Supporting Croatian Primary School Teachers in Designing Game Based Learning Activities: A Case Study

Martina Holenko Dlab[1], Natasa Hoic-Bozic[1], Jasminka Mezak[2], and Marina Zunic[1]
[1]University of Rijeka, Department of Informatics, Rijeka, Croatia
[2]University of Rijeka, Faculty of Teacher Education
mholenko@inf.uniri.hr
natasah@inf.uniri.hr
jasminka.mezak@ufri.uniri.hr
marina.zunic@inf.uniri.hr

Abstract:
This paper presents research about supporting primary school teachers in planning game based learning activities in different school subjects. Teachers can describe learning activities in the form of a learning scenario, which usually includes a list of learning outcomes, teaching methods and strategies, materials, and tools for achieving the learning outcomes. The process of designing a learning scenario can be challenging for teachers, especially those with a lack of ICT skills. Teachers should be familiar with the various ICT based teaching methods, strategies, contents and tools. Therefore, it is necessary to organize educational programmes to support teachers in acquiring appropriate knowledge and skills.
The paper describes results of the study conducted during the education for primary school junior grade teachers organized within the Erasmus+ project GLAT that promotes development of algorithmic thinking using games. The aim of the study was to identify the level of participants' knowledge and skills needed to design scenarios with game based learning activities for developing algorithmic and computational thinking among their students. Using questionnaires, the teachers' self-assessment of familiarity with the terminology related to game based learning and possibilities of adapting and using digital contents, games and tools was determined as well as their self-assessment of progress made during the education. Teachers' progress was realized to the greatest extent for elements related to games, learning scenarios, and applying Web 2.0 tools for learning activities.
The results confirmed the effectiveness of the GLAT instructional model and showed that teachers need support not only through education, but also by providing ICT tools that will make the process of designing learning scenarios easier for them. Therefore, a future work in this direction is planned within the project *Digital games* and will include development of a web application for guiding teachers in the process of designing innovative game based learning scenarios.

Keywords: Computational thinking; Digital games project; GLAT project; learning scenario; primary school teachers.

1. Introduction

This paper presents the final results of the research performed in the context of the Erasmus+ project GLAT – Games for Learning Algorithmic Thinking. One of the primary goals of the project was to support primary school junior grade teachers in acquiring digital skills and competencies in the field of learning design, especially those for planning game based learning activities and adapting, using, and creating the digital content needed to perform these activities (Hoić-Božić *et al.*, 2018), (Hoić-Božić and Holenko Dlab, 2019).

Learning design includes an educational process of planning, sequencing and managing learning activities (Hernández-Leo *et al.*, 2013). During this process, teacher's role is to create the conditions for students to achieve learning outcomes by designing learning activities (Beetham and Sharpe, 2013). Designed learning activities can be described in the form of a learning scenario where the teacher presents forms, methods and teaching strategies as well as contents and tools he/she plans to use (Rojas-López and García-Peñalvo, 2018). Learning activities should be motivating and fun, especially when they are designed for younger students. To ensure this, games based activities are often used, either those that rely on digital contents/tools or unplugged activities that are performed without digital devices (Brackmann *et al.*, 2017; Ching, Hsu and Baldwin, 2018).

The activities of the GLAT project were specifically focused on learning scenarios with game based activities that, in addition to achieving learning outcomes of a particular school subject, enable the development of computational thinking. Computational thinking is a skill considered necessary for successful careers in 21st century that should be incorporated into the daily teaching as much as possible and from the earliest stage of education (Jocius *et al.*, 2020). This paper presents the results of the study conducted to determine the extent of progress regarding the possibilities of using digital games and tools and the familiarity with related terminology that Croatian primary school junior grade teachers achieved during the education organized within the GLAT project.

2. Learning scenarios for development of computational thinking using games

Computational thinking includes an activity of formulating and solving a problem using the following skills: abstraction, decomposition, pattern recognition, algorithmic design, and generalizations. The computational and algorithmic thinking do not necessarily involve the computers (Rojas-López and García-Peñalvo, 2018) but are used to solve the complex problems in algorithmic way and to present this solution so a computer can process it (Wing, 2006). These skills should not be related only to mathematics and computer science since their development can be achieved through other school subjects as well (Yadav, Stephenson and Hong, 2017).

