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# NATIONAL REPORTS - CROATIA

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# INTRODUCTION

# CROATIA

## EXECUTIVE SUMMARY

Implementation and validation of the C4G approach in Croatia took place from February to June 2020 as part of teaching of subject Informatics in primary schools. Due to the COVID-19 pandemic, Croatian schools were at that time closed so the approach was adapted for use in online environment.

Teachers ($N_T$=8) from eight primary schools in Rijeka and students - future teachers of graduate study programme of Informatics at University of Rijeka ($N_{ST}$=43) participated in the validation study and organized online game-based activities for building programming skills among students ($N_S$=773) from 5$^{th}$ to 8$^{th}$ grade of primary school. All implementation activities were based on the selected C4G learning scenarios and instructions for students and assumed independent work of students under the guidance of their teachers in virtual classrooms.

Using developed data collection tools, teachers' and students' attitudes, observations and comments regarding the game-based C4G methodology for building programming skills were collected. In addition, external experts ($N_E$=3) were included in the validation of the approach.

Results showed that students accepted the game-based C4G methodology. Conducted activities enabled them to develop their programming skills in a fun way. Students were motivated to learn programming using tasks that included solving real-life problems. Teachers, students – future teachers, and experts consider this approach as relevant and effective way of acquiring programming skills that is applicable and appropriate for the students aged 10 to 16 years. They also confirmed effectiveness of support tools used in the instructional process. Based on the performed C4G implementation and validation activities in Croatia, it can be concluded that with the help of the developed materials and guidance from teachers, students can achieve learning objectives also in the online environment. In order for the approach to be applied online, it would be useful to allow students to create programs using Scratch. In this way, the technical problems that students encountered when using Snap! on tablets could be avoided.

# IMPLEMENTATION

## Introductory workshops

In line with the C4G validation strategy, implementation of the game-based C4G approach in Croatia started with workshops for teachers and experts who agreed to take part in the implementation and validation activities (Figure 1).

Introductory workshops were organized at the University of Rijeka, Department of Informatics (UNIRI) on 21th of February and 2nd of March 2020. During the workshops, project members presented the information about the CODING4GIRLS project and approach for building programming skills. Details regarding the protocol for implementation and the validation of the approach in the Croatian schools have been agreed. The teachers and experts were also provided with all the necessary contents and tools.

*Figure 1 - Introductory workshop with teachers and experts at UNIRI*

## Data collection tools

During the validation of C4G approach, all the data collection tools provided in the C4G validation strategy were used:

- S1 – Preliminary questionnaire (for students)
- S2 – Follow-up questionnaire (for students)
- S3 – Student's comments
- T1 – Teacher's observations
- T2 – Teacher's comments
- E – Expert's comments

The data collection tools were before validation activities translated into the Croatian language.

Questionnaires S1 and S2 were created using Google Forms while data collection tools S3, T1, T2, and E for teachers and experts were prepared as Word documents in which they could write observations and comments.

## Materials

During the implementation, learning scenarios and instructions for students that were developed by the project partners were used. Unfortunately, developed 3D game environment was not used since it should be used in computer classroom in schools and the implementation activities were carried out online.

In collaboration with the teachers and experts, the following subset of C4G learning scenarios with mini-projects (serious games) was selected to be used in schools:

1. Introduction to Snap! interface
2. Time to bring your sprite to life
3. Cameleon's summer vacation
4. Picking up the trash
5. Buying food for a picnic
6. Recycling
7. Simplified PACMAN game.

This subset covers the basic programming concepts that are in the focus of the C4G approach (loops, conditionals, variables, statements, operators, events, parallelism). Each learning scenario enable students to learn one or multiple programming concepts by creating a game that addresses real-world problem. To further motivate girls to learn programming, the topics of real-world problems are chosen to be attractive to girls. All resourced were translated into the Croatian language prior to implementation.

The implementation approach was adapted for online learning so teachers prepared additional learning materials with instructions and tasks for C4G activities in order to support student's independent work (e.g. Learning programming in Snap!, shown on Figure 2).


*Figure 2 – Thinglink interactive learning material "Learning programming in Snap!"*

Video tutorials were also recorded and published on YouTube (Figure 3) with the aim of making it easier for students to work independently in online environment. For example, sets of videos were prepared to introduce students with the tool (Introduction to Snap!) or to help them with the development of the projects included in the learning scenarios (Picking up the trash, Recycling).

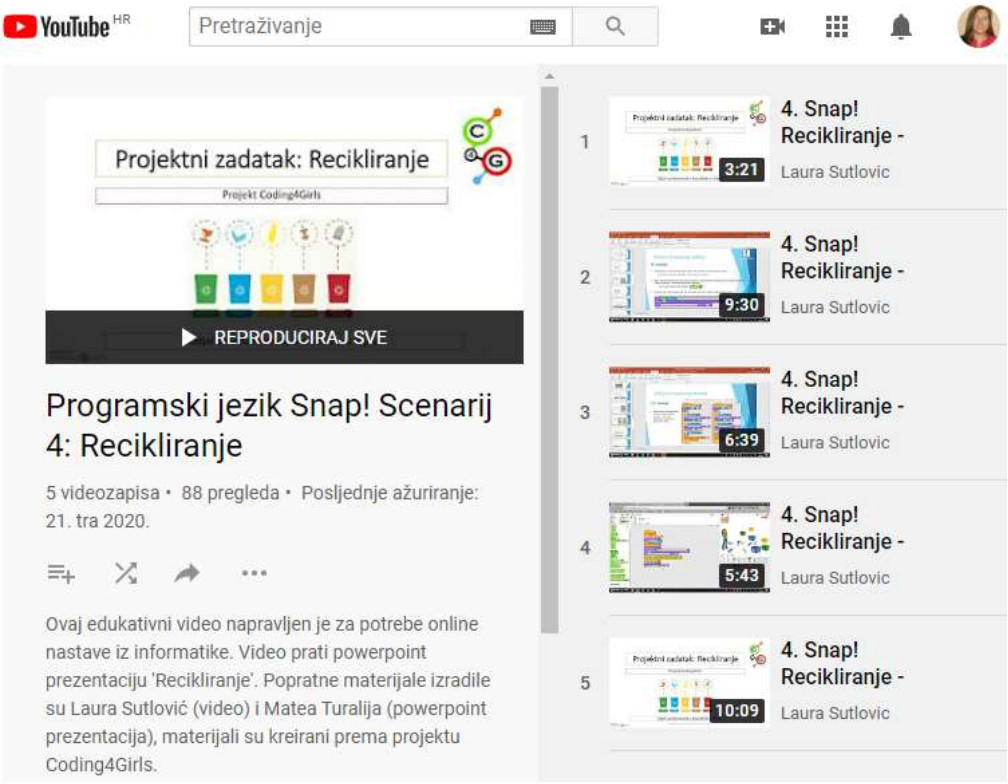


*Figure 3 – A set of video tutorials for the learning scenario "Picking up the trash"*

## Setup model and procedure

Sessions for building programming skills using the C4G approach were organized as a part of regular teaching of subject Informatics in primary school that was at that time carried out in online learning environments due to COVID-19 pandemic. Implementation activities were conducted in 5th and 6th grade where the subject Informatics is compulsory and in 7th and 8th grade of primary where the subject is optional.

Depending on the teacher, implementation activities took place during 6-8 weeks between March and June 2020. Students were expected to dedicate 4 hours of independent work per week. Teachers delivered learning materials to students using virtual classrooms (created with Microsoft Teams, Edmodo or similar tools).

Teachers first organized sessions in order to introduce coding concepts. Students could practice those concepts using exercises and then they were expected to create a serious game using the learnt coding concepts. During the sessions, teachers provided guidance and help to the students with the given tasks. At the end of each session, students could present their games and experiences to peers and participate in de-briefing in the virtual classroom. At the beginning of the implementation in schools, students answered the preliminary questionnaire (S1). After the implementation, in the last session, students answered the follow-up questionnaire (S2) about their perception and views on the C4G learning approach. They were required to write the anonymised code received from the teacher to ensure comparison of results regarding the self-assessment of their programming skill. Teachers collected students' qualitative opinions and comments through a group discussion in virtual classrooms (S3).

