mastery of the course material?

#### **Relevance and importance of the research:**

It is typically easy for students to keep up with technological developments at a user level, for example, various computer and mobile games play a significant role in the lives of many. In IT education, however, we typically do not exploit the potential in games and game development: we do not sufficiently show students the especially interesting part of the world of games, the development process, which includes game design, modelling, creating animations and the programming of the game itself.

Developing an effective, comprehensive methodology for game development-based learning (GDBL) is relevant for students, educators, and parents all around the world. If we can find a tool to address and engage young people in schools, and motivate them to be creative problem-solvers, they are more likely to become lifelong learners who continuously seek new advancements.

#### **Theoretical framework:**

The idea of using games in school has been in the centre of attention for several decades for many researchers, and it becomes increasingly relevant due to the changes in students' preferred way of learning. In the past, the main goal was the transmission of knowledge and content, which should be extended with creativity and critical thinking nowadays.

There are several varieties and approaches when it comes to using games in education, the most widespread are (Bewer & Gladkaya, 2022):

- game based learning (GBL): students play games with the goal of obtaining knowledge
- serious games: games designed with specific learning objectives are used
- gamification: game elements in real life are used to create a game-like experience
- game development-based learning (GDBL): the game being used is created or modified by students

The study of Wu and Wang (2012) focuses on GDBL, based on their literature review there are two main methods in GDBL both possibly implemented individually or in groups: learning by creating and learning by modifying games. All versions of GDBL can be taught by problem-based learning, which is a pedagogical model emphasizing a collaborative discovery process in solving real-life problems, the traditional lecture-oriented approach, or the double stimulus method, where the task designed by the teacher is the first stimulus, and the game development framework (GDF) is the second.

As collected and examined by De Almeida Souza et al (2017), out of 156 studies between 1974 and June 2016, more than half described serious games, a bit more than third described game development-based learning for software engineering education, and less than 10% described gamification. In recent years, the discussion about gamification spread, and while game development-based education is still widely discussed, there are still some gaps where further studies are needed. Based on the review of literature, I think just like in Croatia (Holenko Dlab & Hoic-Bozic, 2021), there is a lack of material and exercise bank collected for using GDBL in Hungary, preventing teachers and students to incorporate game development into computer science education. As there is insufficient appropriate material for using GDBL in IT education, in my research, I aim to start spreading awareness to the topic. My plan is to provide tools for educators, researchers, students, and parents by creating a sample material and measuring the changes in students' attitude and performance by incorporating both the design and development stage of GDBL. In my proposed methodology I plan to combine the best practices in an efficient and motivational way aiming to identify and fill gaps and solve problems in the already existing models to contribute to the advancement of education.

#### **Research design and methods:**

I am assessing whether using a specific game development curriculum improves students' creativity and academic performance compared to traditional teaching methods. Throughout this

process there are several opportunities for potential obstacles, limitations and ethical or practical issues. When I encounter a problem, I will turn to other researchers' experiences through already existing studies and articles to continue my experimental research.

To achieve my aims, first, I will dig into current national and international research on related topics. I will analyse the Hungarian national curriculum, evaluate specific tasks and study different educational practices, routines, and approaches. I will conduct a literature review on game development-based education and relevant teaching methodologies.

In the second phase I will develop materials covering all key aspects of game development with appropriate methodology that can be incorporated into the existing IT curriculum. With this, I plan to create a prototype of the material and tasks used.

Next, I will test an initial methodology in a pilot teaching phase and share it with educators for further testing and feedback. Through a cyclic process reflecting on each lesson then redesigning it, after several rounds of feedback and revision, I will present the best methodology I can find. The schools, educators and students included in the study will be selected after careful consideration to insure heterogenous and diverse groups (urban and rural areas of Hungary, diverse types of schools, etc).

With the finished approach I would like to examine how the application of game development affects students' motivation, persistence and academic results, and how this can inspire them to choose a field of study in STEM (science, technology, engineering, mathematics). This phase of the research will be both qualitative and quantitative: I will use quantitative elements to establish generalizable facts about game development education, like whether students have better results after studying game development, but qualitative research will be used to gather in-depth insights on student motivation through open-ended questions.

Finally, I would like to share my (interim and final) results with others at various conferences, journals, and in my dissertation.

#### **Achieved results (so far):**

Although I do not have any significant results yet, my master's thesis is a case study of teaching game development in an extracurricular study group. There I already collected the most important aspects of game development, I created tasks for students to practice what they learn, and since I tried it with a group of students, I have some experience to reflect on, and I have some feedback from the students as well. When I create my prototype for the current study, I plan to use the lessons I learned there and the experience I gained in preparing a comprehensive curriculum for shorter courses, while also using the project itself as a base by filling gaps.

Other than the experience I gained during teacher training, the various shorter and longer teaching practices, and the short course I developed for my thesis, I also prepared and facilitated dozens of sessions on various open days and camps in the past 6 years (in recent years mainly about 3D modelling and game development). For several semesters, in a total of seven groups, I held a "Scratch programming" preliminary course at ELTE preparing students for the Computer Science BSc program through game development, and currently I teach their first course about coding and programming patterns in the actual Computer Science BSc program. I expect my experiences to help me through the more challenging parts of my research.

#### **References:**

Bewer, N., & Gladkaya, M. (2022). Game development-based approach for learning to program: A systematic literature review. *Wirtschaftsinformatik 2022 Proceedings*. 3. Digital Education & Capabilities, 1-14.

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Wu, B., & Wang, A. I. (2012). A guideline for game development-based learning: A literature review. *International Journal of Computer Games Technology*, 2012, 1-20.  
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### Anticipated project duration

Duration:	4 years
Start date:	2024.09.01
End date:	2028.06.30

### Research Schedule

#### Outline Research Plan for the Remaining Years of the Project

Research phase	Objectives	Deadline
<p>Introduction</p> <p>Getting familiar with other studies</p>	<ul style="list-style-type: none"> <li>- Researching national and international literature related to GDBL</li> <li>- Analysing the Hungarian national curriculum, evaluating specific tasks, studying different educational practices, routines, and approaches</li> <li>- Writing a literature review to get an overview of methodologies used in game development education</li> </ul>	end of 2024/2025 academic year
<p>Developing the base material for the study</p> <p>Creating a methodological prototype</p>	<ul style="list-style-type: none"> <li>- Developing materials covering all key aspects of game development</li> <li>- Finding an appropriate methodology to incorporate the topic into the existing IT curriculum</li> <li>- Recruiting the schools, educators, and students for the pilot teaching phase</li> <li>- Publishing preliminary findings</li> </ul>	end of 2025/2026 academic year
<p>Pilot teaching phase</p> <p>Creating the final approach</p>	<ul style="list-style-type: none"> <li>- Cyclic process:               <ul style="list-style-type: none"> <li>o Testing the prototype with a group of students and sharing the project with educators allowing them to incorporate the topic in their lessons</li> <li>o Reflecting on the lessons based on feedback from students and educators</li> <li>o Redesigning the project</li> </ul> </li> <li>- Presenting the best approach I can design</li> </ul>	end of 2026/2027 academic year
<p>Reflection</p> <p>Examining the effects of GDBL on students</p> <p>Writing the dissertation</p>	<ul style="list-style-type: none"> <li>- Examining the effects of game development on students (motivation, persistence, academic results, carrier goals)</li> <li>- Sharing my findings in form of articles and the dissertation</li> </ul>	end of 2027/2028 academic year