A learning scenario can be designed for any school subject and includes learning activities that are relevant for the subject but also enable the development of computational thinking skills. The main elements of a learning scenario are title, a list learning outcomes, teaching methods and strategies that will be used, description of activities that will be carried out to achieve learning outcomes, and a list of needed materials and tools (Beetham and Sharpe, 2013). In learning scenarios that include activities for developing computational thinking, the outcomes related to the development of computational thinking should also be defined. The scenario can be prepared in written form but visual representation can also be used (Mezak and Pejić Papak, 2018). The learning scenarios for contemporary education could represent how to carry out learning activities in an innovative way, using modern teaching methods and appropriate digital content and tools, including games (Schade *et al.*, 2019).

In general, game based learning approaches have proven to be very efficient for younger students since they remain motivated throughout the learning process (Vos, Van Der Meijden and Denessen, 2011). There are many game based activities for development of computational thinking that can be correlated to any school subject in order to enable the achievement of learning outcomes of this subject. These include digital games (e.g. labyrinths, puzzles, memory games), logic tasks or quizzes (e.g. sorting games, recognizing patterns, brain teasers) (Shute, Sun and Asbell-Clarke, 2017; Holenko Dlab *et al.*, 2019; Jiang *et al.*, 2019). There are also many examples of unplugged activities that include board games, playing with cards, strings and other objects, or making physical movements (Brackmann *et al.*, 2017; Tsarava *et al.*, 2017; Jagušt *et al.*, 2018). In the learning scenarios, these game based activities can be planed for motivation at the beginning of the lesson, for achievement of learning outcomes during the lesson, or for reflection/evaluation at the end of the lesson (Mezak and Pejić Papak, 2018).

Figure 1 shows a graphical representation of an example of learning scenario that includes games based learning activities for repeating addition and subtraction up to 20. Besides learning mathematic, planned game based learning activities may support the development of basic computation thinking skills since students need to apply processes like decomposition, abstraction, and pattern recognition.

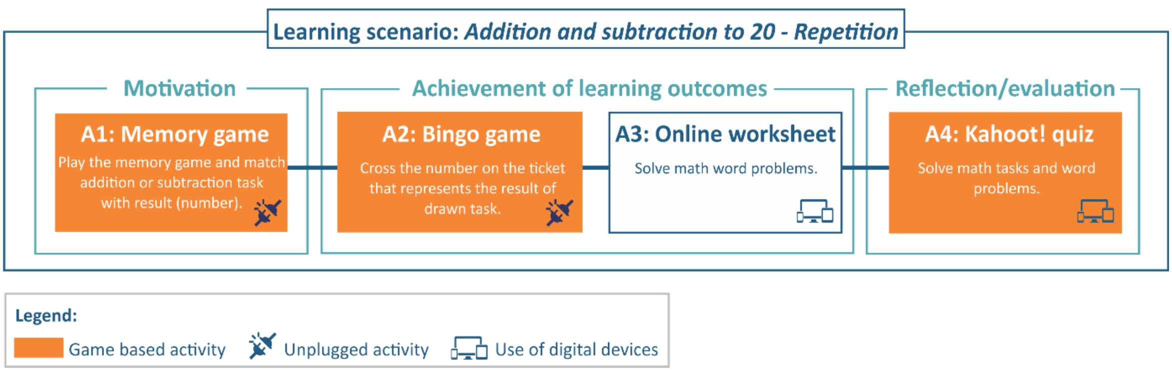

Figure 1: Graphical representation of the learning scenario "Addition and subtraction to 20 - Repetition"

Activities that involve creative thinking and collaboration, essential skills for any problem solving process, can also be used to develop computational thinking. One example is digital storytelling activity where students combine storytelling process steps with creation of digital content and defining game elements (Hoić-Božić *et al.*, 2019).

3. Purpose of the research

The study presented in this paper represents the final results of the research performed within the GLAT project with the aim to identify to what extent are Croatian primary school junior grade teachers familiar with the terminology regarding ICT and the possibilities of using ICT, in particular games, for development of computational thinking and programming skills. It is a continuation of the research that was conducted at the very beginning of the GLAT project in order to help the experts from the project team to improve the GLAT education (Hoic-Bozic, Lončarić and Holenko Dlab, 2019), (Hoić-Božić and Holenko Dlab, 2019).

This final study aims to determine the extent of progress of teachers upon completion of GLAT education regarding the possibilities of using digital games and tools and the familiarity with related terminology. The focus is on knowledge and skills needed to design learning scenarios with game based learning activities for development of algorithmic and computational thinking skills in different school subjects.

4. Material and methods

4.1 GLAT education

Main objective of the GLAT project (glat.uniri.hr) was to encourage the integration of algorithmic and computational thinking into different school subjects to enable younger students to achieve these skills in a fun and attractive way. Project partners have tried to achieve this by designing education for primary school junior grade teachers (Hoić-Božić *et al.*, 2018). Project results and activities are shown in Figure 2.