Teachers also reported the reaction of students and their progress in building coding skills using the game-based C4G approach (T1) and their own views related to the relevance and effectiveness of the CODING4GIRLS game-based learning approach for building programming skills (T2).

To further improve project outputs and ensure that they meet the needs of learners and teachers, the game-based C4G approach for building programming skills views related to the relevance and effectiveness of the CODING4GIRLS game-based learning approach were collected from external experts (E). Experts were given access to project documentation and results as well as to contents created during the implementation.

## Participants

The project team at UNIRI includes researchers and teachers ($N_{PT}$=4) in the field of game-based learning, programming, didactics of informatics, and e-learning. All of them were actively involved in the preparation of the implementation and validation activities, including selection of teachers and experts to participate in the study.

Direct participant of the study were teachers of informatics ($N_T$=8) from 7 primary schools in Rijeka, Croatia together with their students ($N_S$=773). All the selected teachers have years of experience in teaching informatics and they are mentors in informatics for students – future teachers of informatics from UNIRI during the teaching practice in informatics. Students – future teachers of informatics ($N_{ST}$=35) who are in the final year of study and therefore obliged to attend a teaching practice in informatics were also included in the implementation activities. Many of them will start working in schools next school year and will be able to apply the C4G approach with their students. Depending on the number of classes and students, each teacher - mentor was assigned with 3 to 6 students - future teachers who helped to prepare and conduct the C4G activities under mentor's supervision.

The C4G approach for building programming skills was applied in 38 mixed-gender classes and involved a total of 773 students aged from 11 to 15 years (5$^{th}$ to 8$^{th}$ grade of primary school). The subject Informatics is compulsory for 5$^{th}$ and 6$^{th}$ grade students while for 7$^{th}$ and 8$^{th}$ grade students the subject is optional. Table 1 shows number of students – participants of the study by age/grade. The number of students in the classes ranged from 13 to 28 while the average number of students in one class was 20. The most students were from 6$^{th}$ grade (Figure 4).

*Table 1 - Number of students by age/grade*

| Years of age | Grade | Classes | Number of students |
|---|---|---|---|
| 11-12 | 5 | 9 | 191 |
| 12-13 | 6 | 14 | 308 |
| 13-14 | 7 | 8 | 146 |
| 14-15 | 8 | 7 | 128 |
| | **Total** | **38** | **773** |

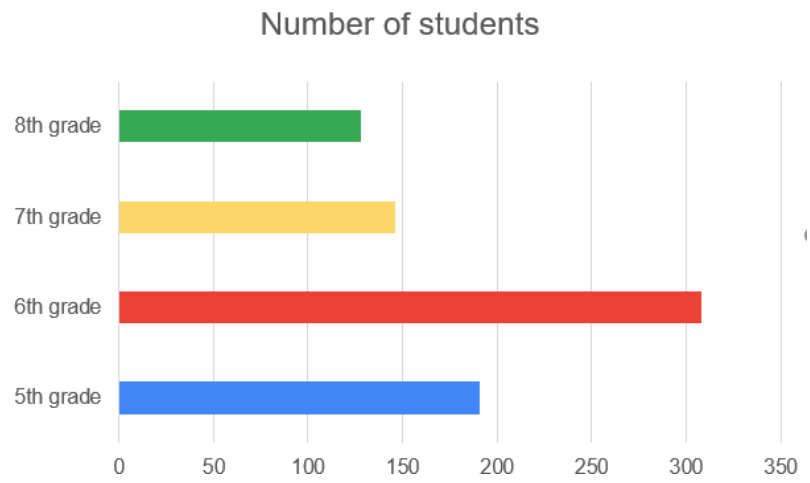


*Figure 4 – Number of students by grade*

Three external experts ($N_E$=3) were chosen for the validation activities based on their expertise. Two of them are university professors and researchers, one in the field of teacher education and the other in the fields of computer science and teaching programming. Third expert is a teacher advisor for informatics who works in a primary school.

## RESULTS

### Results of questionnaires for students

Two questionnaires for students were used: preliminary questionnaire about the use of digital devices and perceived level of programming and the follow-up questionnaire about satisfaction with programming and coding activities, satisfaction with the organization of the implementation, and perception on the acquired coding skills.

In both questionnaires students were asked to self-assess their current level of programming skill. Based on this question, the difference between students' self-assessed initial and final level of programming skill was calculated (the answers from the questionnaires were paired based on the code that students have entered).

A total of 569 students (73.61% of students who participated in C4G activities) solved preliminary questionnaire. A total of 424 students (54.85%) solved the follow-up questionnaire. Self-assessment results were compared only for students who solved both questionnaires - 347 students (44.89%).

*S1 - Preliminary questionnaire*

A total of 569 students solved the preliminary questionnaire about the use of digital devices and perceived level of programming. The mean age of students was 12.31 years (SD=1,024). Table 2 shows number of students who solved S1 by gender and grade. The number of girls and boys who responded is approximately equal (Figure 5).

*Table 2 - Number of students who solved S1 - Preliminary questionnaire by gender and grade*

| | **5th grade** | **6th grade** | **7th grade** | **8th grade** | **Total** |
|---|---|---|---|---|---|
| Boys | 68 | 111 | 57 | 47 | 283 |
| Girls | 74 | 121 | 52 | 39 | 286 |
| **Total** | **142** | **232** | **109** | **86** | **569** |
| Response rate | 74.35% | 75.32% | 74.66% | 67.72% | 73.61% |

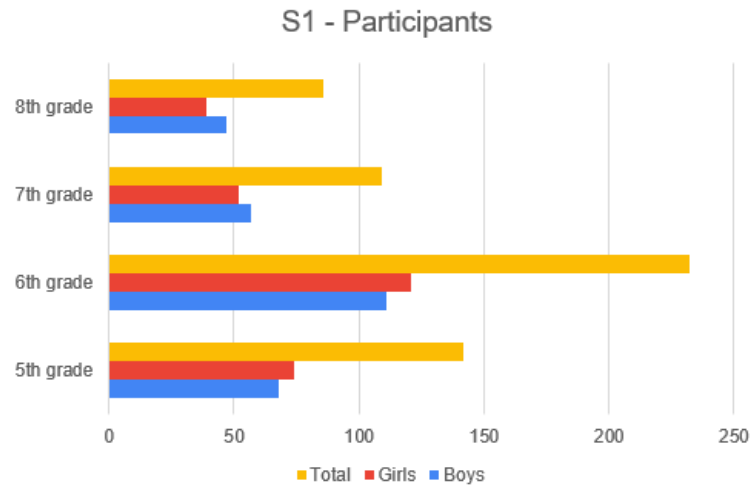


*Figure 5 - Distribution of students who solved S1 - Preliminary questionnaire by gender and grade*

Table 3 shows descriptive statistical analysis of participants' responses to the questions related to the use of digital devices, the internet and video-games. It is worth noting the values of the standard deviation, which for some questions indicates larger deviances from the average values. The comparison of the overall average results by gender (Figure 6) shows that boys and girls have been using digital devices for the same length of time. However, on a weekly basis, boys use digital devices and the Internet more and spend significantly more time playing games.

*Table 3 - The use of digital devices, the internet and video-games by gender*

| Question | | N | Min | Max | Mean | SD |
|---|---|---|---|---|---|---|
| 1. For how long have you been using computers, tablets or other digital devices (in years)? | Boys | 283 | 1 | 12 | 6.237 | 2.055 |
| | Girls | 286 | 0 | 14 | 5.767 | 1.882 |
| | **Total** | **569** | **0** | **14** | **6.001** | **1.982** |
| 2. How many hours per week do you use a computer, tablet or other digital device? | Boys | 283 | 1 | 168 | 19.834 | 19.637 |
| | Girls | 281 | 0 | 168 | 16.196 | 19.419 |
| | **Total** | **564** | **0** | **168** | **18.021** | **19.596** |
| 3. How many hours per week do you use the Internet? | Boys | 282 | 1 | 140 | 21.603 | 21.315 |
| | Girls | 277 | 0 | 168 | 17.643 | 19.502 |
| | **Total** | **559** | **0** | **168** | **19.611** | **20.517** |
| 4. How many hours per week do you play video games? | Boys | 282 | 0 | 62 | 11.261 | 10.803 |
| | Girls | 284 | 0 | 35 | 2.905 | 4.922 |
| | **Total** | **565** | **0** | **62** | **7.075** | **9.367** |

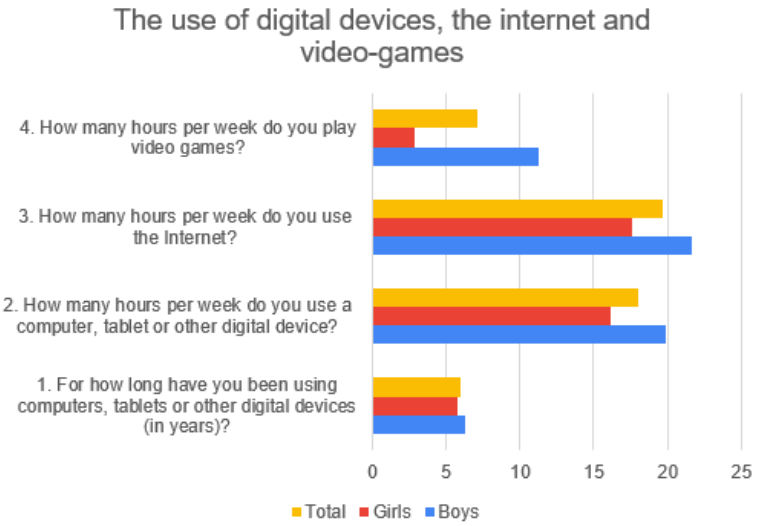


*Figure 6 - The use of digital devices, the internet and video-games – comparison by gender*

The average values show that students spend a little more time on the Internet than using digital devices. It can be assumed that such numbers are results of misconceptions. For example, some students may think that using their smartphone to access the Internet does not count.

By comparing the data by grade (Table 4) it can be noticed that 5$^{th}$ and 6$^{th}$ grade students use digital devices and the Internet less than 7$^{th}$ and 8$^{th}$ grade students. Analysis of individual responses shows that some 7$^{th}$ and 8$^{th}$ grade students reported very high values (e.g., 100 hours per week for the use of Internet) which affected these average results.

*Table 4 - The use of digital devices, the internet and video-games by grade and gender*

| Question | | 5th grade | 6th grade | 7th grade | 8th grade |
|---|---|---|---|---|---|
| 1. For how long have you been using computers, tablets or other digital devices (in years)? | Boys | 5.279 | 6.000 | 7.000 | 7.255 |
| | Girls | 4.804 | 5.876 | 6.192 | 6.692 |
| | **Total** | **5.032** | **5.935** | **6.615** | **7.000** |
| 2. How many hours per week do you use a computer, tablet or other digital device? | Boys | 18.426 | 15.324 | 24.035 | 27.426 |
| | Girls | 12.528 | 14.819 | 18.250 | 24.333 |
| | **Total** | **15.414** | **15.063** | **21.275** | **26.023** |
| 3. How many hours per week do you use the Internet? | Boys | 18.537 | 18.261 | 26.105 | 28.404 |
| | Girls | 12.522 | 15.534 | 22.510 | 26.487 |
| | **Total** | **15.485** | **16.798** | **24.390** | **27.535** |
| 4. How many hours per week do you play video games? | Boys | 10.828 | 8.833 | 12.412 | 16.213 |
| | Girls | 2.603 | 3.213 | 2.981 | 2.410 |
| | **Total** | **6.586** | **5.914** | **7.913** | **9.953** |

The participants (N=569, 283 boys, 286 girls) self-assessed the level of their programming skills on the scale from *0 - I have never coded or programmed before* to *4 - I can design a solution of a problem in the form of a program*. Results are shown in the Table 5. Most of the students stated for themselves that they are at level *1 - novice programmers* (33.39%) or on level *2 – can code simple programs* (32.51%). If we compare these results by gender (Figure 7), it can be seen that the boys prevail among the students that self-assess their level of programming with the levels 3 and 4.

*Table 5 - Self-assessment of programming skills by gender*

| Level of programming skills | Boys | Girls | Total |
|---|---|---|---|
| 0 - I have never coded or programmed before | 9.54% | 7.34% | 8.44% |
| 1 - I am a novice programmer (just have basic ideas) | 31.45% | 35.31% | 33.39% |
| 2 - I can code simple programs | 29.68% | 35.31% | 32.51% |
| 3 - I am fluent in programming (can create a full program) | 23.32% | 17.48% | 20.39% |
| 4 - I can design a solution of a problem in the form of a program | 6.01% | 4.56% | 5.27% |

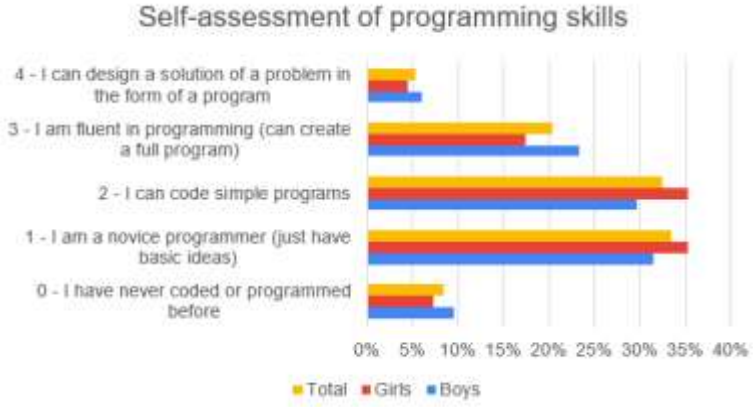


*Figure 7 - Self-assessment of programming skills – comparison by gender*

The analysis by grades (Table 6) shows that the largest number of students who have never coded (level 0) is from the 5th grade, as expected. In 6th, 7th and 8th grade most of the students stated that they can code simple programs (level 2).

*Table 6 - Self-assessment of programming skills by grade and gender*

| Level of programming skills | | 5th grade | 6th grade | 7th grade | 8th grade |
|---|---|---|---|---|---|
| 0 - I have never coded or programmed before | Boys | 19.12% | 6.31% | 10.53% | 2.13% |
| | Girls | 20.27% | 2.48% | 3.85% | 2.56% |
| | **Total** | **19.72%** | **4.31%** | **7.34%** | **2.33%** |
| 1 - I am a novice programmer (just have basic ideas) | Boys | 41.18% | 26.13% | 26.32% | 36.17% |
| | Girls | 45.95% | 32.23% | 30.77% | 30.77% |
| | **Total** | **43.66%** | **29.31%** | **28.44%** | **33.72%** |
| 2 - I can code simple programs | Boys | 23.53% | 32.43% | 35.09% | 25.53% |
| | Girls | 20.27% | 38.02% | 44.23% | 43.59% |
| | **Total** | **21.83%** | **35.34%** | **39.45%** | **33.72%** |
| 3 - I am fluent in programming (can create a full program) | Boys | 13.24% | 25.23% | 24.56% | 31.91% |
| | Girls | 9.46% | 23.14% | 15.38% | 17.95% |
| | **Total** | **11.27%** | **24.14%** | **20.18%** | **25.58%** |
| 4 - I can design a solution of a problem in the form of a program | Boys | 2.94% | 9.91% | 3.51% | 4.26% |
| | Girls | 4.05% | 4.13% | 5.77% | 5.13% |
| | **Total** | **3.52%** | **6.90%** | **4.59%** | **4.65%** |

In the preliminary questionnaire the participants also stated which programming concepts are they familiar with. The results (Table 7) show that students are mostly familiar with the *statements* (72.23%) and *loops* (61.51%) while they are the least familiar with the *operators* (12.48%) and *parallelism* (2.28%). According to the results, there is no major difference in familiarity of programming concepts between the genders (Figure 8). The largest difference in percentages can be observed for the concept *operators*.