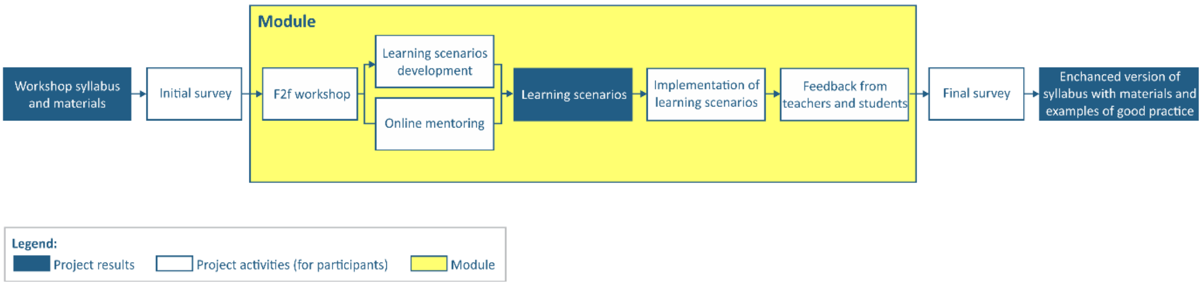

Figure 2: Activities and results of the GLAT project

GLAT education was carried out according to blended model of e-learning (Hoic-Bozic, Holenko Dlab, & Mornar, 2016) and in line with the first project result – document *Workshop syllabus and materials* (*GLAT project - Results*, 2019). The activities for participants were organized in three modules: *Game Based Learning and unplugged activities*, *Problem Based Learning*, *online quizzes and logical tasks*, and *Inquiry based learning, games and tools for programming* (Hoić-Božić *et al.*, 2018).

Each module started with the two-day face-to-face workshop where participants were introduced to theoretical background and examples of activities and learning scenarios as well as ICT tools. Activities after each workshop were mainly performed online, using an e-course in learning management system Moodle where participants could access all learning materials and submit results of the tasks. The main task after each workshop was to develop a learning scenario for chosen school subject and lesson from the curriculum. Participants were expected to apply newly acquired knowledge about contemporary teaching and learning methods and digital tools and develop a scenario in written form, using a given template (Mezak and Pejić Papak, 2018). In that process, experts from the project team provided feedback (online mentoring) to ensure that participants planned adequate activities for developing computational thinking skills.

A document with a set of outstanding learning scenarios that serve as examples of good practice also represents one of the results of the project. Development of learning scenario was followed by the implementation of the scenarios by the participants in the classrooms with their students. At the end of each module, feedback from participants regarding prepared materials and examples was collected as well as their experiences with the implementation of the developed learning scenario in classrooms. Based on this information, the main project result was created - *Enhanced version of syllabus with materials and examples of good practice* (GLAT project - Results, 2019).

4.2 Instruments and procedure

The extent of teachers' progress regarding familiarity with the terminology and the possibilities of using games and other means of ICT in teaching for development of computational thinking skills was determined using two anonymous questionnaires, an initial and final questionnaire (Hoić-Božić and Holenko Dlab, 2019).

As shown in Figure 1, before the first module of the GLAT education, teachers completed the initial questionnaire and self-assessed to what extent they are familiar with the given items (terms, tools, forms, methods and teaching strategies). Upon completion of the last module, teachers completed the final questionnaire in which they self-assessed whether they had made progress and how much progress had been made. To ensure the comparability of the results, participants were instructed to choose and remember unique code and use it on the initial and the final questionnaire. Increase in the level of familiarity with the terminology and possibilities related to contemporary teaching and learning methods and digital tools is considered a prerequisite for using them in everyday teaching practice.

Both questionnaires included demographic questions regarding participants' age and work experience at school (in years). Since only one participant was male, gender was not included as this would impair their anonymity. Participants were also required to indicate the class in which they are currently teaching.

The main part of the initial questionnaire included a list of statements for self-assessment of the extent of familiarity with the terminology and the possibilities of using games and other means of ICT in teaching for development of computational thinking skills. Self-assessment was made using 5-point Likert scale response format with values ranging from 0 (not at all familiar) to 4 (very familiar). Statements were divided into the three groups to identify (Hoić-Božić and Holenko Dlab, 2019):

1) to what extent are the teachers familiar with the terminology related to the methods and teaching strategies as well as digital games and tools,
2) to what extent are the teachers familiar with the possibilities of adapting, creating and using methods, contents and tools,
3) to what extent are the teachers using non-specific forms, methods and teaching strategies.