*Table 7 - Familiarity with the programming concepts*

| Concept | Boys | Girls | Total |
|---|---|---|---|
| Loops | 60.78% | 62.24% | 61.51% |
| Conditionals | 47.70% | 46.50% | 47.10% |
| Variables | 51.24% | 46.85% | 49.03% |
| Statements (sounds, movement, looks, drawing) | 71.38% | 73.08% | 72.23% |
| Operators | 15.55% | 9.44% | 12.48% |
| Events | 38.52% | 36.01% | 37.26% |
| Parallelism | 1.77% | 2.80% | 2.28% |

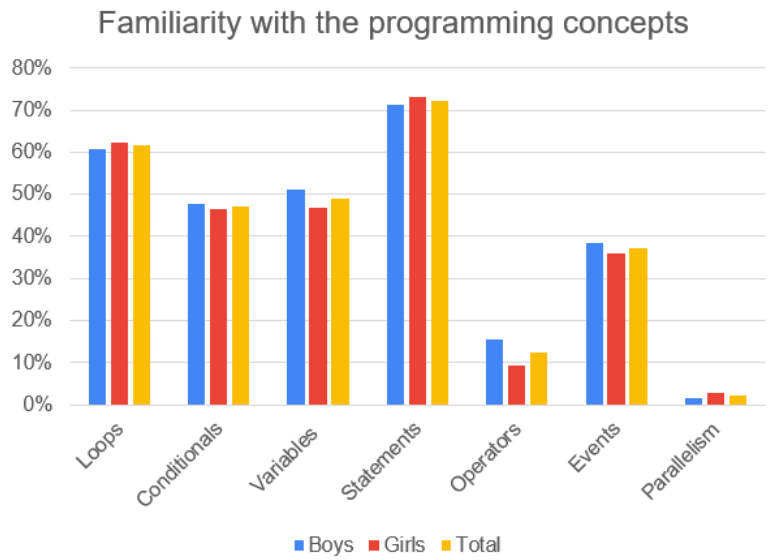


*Figure 8 - Familiarity with the programming concepts – comparison by gender*

Comparison of the results by grade and gender (Table 8) shows that 5th graders are at least familiar with all the concepts.

*Table 8 - Familiarity with the programming concepts by grade and gender*

| **Concept** | | **5th grade** | **6th grade** | **7th grade** | **8th grade** |
|---|---|---|---|---|---|
| Loops | Boys | 39.71% | 64.86% | 68.42% | 72.34% |
| | Girls | 39.19% | 71.07% | 71.15% | 66.67% |
| | **Total** | 39.44% | 68.10% | 69.72% | 69.77% |
| Conditionals | Boys | 26.47% | 45.95% | 61.40% | 65.96% |
| | Girls | 25.68% | 47.93% | 63.46% | 58.97% |
| | **Total** | 26.06% | 46.98% | 62.39% | 62.79% |
| Variables | Boys | 16.18% | 49.55% | 73.68% | 78.72% |
| | Girls | 13.51% | 45.45% | 78.85% | 71.79% |
| | **Total** | 14.79% | 47.41% | 76.15% | 75.58% |
| Statements (sounds, movement, looks, drawing) | Boys | 63.24% | 73.87% | 70.18% | 78.72% |
| | Girls | 62.16% | 75.21% | 82.69% | 74.36% |
| | **Total** | 62.68% | 74.57% | 76.15% | 76.74% |
| Operators | Boys | 11.76% | 11.71% | 17.54% | 27.66% |
| | Girls | 9.46% | 7.44% | 9.62% | 15.38% |
| | **Total** | 10.56% | 9.48% | 13.76% | 22.09% |
| Events | Boys | 26.47% | 45.05% | 45.61% | 31.91% |
| | Girls | 22.97% | 40.50% | 48.08% | 30.77% |
| | **Total** | 24.65% | 42.67% | 46.79% | 31.40% |
| Parallelism | Boys | 0.00% | 1.80% | 0.00% | 6.38% |
| | Girls | 2.70% | 2.48% | 0.00% | 7.69% |
| | **Total** | 1.41% | 2.16% | 0.00% | 6.98% |

For some of the concepts (*loops*, *statements*), the results for 6th, 7th and 8th grade students do not differ, while for some (more advanced) concepts (*conditionals*, *variables*, *operators*) there is an increase in the level of familiarity. As in the case of overall results, there are no major gender differences in the familiarity with the programming concepts except of concept *operators*.

Table 9 shows students' responses about what motivates them to learn to program (students could choose one or more responses). The most of the students are motivated by a success in the programming class (60.63%). Comparison by gender (Figure 9) shows that this factor motivates girls (70.98%) to a greater extent than boys (50.18%). Also, remarkably more boys want to follow career in programming.

*Table 9 - Motivation for learning programming*

| Response | Boys | Girls | Total |
|---|---|---|---|
| I'm not motivated | 17.31% | 15.38% | 16.34% |
| I want to succeed in the programming class | 50.18% | 70.98% | 60.63% |
| I want to show other students I can program | 10.95% | 8.04% | 9.49% |
| I want to follow a career in programming | 22.97% | 5.24% | 14.06% |
| I enjoy solving logic problems and puzzles | 24.38% | 19.58% | 21.97% |

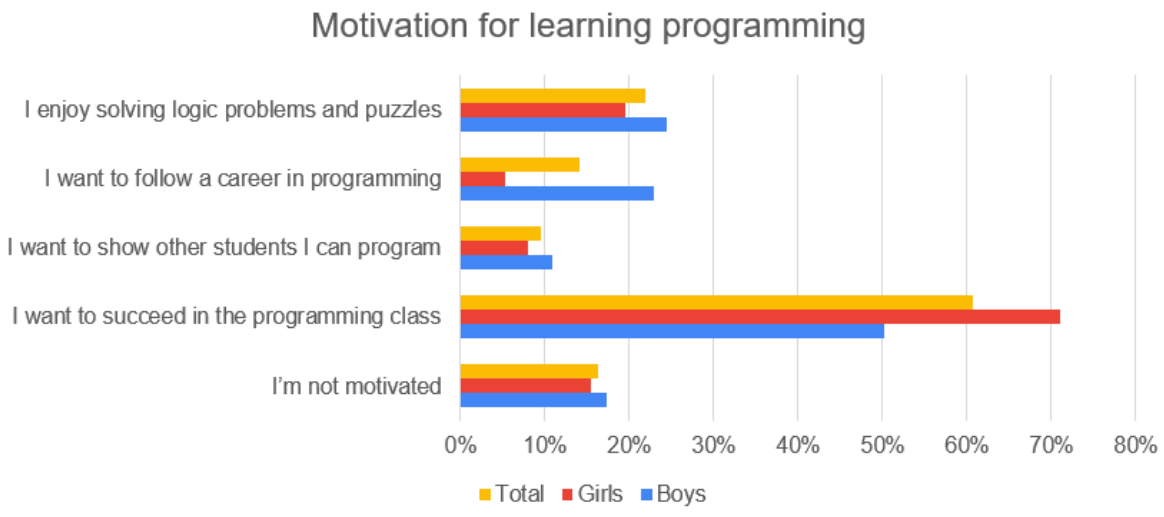


*Figure 9 - Motivation for learning programming – Comparison by gender*

Comparison by grade (Table 10) show that 6th graders are the most motivated, especially by wanting to succeed in the programming class. They also enjoy solving logic problems and puzzles more than students from other grades (particularly boys).

*Table 10 - Motivation for learning programming by grade and gender*

| Statement | | 5th grade | 6th grade | 7th grade | 8th grade |
|---|---|---|---|---|---|
| I'm not motivated | Boys | 17.65% | 13.51% | 24.56% | 17.02% |
| | Girls | 17.57% | 8.26% | 19.23% | 28.21% |
| | **Total** | **17.61%** | **10.78%** | **22.02%** | **22.09%** |
| I want to succeed in the programming class | Boys | 42.65% | 53.15% | 49.12% | 55.32% |
| | Girls | 62.16% | 80.99% | 67.31% | 61.54% |
| | **Total** | **52.82%** | **67.67%** | **57.80%** | **58.14%** |
| I want to show other students I can program | Boys | 8.82% | 11.71% | 10.53% | 12.77% |
| | Girls | 9.46% | 9.09% | 7.69% | 2.56% |
| | **Total** | **9.15%** | **10.34%** | **9.17%** | **8.14%** |
| I want to follow a career in programming | Boys | 29.41% | 20.72% | 22.81% | 19.15% |
| | Girls | 4.05% | 7.44% | 1.92% | 5.13% |
| | **Total** | **16.20%** | **13.79%** | **12.84%** | **12.79%** |
| I enjoy solving logic problems and puzzles | Boys | 23.53% | 30.63% | 15.79% | 21.28% |
| | Girls | 20.27% | 22.31% | 19.23% | 10.26% |
| | **Total** | **21.83%** | **26.29%** | **17.43%** | **16.28%** |

Besides choosing among the offered responses, students had the opportunity to write everything else that motivates them to learn to program. Among the answers, they stated: "*It's fun*", "*I'm interested in making programs or games*", "*I want to learn how to make my own game*", "*I want to learn something new*", "*I want to acquire new skills*", and "*I'm motivated by my uncle who also programs*".

*S2 – Follow-up questionnaire*

A total of 424 students solved the follow-up questionnaire about satisfaction with programming and coding activities, satisfaction with the organization of the implementation, and perception on the acquired coding skills. The mean age of students was 12.25 years (SD=1,047). Table 11 shows number of students who solved S2 by gender and grades. The number of girls and boys who responded is approximately equal in all grades except in the 8th grade (Figure 10).

*Table 11 - Number of students who solved S2 - Follow-up questionnaire by gender and grades*

| | 5th grade | 6th grade | 7th grade | 8th grade | Total |
|---|---|---|---|---|---|
| Boys | 72 | 78 | 31 | 35 | 225 |
| Girls | 67 | 79 | 30 | 23 | 199 |
| **Total** | **139** | **166** | **61** | **58** | **442** |
| Response rate | 72.77% | 53.9% | 41.78% | 45.31% | 54.85% |

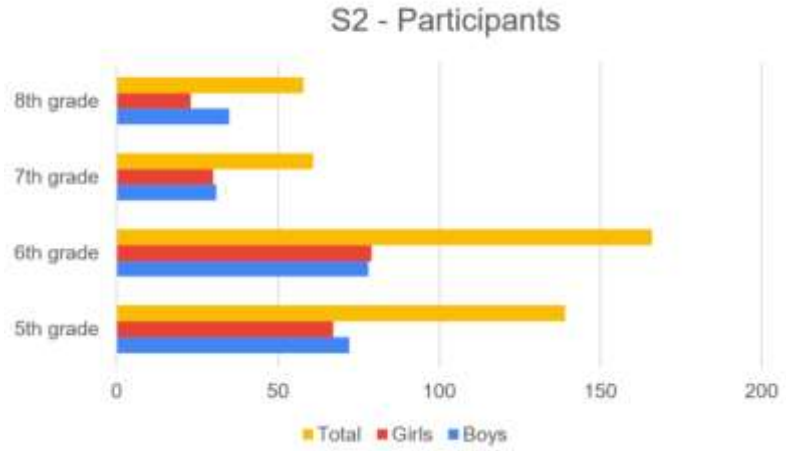


*Figure 10 - Distribution of students who solved S2 - Follow-up questionnaire by gender and grades*

In the follow-up questionnaire, students expressed their attitudes regarding the C4G learning methodology and the implementation of activities using the 5-point Likert scale (1 – strongly disagree, 2 – disagree, 3 – neutral, 4 – agree, 5 – strongly agree). According to the results (Table 12), both boys and girls felt engaged with this way of learning and think that conducted activities were relevant for learning programming. They understood presented concepts and had fun during conducted activities. Boys enjoyed programming to a slightly greater extent and think that things they have learned will be relevant for their future.

*Table 12 – Satisfaction with C4G learning methodology*

| Statement | | 1 | 2 | 3 | 4 | 5 | AVG | SD |
|---|---|---|---|---|---|---|---|---|
| 1. I found programming challenging. | Boys | 9.78% | 25.33% | 31.12% | 24.44% | 9.33% | 2.982 | 1.126 |
| | Girls | 4.02% | 23.12% | 33.16% | 31.16% | 8.54% | 3.171 | 1.011 |
| | **Total** | **7.08%** | **24.29%** | **32.08%** | **27.59%** | **8.96%** | **3.071** | **1.076** |
| 2. I found programming motivating. | Boys | 2.67% | 9.78% | 18.22% | 46.67% | 22.66% | 3.769 | .995 |
| | Girls | 6.03% | 13.57% | 21.61% | 41.2% | 17.59% | 3.508 | 1.114 |
| | **Total** | **2.24%** | **11.56%** | **19.81%** | **44.11%** | **20.28%** | **3.646** | **1.06** |
| 3. I found programming easy. | Boys | 12.44% | 28.44% | 29.78% | 20.44% | 8.9% | 2.849 | 1.151 |
| | Girls | 14.07% | 30.65% | 32.67% | 18.59% | 4.02% | 2.678 | 1.057 |
| | **Total** | **13.21%** | **29.48%** | **31.13%** | **19.58%** | **6.6%** | **2.769** | **1.11** |
| 4. I enjoyed programming. | Boys | 3.55% | 7.56% | 19.56% | 28.89% | 40.44% | 3.951 | 1.107 |
| | Girls | 6.02% | 11.06% | 21.61% | 33.67% | 27.64% | 3.658 | 1.169 |
| | **Total** | **4.72%** | **9.2%** | **20.52%** | **31.13%** | **34.43%** | **3.814** | **1.145** |
| 5. I understood most of programming concepts. | Boys | 3.11% | 7.56% | 13.78% | 48.88% | 26.67% | 3.884 | .989 |
| | Girls | 4.53% | 8.04% | 20.6% | 38.19% | 28.64% | 3.784 | 1.086 |
| | **Total** | **3.77%** | **7.78%** | **16.98%** | **43.88%** | **27.59%** | **3.837** | **1.036** |
| 6. Learning this way is fun. | Boys | 4% | 8.89% | 15.11% | 38.67% | 33.33% | 3.884 | 1.092 |
| | Girls | 4.02% | 9.05% | 21.61% | 29.65% | 35.68% | 3.839 | 1.13 |
| | **Total** | **4%** | **8.96%** | **18.16%** | **34.42%** | **34.42%** | **3.863** | **1.109** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 7. I felt engaged with this way of learning. | Boys | 1.33% | 6.67% | 7.56% | 35.11% | 49.33% | 4.244 | .949 |
| | Girls | 2.51% | 5.02% | 9.55% | 29.15% | 53.77% | 4.266 | .997 |
| | **Total** | **1.88%** | **5.9%** | **8.49%** | **32.31%** | **51.42%** | **4.255** | **.971** |
| 8. The activities were relevant to learn. | Boys | 1.33% | 4.89% | 7.56% | 40.89% | 45.33% | 4.24 | .889 |
| | Girls | 3.01% | 3.52% | 13.57% | 36.68% | 43.22% | 4.136 | .983 |
| | **Total** | **2.12%** | **4.25%** | **10.37%** | **38.92%** | **44.34%** | **4.191** | **.935** |
| 9. At any time, it was clear what I had to do. | Boys | 3.56% | 11.56% | 19.56% | 35.11% | 30.22% | 3.769 | 1.11 |
| | Girls | 5.03% | 16.58% | 29.14% | 28.14% | 21.11% | 3.437 | 1.144 |
| | **Total** | **4.25%** | **13.92%** | **24.06%** | **31.84%** | **25.94%** | **3.613** | **1.137** |
| 10. What I learned will be relevant for my future. | Boys | 3.11% | 4.89% | 16.89% | 36% | 39.11% | 4.031 | 1.019 |
| | Girls | 5.03% | 7.03% | 22.11% | 37.69% | 28.14% | 3.769 | 1.09 |
| | **Total** | **4%** | **5.9%** | **19.34%** | **36.79%** | **33.96%** | **3.908** | **1.06** |

The participants again self-assessed the level of their programming skills on the scale from *0 - I have never coded or programmed before* to *4 - I can design a solution of a problem in the form of a program*. A total of 347 students (179 boys, 168 girls) solved the preliminary and the follow-up questionnaire so their self-assessment results were compared. Table 13 shows data on the difference between the self-assessed initial level and the self-assessed final level of programming skill. Over 40% of students stated that they have progressed, the most of them for 1 level (29.39%). Almost 5% of students self-assessed their programming skill level higher before participating in C4G activities. The analysis showed that most of them were students who initially self-assessed their skill with level 3 or 4. It can be assumed that these students were not able to self-assess their programming skill realistically before the C4G activities. Comparison by gender shows that slightly fewer girls remained at the same level of programming skill than boys (difference is 0). Also, slightly more girls progressed by one level than boys (difference is 1). For other values (differences), the results are approximately the same.