To determine the changes in comparison with the results of the initial questionnaire, the final questionnaire followed the structure of the initial questionnaire. The same statements were used but with different Likert-type response format - participants were required to self-assess whether they had made progress and how much progress had been made on the scale from 0 (not at all) to 4 (to a great extent).

The final questionnaire also included an open-ended question for participants' comments regarding the project as a whole.

4.3 Participants

A total of 24 primary school junior grade teachers, 1 male and 23 females, voluntarily participated in the GLAT education. Participants were chosen in with the help of the Croatian Education and Teacher Training Agency among teachers who applied for the education (Hoić-Božić and Holenko Dlab, 2019).

All selected teachers were highly motivated for acquiring knowledge and skills regarding possibilities to use games for development of computational thinking skills among their students. At the time, all of them were working with students aged 6 to 11 years (first to fourth grade of primary school) and with classes ranging from 10 to 24 students. All participants completed the initial questionnaire (N=24; Age: M=43,167; SD=7,585; Years of work experience at school: M = 18,458; SD = 7,962) while 20 participant completed the final questionnaire (N=20; Age: M=43,250; SD=7,078; Years of work experience at school: M=18,950; SD=7,451).

5. Results

An analysis of teachers' responses in the initial and final questionnaire was made. The following descriptive statistics indicators were determined: minimum (Min), maximum (Max), arithmetic mean (Mean), and standard deviation (SD). Table 1 presents the results regarding how well the respondents were familiar with the listed terms at the beginning of the GLAT education (the initial questionnaire) and how much they had progressed during the education in applying and understanding these terms (the final questionnaire). In order to better observe the comparison of initial status and progress, the mean values are also presented using graph (Figure 2). Obtained results showed that the least familiar term to participants was "Basic programming concepts" and according to the self-assessment of the progress, they made the least progress for this term. They were most familiar with the term "Digital competencies" but also made a great progress for this term. Participants have made the most progress regarding the terms "Game Based Learning" and "Learning scenario".

Table 1: Familiarity with the terminology

	Term	Initial questionnaire					Final questionnaire				
		N	Min	Max	Mean	SD	N	Min	Max	Mean	SD
1.	Digital competencies	24	1	3	2,00	,780	20	2	4	3,20	,616
2.	Problem Based Learning	24	0	4	1,83	1,049	20	2	4	3,25	,550
3.	Game Based Learning	23	0	3	1,78	1,043	20	2	4	3,40	,598
4.	Digital Serious Games	24	0	4	1,71	,955	20	2	4	3,30	,571
5.	Inquiry Based Learning	24	0	3	1,50	1,063	20	2	4	2,90	,553
6.	Unplugged activities	24	0	3	1,42	,881	20	2	4	3,05	,605
7.	Algorithmic thinking	24	0	2	1,29	,751	20	2	4	3,20	,616
8.	Web 2.0 tools	23	0	4	1,13	1,014	20	2	4	3,35	,587
9.	Learning scenario	23	0	3	1,00	,953	20	3	4	3,40	,503
10.	Basic programming concepts	24	0	3	,92	1,060	20	1	4	2,75	,786

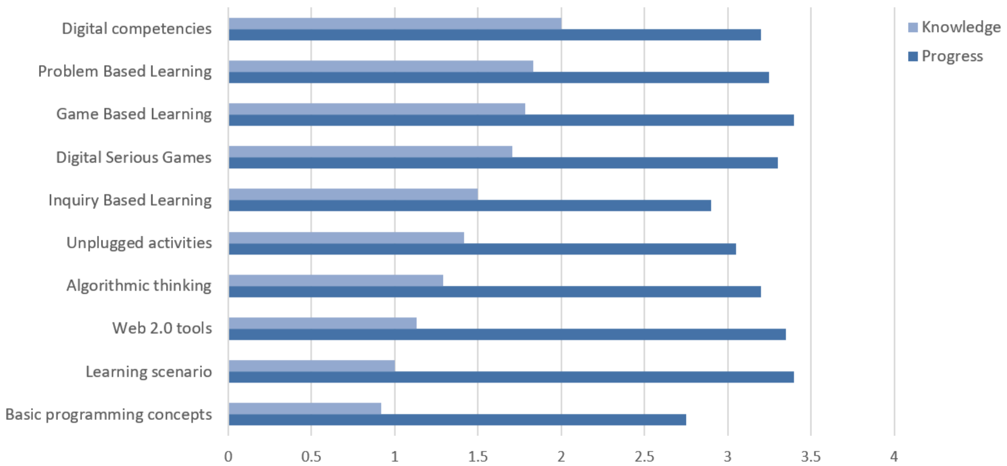

Figure 2: Familiarity with the terminology - comparison of the initial state and progress

Table 2 presents the results regarding how well the respondents were familiar with the listed possibilities of adapting, creating and using teaching contents and methods at the beginning of the GLAT education (the initial questionnaire) and how much they had progressed with these possibilities during the education (the final questionnaire). Results indicate that participants were most familiar with the possibility of digital content creation. They were the least familiar with the possibilities of using programming languages and tools for visual programming.

Table 2: Familiarity with the possibilities of adapting, creating and using teaching contents and methods

	Possibility	Initial questionnaire					Final questionnaire				
		N	Min	Max	Mean	SD	N	Min	Max	Mean	SD
1.	Digital content creation	24	0	3	1,63	1,013	20	3	4	3,25	,444
2.	Gamification	24	0	3	1,42	,830	20	2	4	3,00	,324
3.	Online quizzes and logical tasks	24	0	3	1,38	,970	20	2	4	3,60	,598
4.	Web 2.0 tools for digital content creation (e.g. Canva, Sketchpad)	24	0	2	,79	,833	20	2	4	3,30	,657
5.	Programming languages	24	0	2	,58	,717	20	1	4	2,45	1,050
6.	Tools for visual programming (e.g. Scratch, Snap!)	24	0	2	,58	,776	20	2	4	2,85	,745

As it can be seen on Figure 3 which shows graph with comparison of the initial state and progress regarding this group of statements, participants made the most progress regarding the possibility of creating online quizzes and logical tasks. Participants made the least progress regarding the programming languages and tools for visual programming.

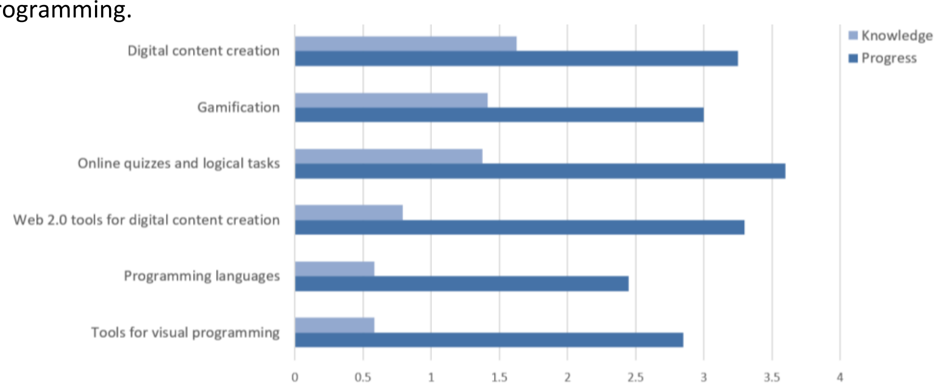

Figure 3: Familiarity with the possibilities of adapting, creating and using teaching contents and methods - comparison of the initial state and progress

The statements in the third part of the questionnaires were used to determine how frequent did teachers used listed forms, methods, and teaching strategies in their teaching practice with students before the GLAT education (initial questionnaire) and increase in frequency of using these forms, methods and teaching strategies after the education (final questionnaire). Table 3 shows descriptive statistics indicators while Figure 4 shows graph with mean values of the initial frequency and the increase of frequency for third group of statements. According to the results from the initial questionnaire, the most often used forms, methods and/or teaching strategies were “Game” and “Individual work”. Results of the final questionnaire showed the relatively high increase of frequency of using “games” as well as “Collaborative learning strategies” and “Creative thinking techniques”. The “debate” was rarely used and the increase in frequency regarding this item was among the lowest (together with the “frontal teaching”).

Table 3: Initial frequency of use of forms, methods and teaching strategies

	Forms, methods, and teaching strategies	Initial questionnaire					Final questionnaire				
		N	Min	Max	Mean	SD	N	Min	Max	Mean	SD
1.	Game	24	3	4	3,33	,482	20	2	4	3,15	,745
2.	Individual work	24	2	4	3,17	,482	20	0	3	1,90	1,021
3.	Demonstration	24	2	4	3,00	,511	20	0	4	2,35	,933
4.	Frontal teaching	24	2	4	3,00	,417	20	0	3	,85	,988
5.	Work in pairs	24	2	4	3,00	,417	20	0	4	2,50	,946
6.	Practical tasks	24	2	4	2,83	,565	20	1	4	2,90	,718
7.	Students self-assessment	24	2	4	2,79	,721	19	1	4	2,79	1,084
8.	Presentation of students’ work	24	2	3	2,79	,415	20	1	4	2,50	,761
9.	Group work	24	2	3	2,75	,442	20	0	4	2,35	,988
10.	Discussion	24	1	4	2,67	,702	20	0	4	2,40	,995
11.	Creative thinking techniques	24	1	4	2,54	,721	20	2	4	3,10	,641
12.	Peer-to-peer learning	24	2	4	2,54	,588	20	0	4	2,65	,933
13.	Collaborative learning strategies	24	2	4	2,54	,588	19	1	4	3,00	,667
14.	Research tasks (problems)	24	1	4	2,38	,647	20	0	4	2,80	,951
15.	Project-based tasks	24	1	3	2,25	,737	20	1	4	2,55	,826
16.	Role-playing	24	1	3	2,17	,702	20	1	4	2,65	,933
17.	Debate	24	0	3	1,83	,702	20	0	4	1,75	1,209