*Table 13 - The difference between the self-assessed levels of programming skill*

| | **Difference** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **-2** | **-1** | **0** | **1** | **2** | **3** | **4** |
| Boys | 0.56% | 3.91% | 55.31% | 25.70% | 11.73% | 2.23% | 0.56% |
| Girls | 0.60% | 4.76% | 48.81% | 33.33% | 9.52% | 2.98% | 0% |
| **Total** | 0.58% | 4.32% | 52.16% | 29.39% | 10.66% | 2.59% | 0.29% |

A Wilcoxon's signed rank test for paired samples showed that students self-assessed their programming skill significantly higher after the C4G activities compared to self-

assessment before the C4G activities (Table 14). The results of rank-biserial correlation (rB), which are considered as an effect size, show large effect size, overall and by gender.

*Table 14 - Comparison of self-assessment of programming skill*

| | | Descriptive statistics | | | | | Wilcoxon's signed rank test results | | |
|---|---|---|---|---|---|---|---|---|---|
| | | N | MIN | MAX | MEAN | SD | W | p | Effect size (rB) |
| Boys | S1 | 181 | 0 | 4 | 1.878 | 1.068 | 3112.5 | < .001 | .829 |
| | S2 | 181 | 1 | 4 | 2.403 | .982 | | | |
| Girls | S1 | 166 | 0 | 5 | 1.825 | 1.015 | 3168 | < .001 | .818 |
| | S2 | 166 | 1 | 4 | 2.380 | .938 | | | |
| **Total** | **S1** | **347** | **0** | **4** | **1.850** | **1.034** | **12702** | **< .001** | **.833** |
| | **S2** | **347** | **1** | **4** | **2.392** | **.960** | | | |

*Students' comments*

In their comments after the implementation activities, the students stated that they are very happy with this way of learning, think that they have learned a lot, and feel like real developers because they created their games. During the implementation of C4G approach, they could hardly wait for every new task and new project. They were very satisfied with the received materials. This way of learning was very fun and they can't wait for more tasks like these.

Students who are familiar with the programming language Scratch stated that they would like to use it instead of the Snap!. Students prefer Scratch because it has more features and works very well on tablets while with Snap! students who used tablets had technical difficulties.

## Teachers' observations and comments

After the implementation activities, teachers and students – future teachers were asked to express their qualitative opinions about the C4G methodology and the implementation process using the forms T1 and T2.

*Teachers' observations*

Using the form T1, teachers ($N_T$=8) and students – future teachers ($N_{ST}$=35) reported on students' participation and engagement as well as learning difficulties and problems.

All of them stated that the students were interested and actively participated in the activities. Most of the student successfully completed all the tasks with the help of prepared materials. Video tutorials were especially useful to them. The students' projects selected by the teachers were published in the collection C4G Croatia in Snap! cloud (Figure 11).

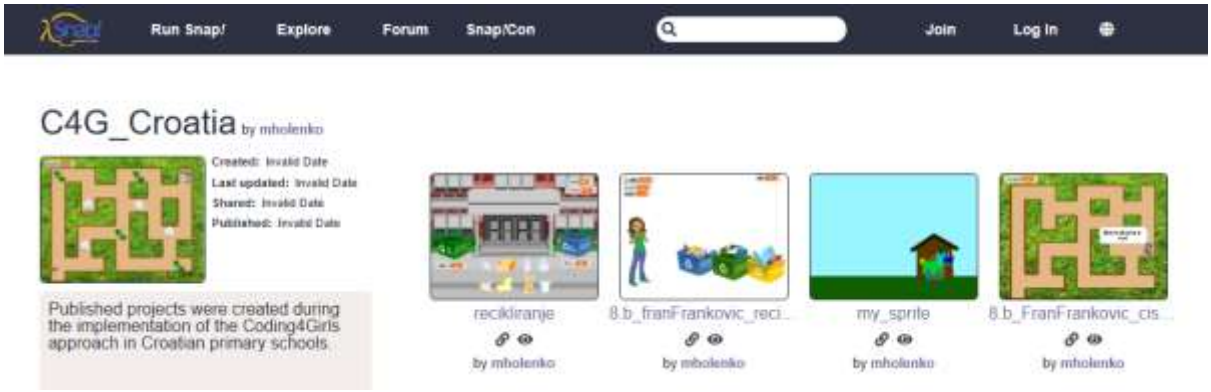


*Figure 11 – Snap! collection "C4G Croatia"*

Students collaborated in virtual classroom and were happy to answer each other's questions about the problems they encountered. However, teachers think that due to the specifics of online learning students were not able to collaborate to the extent that collaboration would be achieved in regular classes.

Due to technical limitations, some students were slower in completing assignments. Students working on tablets had problems with the Snap! since the tool did not work right and fast enough. Students had problems with adding costumes to sprites and with occasional freezing of its interface. The students who were creating projects on desktop computers or laptops had no problems. The teachers suggested programming language Scratch as a replacement since there is a mobile application that works well on tablets.

## Teachers' comments

Using the form T2, teachers ($N_T$=8) and students – future teachers ($N_{ST}$=35) reported on accomplishment of learning objectives, relevance, effectiveness and acceptance of the proposed methodology by the students, and the overall organization of the implementation.

The opinion of the teachers is that game-based learning is fun for students. They are motivated to solve tasks (problems) which makes this way of learning effective for learning programming. All teachers stated that the learning objectives were fully achieved by the students during the C4G activities.

According to teachers, the students fully accepted the C4G methodology. The topics of the projects were very interesting to them and most of students enjoyed using newly acquired programming knowledge to create games. C4G projects had a positive effect on

their desire and motivation to eliminate all mistakes. Students persisted until they reached the set goal - a game they could play.

Since the C4G activities were conducted online, the insight regarding achieved fun by the students could not be complete, but teachers stated that it is evident from the communication with the students that the students had fun and were looking forward to gaining new knowledge using the C4G methodology.

Regarding the overall organization of the implementation, teachers reported that it was fully aligned to the teaching needs (achievement of the outcomes related to programming). Created materials for implementation of C4G activities are comprehensive and clear. During the implementation, logistical support from project team members was efficient and available at any time.

Teachers also agree that the C4G game-based, design thinking educational framework is applicable in future work. Learning scenarios with projects that need to be developed in Snap! are appropriate to the age of students. Teachers who participated in the implementation activities plan to use them in their future work. Teachers also believe that a design thinking approach in combination with game-based learning can be used not only for development of programming skills but also to enhance students' creative potential which can result in some new ideas and solutions.

**Experts' comments**

External validators - experts ($N_E$=3) were also asked to give their qualitative opinions regarding the accomplishment of learning objectives by the students, relevance, effectiveness and acceptance of the proposed methodology by the students, and the overall organization of the implementation.

All three experts agreed that for developing basic programming skills in among students from 10-16 years, the C4G methodology is very suitable. Snap! programming interface allow students to create interactive stories and games which is fun and stimulating for them. The advantage of coding using blocks is that students of that age do not need to learn the programming syntax because this negatively affects students' motivation to learn programming (they usually forget the syntax very quickly).