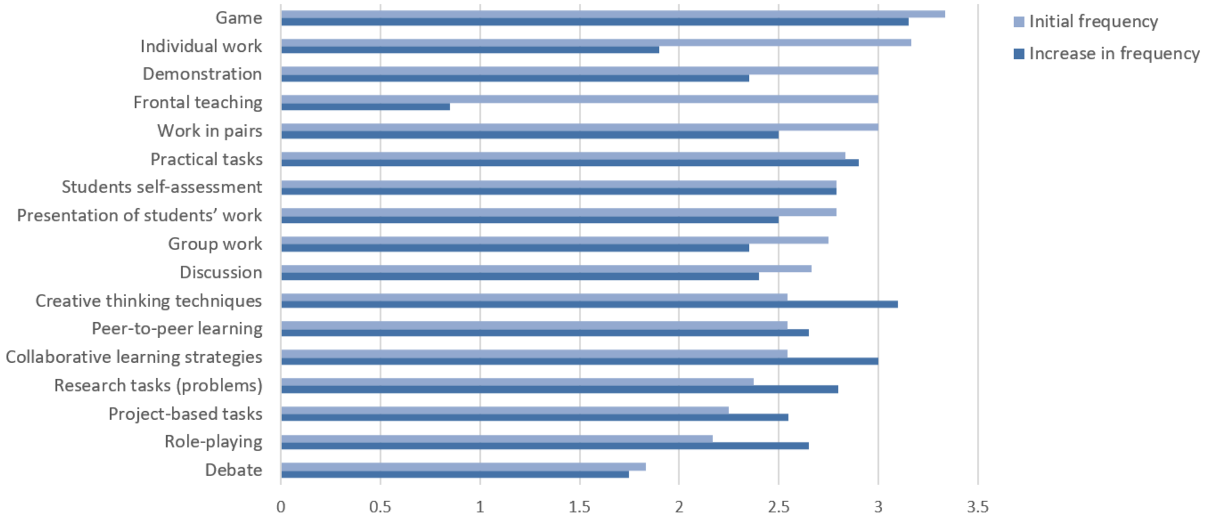

Figure 4: Frequency of using teaching forms, methods and strategies - Comparison of initial frequency and increase in frequency

In the last part of the final questionnaire, teachers gave a descriptive, mostly positive final review of the project, in particular the three workshops that were organized during the project. In their comments, teachers emphasized satisfaction of being involved in the project and the possibility to apply the acquired knowledge and skills in their everyday practice. The teachers wrote: "I am extremely pleased that I was given the opportunity to participate in the GLAT project. I learned a lot and improved my own competencies, but also refreshed my way of working.", "Excellent preparation of the workshops and expertise, interesting content, pleasant and very friendly lecturers. I had chance to develop my creativity and was encouraged for constant participation.", "Everything was great! I hope that technical conditions in my school will improve so I will be able to apply most of the games and knowledge in general in my classroom.".

6. Discussion

Results are discussed based on the descriptive indicators of self-assessment of progress made by study participants in the final questionnaire. The results are contextualized with respect to the initial state that was self-assessed by participants in the initial questionnaire to draw conclusions about the effectiveness of the GLAT education for encouraging teachers to design Game Based Learning activities.

Results indicate that participants progress depend on pre-existing knowledge of terminology and possibilities of adapting, creating and using teaching contents and methods. The higher progress is related to the items where the participants showed relatively high initial level of familiarity: the terms "Problem based learning", "Game based learning", and "Digital serious games", and the possibility for digital content creation. The lowest progress was achieved for items with a relatively low initial familiarity level: the term "Basic programming concepts" and the possibilities for using programming languages and tools for visual programming. This was expected since most of the participants did not have the opportunity to acquire knowledge about computer programming during their formal education nor the goal of the GLAT education was to teach them how to program. Participants, who were primary school junior grade teachers and not computer science teachers, were introduced with visual programming tools that can be used game-based activities in order to indirectly familiarise students with basic programming concepts and algorithmic thinking.

If participants' progress is contextualized with respect to the initial state, it can be concluded that they have made the greatest progress for the items with a relatively low initial result: the terms "Learning scenarios" and "Web 2.0 tools", and the possibility for using Web 2.0 tools for digital content creation. The teachers were familiar with planning learning activities but the novelty for them was the approach of organizing activities with learning scenarios as well as possibility to prepare digital content for which teachers were not aware that they could create on their own with the help of the appropriate Web 2.0 tools. The results show that teachers recognized and accepted digital tools as a teaching tool they can use for various learning activities that will motivate their students to learn.

During the analysis of the frequency of individual responses, it was observed that for all items at least three participants indicated the value 0 (not at all familiar). Results of the final questionnaire showed that there was no item on which participants reported no progress and for most items most respondents self-assessed their progress as significant.

Regarding the extent of using non-specific forms, methods and teaching strategies, the obtained results show the highest frequency increase in item "Game". For this item, the participants reported the highest initial frequency. The lowest level of increase in frequency was observed for items "Frontal work" and "Individual work" for which the GLAT project activities have not aim to increase the level of use (for these items teachers reported a relatively high initial frequency). When contextualizing progress with respect to the initial results, it can be concluded that the greatest impact of participation in the education was achieved on items "Collaborative learning strategies" and "Creative thinking techniques".

These results confirm the effectiveness of the instructional model used during the GLAT education. Increase in the level familiarity with the terminology and possibilities related to contemporary teaching methods and digital games and tools, has been achieved, and this was considered a prerequisite for using them in everyday teaching practice. Group of teachers who applied for the education consisted of teachers who were very interested in the main education topics which certainly influenced the achievement of these results. Teachers were not familiar with the concept of algorithmic thinking nor the possibilities for creating learning scenarios containing games, digital contents and tools in order to support algorithmic thinking development, but were highly motivated to acquire new knowledge and skills in this area. In addition to self-assessed progress, during the learning scenarios development, the teachers showed that they are ready to apply the newly acquired knowledge in their everyday teaching of different school subjects. The effectiveness of the education is also supported with the positive feedback received from the participants. They expressed their satisfaction with the included topics, lecturers and acquired knowledge and skills.

7. Conclusions and plans for future work

The aim of the study presented in this paper was to determine the extent of progress of teachers, participants of the GLAT education, regarding the possibilities of creating learning scenarios with activities that include digital games and tools for development of computational thinking, and the familiarity with related terminology.

The results confirmed effectiveness of the GLAT education for participants as they made significant progress for the most of the examined items. The teachers were not familiar with the terms and possibilities that were in the focus of this study like algorithmic thinking, learning scenarios, and digital content creation using Web 2.0 tools. After the education, their progress was realized to the greatest extent exactly with these items. They have also made great progress in terms of usage teaching forms, methods and strategies related to games, which they used most often before, as well as creative thinking techniques and collaborative learning strategies that are important for developing algorithmic and computational thinking skills. Besides the self-assessed progress reported in the final questionnaire, their progress was evident from the results of their practical work – developed learning scenarios.

In addition to the possibility to support teachers in designing game based learning activities through education, it would be useful to have additional opportunities to reach a larger number of teachers. One of them is to develop specialized ICT tool that will guide teachers through the process of designing innovative learning scenarios that include game based learning activities. Therefore, a future work within the project *Digital games* will include development of a web application that will make the process of designing learning scenarios easier for teachers. Using this tool, teachers will be able to review examples of good practice and receive recommendations of different games and activities that they can include in their scenario. In this way, efforts will be made to encourage teachers to include activities for development of computational thinking into their scenarios to a greater extent.

8. Acknowledgements

The research has been funded by the Erasmus+ Programme of the European Union under the project „Games for Learning Algorithmic Thinking" (2017-1-HR01-KA201-035362) and by the University of Rijeka (Croatia) under the project "Digital games in the context of learning, teaching, and promoting inclusive education" (uniri-drustv-18-130).

References

Beetham, H. and Sharpe, R. J. (2013) 'Rethinking pedagogy for a digital age: designing for 21st Century Learning', *RoutledgeFalmer*.

Brackmann, C. P. *et al.* (2017) 'Development of Computational Thinking Skills through Unplugged Activities in Primary School', in *Proceedings of the 12th Workshop on Primary and Secondary Computing Education - WiPSCE '17*. New York, New York, USA: ACM Press, pp. 65–72. doi: 10.1145/3137065.3137069.