They stressed out that the C4G approach assumes solving real-life problems which is interesting to students, especially girls. In programming classes, mathematical tasks are very common (e.g. calculating the range, area of a square, rectangle or currency conversion and the like), which further demotivates students for learning programming. According to the experts, projects in C4G learning scenarios are well designed and enable accomplishment of learning objectives. The projects stimulate students to be creative and enable them to learn in a fun way by creating games. Topics included in the projects are interesting to the girls and motivate them to solve the given problem using newly acquired programming knowledge. At the same time, topics are interesting to boys as well.

According to experts' opinion, C4G design thinking educational framework is effective and applicable for teaching programming to girls as well as boys. Due to observed technical problems with Snap!, experts suggest that its further development include also possibility of learning programming using Scratch.

## DISCUSSION AND CONCLUSIONS

The results of the preliminary questionnaire (S1) showed that students of both genders use the Internet and digital devices, on average a couple of hours a day, and have 5 to 6 years of experience in their use. This shows that the students had the appropriate digital skills necessary for the implementation of the C4G approach. The large number of hours that some students spend per week using digital devices and the Internet is partly conditioned by the online teaching that was conducted during this study because students were expected to study teaching materials, create assignments, and communicate with teachers in virtual classrooms. Results also showed that students play video games and that boys spend significantly more time playing them than girls. This indicates that game-based activities, such as those designed within the C4G approach, should be tailored to interests of the girls to keep the girls motivated.

Results of the preliminary questionnaire also indicated that younger students, especially 6$^{th}$ graders, are more motivated for learning programming than 7$^{th}$ and 8$^{th}$ grade students, even though for 7$^{th}$ and 8$^{th}$ grade students the subject Informatics is not compulsory, but optional. In general, students are mostly motivated by success in the programming class (girls to a greater extent that boys). Students (especially 6$^{th}$ graders) are

motivated by the fact that they enjoy solving problems and puzzles and because creating their own games is fun for them. This confirms that the C4G methodology which includes creating games for solving real-life problems is appropriate for the target group of students. According to the results, boys (especially 5$^{th}$ graders) are further motivated by the desire to become programmers while girls are very little motivated by this factor. This shows that girls are less interested to follow a career in programming so they need to be motivated by approaches like C4G.

In the initial self-assessment of their programming skills, the most of the students stated that they are novice programmer s (level 1) or that they can code simple programs (level 2). This is confirmed by the results regarding the familiarity with programming concepts which showed that most students are familiar only with basic concepts such as statements and loops. Some students attend the subject Informatics for several years but do not consider that they have developed programming skills. The reason for this may be that they find programming difficult and are not interested in learning.

After the implementation activities, teachers and student teachers reported that conducted activities enable students to achieve learning outcomes and at the same time had fun. Teachers think that creating games is a very effective way for students to learn programing concepts and they plan to apply the C4G methodology in the future as well. They observed that C4G approach encouraged creativity and problem solving and students were motivated to complete the project (their own game) to the end. The external experts who participated in the validation activities agreed with these observations and support the application of game-based learning approach using visual programming tools for learning programming. They emphasized the good choice of topics of the projects included in the learning scenarios which are interesting to girls and encouraged them to apply their programming knowledge.

Results of the comparison of self-assessment confirmed the effectiveness of implemented activities for learning programming. Students self-assessed their programming skill significantly higher after the C4G activities compared to self-assessment before the C4G activities (large effect size is present for overall results and results grouped by gender).

Students' attitudes regarding the C4G methodology, expressed in the follow-up questionnaire, shown that they consider the approach relevant for learning programming

and that they had fun and enjoyed programming which also supports the validation of the C4G approach. Student qualitative feedback was also very positive. They expressed their satisfaction with the approach and acquired skills but many of them stated that they would prefer to use Scratch over Snap!. This is not surprising since Scratch is the widely used tool for visual programming in Croatian schools so many students are used to it. In addition, students who used tablets experienced technical problems.

In conclusion, the C4G methodology is appropriate for students who are 10 – 16 years old and enable the achievement of learning outcomes in an effective and fun way. Additionally, the approach has proven applicable in an online environment. Regarding the possible improvements, the main problem were technical difficulties encountered by students who used Snap! on tablets, so the next version of the C4G methodology should include the possibility of using Scratch instead of Snap!.

# ANNEXES

## S1. PRELIMINARY QUESTIONNAIRE FOR STUDENTS (in Croatian)

### S1. UVODNI UPITNIK ZA UČENIKE

Ovo je preliminarni upitnik o korištenju digitalnih uređaja i iskustva s programiranjem koji se provodi u okviru projekta CODING4GIRLS. Cilj projekta je poticanje razvoja vještina programiranja korištenjem obrazovnih igara.

Tvoji odgovori će biti **anonimni** i korišteni samo u svrhu istraživanja. Hvala na suradnji!

Za početak, **upiši kôd** koji si dobio/dobila od učitelja/učiteljice.

**KOD I OSNOVNE INFORMACIJE**

Kôd: _____ Škola: _____

Godine: _____ Razred: _____

Spol: M Ž

**KORIŠTENJE DIGITALNIH UREĐAJA, INTERNETA I VIDEO IGARA**

| | |
|---|---|
| 1. Koliko godina koristiš računala, tablete i ostale digitalne uređaje? | _____ godina |
| 2. Koliko sati tjedno koristiš računalo, tablet ili neki drugi digitalni uređaj? | _____ sati |
| 3. Koliko sati tjedno koristiš Internet? | _____ sati |
| 4. Koliko sati tjedno igraš video igre? | _____ sati |

**ISKUSTVO S PROGRAMIRANJEM**

5. Koliko si trenutno vješt/vješta u programiranju? *Zaokruži jedan odgovor.*
   a) Nisam nikad programirao/programirala
   b) Početnik/početnica sam (imam samo osnovna znanja)
   c) Mogu izraditi samo jednostavne programe
   d) Mogu izraditi i nešto složenije programe
   e) Mogu izraditi program kojim će se riješiti zadani problem

6. Ako već imaš iskustva s programiranjem, koji su ti od navedenih koncepata poznati? *Označi kvačicom jedan ili više odgovora.*

| | | |
|---|---|---|
| ☐ Petlje (ponavljanje) | ☐ Varijable | ☐ Događaji |
| ☐ Uvjeti (ako – onda) | ☐ Operatori | ☐ Paralelizam |
| ☐ Naredbe za kretanje i izgled likova, crtanje, zvukove | | |

7. Što te motivira na učenje programiranja? *Označi kvačicom jedan ili više odgovora.*
   - ☐ Nisam motiviran/motivirana
   - ☐ Želim uspješno savladati nastavno gradivo vezano za programiranje
   - ☐ Želim pokazati drugim učenicima da znam programirati
   - ☐ U budućnosti želim raditi kao programer/programerka
   - ☐ Uživam rješavati logičke zadatke
   - ☐ Nešto drugo: _____

## S2. FOLLOW-UP QUESTIONNAIRE FOR STUDENTS (in Croatian)

### S2. ZAVRŠNI UPITNIK ZA UČENIKE

Ovo je upitnik o zadovoljstvu s učenjem prema projektu CODING4GIRLS i aktivnostima koje su provedene za razvoj vještina programiranja. Tvoji odgovori će biti **anonimni** i korišteni samo u svrhu istraživanja. Hvala na suradnji!

Za početak, **upiši kôd** koji si dobio/dobila od učitelja/učiteljice (to je isti kôd kao i za uvodni upitnik).