Ching, Y.-H., Hsu, Y.-C. and Baldwin, S. (2018) 'Developing Computational Thinking with Educational Technologies for Young Learners', *TechTrends*. Springer, 62(6), pp. 563–573. doi: 10.1007/s11528-018-0292-7.

GLAT project - Results (2019). Available at: https://glat.uniri.hr/?page_id=336 (Accessed: 19 April 2020).

Hernández-Leo, D. *et al.* (2013) 'Towards an Integrated Learning Design Environment. In: Hernández-Leo D., Ley T., Klamma R., Harrer A.', *Hernández-Leo D., Ley T., Klamma R., Harrer A. (eds) Scaling up Learning for Sustained Impact. EC-TEL 2013. Lecture Notes in Computer Science*, 8095(Springer, Berlin, Heidelberg).

Hoić-Božić, N. *et al.* (2018) 'Project GLAT-Encouraging algorithmic thinking using didactic games', *International Journal of Multidisciplinary Research*, 4(2), pp. 73–95.

Hoić-Božić, N. *et al.* (2019) 'Development of computational thinking skills in primary school through digital storytelling with Scratch', in *Proceedings of the 10th International Conference on e Learning*. Belgrade, Serbia, pp. 114–119.

Hoić-Božić, N. and Holenko Dlab, M. (2019) *GLAT Project Dissemination*. Available at: https://glat.uniri.hr/wp-content/uploads/2019/12/GLAT_Project_dissemination.pdf (Accessed: 18 April 2020).

Hoic-Bozic, N., Lončarić, D. and Holenko Dlab, M. (2019) 'Preparing Primary Junior Grade Teachers to Teach Computational Teaching: Experiences from the GLAT Project', *Mathematics and Informatics*, 62(5), pp. 487–499.

Holenko Dlab, M. *et al.* (2019) 'Digital games and tools for development of computational thinking in primary school', in *Proceedings of the International Conference on Management, Economics & Social Science - ICMESS 2019*. Brussels, Belgium, pp. 1–7.

Jagušt, T. *et al.* (2018) 'Exploring Different Unplugged Game-like Activities for Teaching Computational Thinking', in *IEEE Frontiers in Education Conference*, pp. 1–5.

Jiang, X. *et al.* (2019) 'The computational puzzle design framework', in *Proceedings of the 14th International Conference on the Foundations of Digital Games - FDG '19*. New York, New York, USA: ACM Press, pp. 1–11. doi: 10.1145/3337722.3337768.

Jocius, R. *et al.* (2020) 'Code, Connect, Create: The 3 C Professional Development Model to Support Computational Thinking Infusion', in *Proceedings of the 51st ACM Technical Symposium on Computer Science Education*. New York, NY, USA: ACM, pp. 971–977. doi: 10.1145/3328778.3366797.

Mezak, J. and Pejić Papak, P. (2018) 'Learning scenarios and encouraging algorithmic thinking', in *41st International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO)*. Rijeka, pp. 836–841.

Rojas-López, A. and García-Peñalvo, F. J. (2018) 'Learning Scenarios for the Subject Methodology of Programming From Evaluating the Computational Thinking of New Students', *IEEE Revista Iberoamericana de Tecnologias del Aprendizaje*, 13(1), pp. 30–36.

Schade, C. *et al.* (2019) 'Between Learning Objectives and Learning Experience: Methods for the Development of Game Based Learning Scenarios', in *European Conference on Games Based Learning*, pp. 605–613.

Shute, V. J., Sun, C. and Asbell-Clarke, J. (2017) 'Demystifying computational thinking', *Educational Research Review*. Elsevier, 22, pp. 142–158. doi: 10.1016/J.EDUREV.2017.09.003.

Tsarava, K. *et al.* (2017) 'Training Computational Thinking: Game-Based Unplugged and Plugged-in Activities in Primary School', in *Proceedings of the 11th European Conference on Game-Based Learning ECGBL 2017*. Graz, Austria, pp. 687–695.

Vos, N., Van Der Meijden, H. and Denessen, E. (2011) 'Effects of constructing versus playing an educational game on student motivation and deep learning strategy use', *Computers and Education*, 56(1), pp. 127–137. doi: 10.1016/j.compedu.2010.08.013.

Wing, J. M. (2006) 'Computational thinking', *Communications of the ACM*, 49(3), pp. 33–35.

Yadav, A., Stephenson, C. and Hong, H. (2017) 'Computational thinking for teacher education', *Communications of the ACM*. Association for Computing Machinery, 60(4), pp. 55–62. doi: 10.1145/2994591.