### KOD I OSNOVNE INFORMACIJE

Kôd: _____ Škola: _____

Godine: _____ Razred: _____

Spol: M Ž

### C4G METODOLOGIJA

| 8. Izrazi mišljenje o sljedećim tvrdnjama: | *Uopće se ne slažem* | *Ne slažem se* | *Niti se slažem, niti se ne slažem* | *Slažem se* | *U potpunosti se slažem* |
|---|---|---|---|---|---|
| a) Smatram da je programiranje zahtjevno. | 1 | 2 | 3 | 4 | 5 |
| b) Smatram da je programiranje motivirajuće. | 1 | 2 | 3 | 4 | 5 |
| c) Smatram da je programiranje jednostavno. | 1 | 2 | 3 | 4 | 5 |
| d) Uživao/uživala sam u programiranju. | 1 | 2 | 3 | 4 | 5 |
| e) Razumijem većinu prezentiranih koncepata iz programiranja. | 1 | 2 | 3 | 4 | 5 |
| f) Smatram da je učenje na ovaj način zabavno. | 1 | 2 | 3 | 4 | 5 |
| g) Aktivno sam sudjelovao/sudjelovala tijekom ovakvog načina učenja. | 1 | 2 | 3 | 4 | 5 |
| h) Aktivnosti u kojima sam sudjelovao/sudjelovala su bile prikladne za učenje programiranja. | 1 | 2 | 3 | 4 | 5 |
| i) Uvijek mi je bilo jasno što trebam raditi. | 1 | 2 | 3 | 4 | 5 |
| j) Naučeno će mi koristiti u budućnosti. | 1 | 2 | 3 | 4 | 5 |

### ISKUSTVO S PROGRAMIRANJEM

9. Koliko si trenutno vješt/vješta u programiranju? *Zaokruži jedan odgovor.*
   a) Nisam nikad programirao/programirala
   b) Početnik/početnica sam (imam samo osnovna znanja)
   c) Mogu izraditi samo jednostavne programe
   d) Mogu izraditi i nešto složenije programe
   e) Mogu izraditi program kojim će se riješiti zadani problem

## S3. STUDENT'S COMMENTS (in Croatian)

| **S3. KOMENTARI UČENIKA** |
|---|
| Nakon primjene C4G pristupa za stjecanje vještina programiranja koji se zasniva na igrama, učitelj prikuplja kvalitativna mišljenja i komentare učenika u grupnom intervjuu.<br><br>Molimo da grupirate sve učenike razrednog odjela te da kroz razgovor prikupite njihova kvalitativna mišljenja i komentare. Pitajte učenike o aspektima navedenim u nastavku i zabilježite njihove komentare pomoću ovog obrasca.<br><br>Hvala Vam na Vašem vremenu i suradnji! |
| **OSNOVNE INFORMACIJE** |
| Nastavnik: _____ Razred: _____<br>Škola: _____ Datum: _____ |
| **CJELOKUPNA ORGANIZACIJA I ISKUSTVA UČENIKA** |
| *Možete pitati učenike o cjelokupnoj organizaciji učenja programiranja putem C4G pristupa, o njihovoj percepciji o stečenom znanju, o relevantnosti i učinkovitosti korištenog pristupa učenju programiranja koje se temelji na igrama te da li im je ovakav način učenja bio zabavan.* |
| **POTEŠKOĆE PRILIKOM UČENJA I PROBLEMI S TEHNOLOGIJOM** |
| *Možete pitati učenika o poteškoćama u učenju ili problemima s kojima su se suočavali te što su radili kad su naišli na te probleme.* |
| **STAVOVI UČENIKA O TOME KAKO POBOLJŠATI C4G METODOLOGIJU, ALATE I SADRŽAJE** |
| |
| **BILO ŠTO DRUGO ŠTO SMATRATE RELEVANTNIM** |
| |

## T1. TEACHER'S OBSERVATIONS (in Croatian)

| **T1. ZAPAŽANJA UČITELJA** | | | |
|---|---|---|---|
| Tijekom implementacije, učitelj promatra i vodi bilješke o reakcijama učenika i njihovom napretku u usvajanju vještina programiranja pomoću C4G pristupa koji se zasniva na igrama.<br><br>Molimo da koristeći ovaj obrazac navedete Vaša zapažanja o aspektima navedenim u nastavku.<br><br>Hvala Vam na Vašem vremenu i suradnji! | | | |
| **OSNOVNE INFORMACIJE** | | | |
| Nastavnik: | _____ | Razred: | _____ |
| Škola: | _____ | Datumi (od-do): | _____ |
| **SUDJELOVANJE I AKTIVNOST UČENIKA** | | | |
| *Jesu li učenici aktivni? Surađuju li međusobno? Zabavljaju li se? itd.* | | | |
| **POTEŠKOĆE PRILIKOM UČENJA I PROBLEMI S TEHNOLOGIJOM** | | | |
| *Da li učenici imaju problema sa sadržajem i/ili tehnologijom? Traže li pomoć? itd.* | | | |
| **BILO ŠTO DRUGO ŠTO SMATRATE RELEVANTNIM** | | | |
| | | | |

## T2. TEACHER'S COMMENTS (in Croatian)

| **T2. KOMENTARI UČITELJA** |
|---|
| Nakon primjene C4G pristupa za stjecanje vještina programiranja koji se zasniva na igrama, prikupljaju se kvalitativna mišljenja i komentari učitelja.<br><br>Molimo da koristeći ovaj obrazac navedete Vaše stručno mišljenje o aspektima navedenim u nastavku.<br><br>Hvala Vam na Vašem vremenu i suradnji! |
| **OSNOVNE INFORMACIJE** |
| Nastavnik: _____ Razred: _____<br>Škola: _____ Datum: _____ |
| **OSTVARENOST ISHODA UČENJA KOD UČENIKA** |
| |
| **VAŽNOST I UČINKOVITOST UČENJA TEMELJENOG NA IGRI ZA STJECANJE VJEŠTINA PROGRAMIRANJA – OPĆENITO TE SPECIFIČNO ZA C4G PRISTUP** |
| |
| **PRIHVAĆANJE PREDLOŽENE C4G METODOLOGIJE OD UČENIKA** |
| |

| U KOJOJ MJERI SU SE UČENICI ZABAVLJALI? |
| --- |
| |
| **VAŠE MIŠLJENJE O CJELOKUPNOJ ORGANIZACIJI IMPLEMENTACIJE C4G PRISTUPA** |
| |
| **PRIMJENJIVOST I PRIHVATLJIVOST C4G OBRAZOVNOG OKVIRA ZASNOVANOG NA IGRAMA I *DIZAJN THINKING* PRISTUPU U BUDUĆAM RADU** |
| |
| **BILO ŠTO DRUGO ŠTO SMATRATE RELEVANTNIM** |
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## E. EXPERT'S COMMENTS (in Croatian)

| **E. KOMENTARI STRUČNJAKA** | |
|---|---|
| Nakon primjene C4G pristupa za stjecanje vještina programiranja koji se zasniva na igrama, kvalitativna mišljenja i komentari stručnjaka se prikupljaju u strukturiranom intervjuu.<br><br>Upotrijebite ovaj obrazac i navedite stručno mišljenje o aspektima navedenim u nastavku. | |
| **OSNOVNE INFORMACIJE** | |
| Ime stručnjaka: _____ | Radno mjesto: _____ |
| Institucija: _____ | Datum: _____ |
| **OSTVARENOST ISHODA UČENJA KOD UČENIKA** | |
| | |
| **VAŽNOST I UČINKOVITOST UČENJA TEMELJENOG NA IGRI ZA STJECANJE VJEŠTINA PROGRAMIRANJA – OPĆENITO TE SPECIFIČNO ZA C4G PRISTUP** | |
| | |
| **PRIHVAĆANJE PREDLOŽENE C4G METODOLOGIJE OD UČENIKA – OPĆENITO I OD STRANE POSEBNO DJEVOJČICA** | |
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| **U KOJOJ MJERI SU SE UČENICI ZABAVLJALI?** |
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| **VAŠE MIŠLJENJE O CJELOKUPNOJ ORGANIZACIJI IMPLEMENTACIJE C4G PRISTUPA** |
| |
| **PRIMJENJIVOST I PRIHVATLJIVOST C4G OBRAZOVNOG OKVIRA ZASNOVANOG NA IGRAMA I *DIZAJN THINKING* PRISTUPU ZA UČENJE PROGRAMIRANJA, ZA DJEVOJČICE I OPĆENITO** |
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| **BILO ŠTO DRUGO ŠTO SMATRATE RELEVANTNIM** |
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