Distance learning: examples of good practice, analysis and experience

Maja Mačinko*, Ana Sović Kržić** and Ivan Mudri***

* OŠ Ivana Cankara/Cankareva 10, Zagreb, Croatia
** University of Zagreb Faculty of Electrical Engineering and Computing, Unska 3, Zagreb, Croatia
***OŠ Ivana Cankara/Cankareva 10, Zagreb, Croatia
* maja,macinko@skole.hr
** ana.sovic.krzic@fer.hr
*** ivan.mudri@skole.hr

Abstract - Due to the COVID-19 pandemic, schools in Croatia are closed for students. Teachers had to develop some new ways of teaching/learning. In this paper, we present how subjects of STEM (Technical culture and Informatics) can be learned online and what do students think about it. Additionally, to the regular STEM classes, we will describe an online competition Robotic Simulation League and its goals.

Keywords - STEM; technology, information technology; robotics; distance learning; educational robots

I. INTRODUCTION

Distance learning has become a necessary type of teaching today. The possibilities it offers are endless. The learning process is placed in the hands of the students, and it is the teacher who creates the content tailored to them. The student determines the pace of work and is often very encouraging for students because of the possibility of repeating the process and additional sources of knowledge that they can search on the Internet. Feedback is extremely important, both from teachers and students. Further, a great advantage of this type of teaching is that students learn from each other.

Education needed to be adapted to the current situation in the world, so distance learning has emerged as the best learning option. The combination of synchronous learning where students had live instruction through tools such as Teams video calls in Office 365 [1] and Zoom [2] where the teacher explained while students followed and asked questions, and asynchronous learning where the teacher sent self-study materials resulted in a successful end of the school year.

CARNet and Microsoft provided great support to Croatian schools with their Teams [3] and Yammer [3] classrooms, which are free for educational institutions, and provided an online classroom that combined virtual face-to-face connections, files, tasks and conversations all on the same platform that students accessed via cell phones, tablets and computers according to recommendations of the Ministry of Science and Education [5]. Additionally, Robotic Simulation League for elementary school students is launched. The League is based on the Miranda software and also provided all participants with free use of the software. In this paper, we will show some of the examples of good practice that have been used in Croatian schools and what students think about this way of schooling.

II. DISTANCE LEARNING EXAMPLES

A. Technical culture

The current situation in the world has led us all to teach students online. Technical culture as a subject performed in cabinets and specialized classrooms equipped with tools has faced special challenges. How to make interest in practical work, make sure that they can complete tasks on their own without injuries at work, and think about the materials they have at home so that they do not have to go shopping.

The fifth graders made a useful geometric object in order to repeat the technical drawing and some basic knowledge (Fig. 1). The task was fun and creative for the students and they showed diversity and creativity.

Sixth graders had two practical assignments. The first task was to make a rocket and design a propellant for it, and also to record a video for the above. They were given the task to connect it with the topic of fuel energy. Another task they had was to build a lattice bridge [6] (Fig. 2). Spaghetti or skewer sticks were used as material. After completing the task, they had to test the load capacity of the bridge, photograph everything and send it to their virtual classroom.

Seventh grade students covered the topic of metal and its processing with the material. After learning all about metals, their task was to make a useful object out of metal. They made jewelry, a cube for the Man Don't Get Angry, and a Criss-Cross game (Fig. 3).

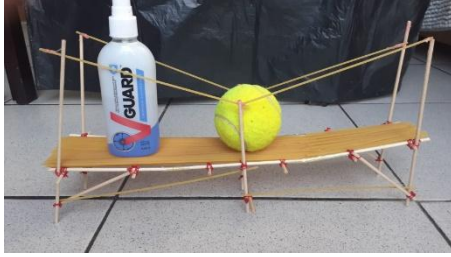Figure 1. Geometric body made of plastic bottle.

Figure 2. Bridge made of spaghetti and skewer sticks.

Figure 3. Recycling of metal – Criss-Cross game.

In addition to this type of work, with the topic of electrical installations in the house, their task was to monitor the electricity consumption in their house according to the given table and record the situation for seven days. In this way, they learned about the rational consumption of electricity.

Eighth graders repeated their knowledge of electronics and robotics and were finally given the practical task of making a car that can drive. Some used a balloon and air, others used water. It turned out that the students were willing to cooperate and could hardly wait for assignments to do something useful.

B. Informatics

Switching to the online classes was not a problem in Informatics class. Students got used to using a computer in class, and all they needed at home was a computer or tablet with Office 365 for schools package and internet. In order not to turn the teaching of Informatics into mere copying of the answers from the textbook, the students were given the tasks they had to complete in order to get feedback on their work. At the same time, this was a great opportunity to use the full range of applications that can easily be used for evaluation.

Second-grade students created characters, backgrounds, and programs in Scratch [7]. For each created character, they had to make an accompanying story e.g. why they had chosen that character. One of the stories goes like this (Fig. 4): "The picture shows a ruined city destroyed by a villain and fled, so the Hulk came. The picture shows destroyed buildings and roads." The task was a lot of fun for the students, and they were able to show their creative side in it and at the same time get the frustration out of themselves.

Figure 4. Scratch Program – Hulk.

Sixth graders were given the role of an editor at the publishing house, and the resulting text had to be edited, reviewed, and approved for publication. With this type of task students skills in MS Word were tested and at the same time their creativity was encouraged. Students were active seekers of information who revises and updates their knowledge through the process of gathering new information [8]. The students really liked such a role, but what fascinated them was the Kahoot quiz after each lesson [9].

In seventh grade Kahoot also proved to be a great tool, but while teaching HTML lesson, a video lesson was recorded for them, which was posted on the popular Youtube platform (Fig. 5). The combination of a new lesson, working on HTML and the Youtube platform proved to be effective, and the students expressed that it would be much easier and more fun for them to have similar lectures. Incorporating interactive video into a distance learning environment may not always result with improved learning, but this kind of tool may lead to better learning outcomes and higher learner achievement [10].

Eighth-grade students were given a project to create a website on Wix [11] (Fig. 6), and had to follow the rules of working on project tasks and teamwork. The students were competitive and expressed how this type of work also draws them from the monotony of other subjects.
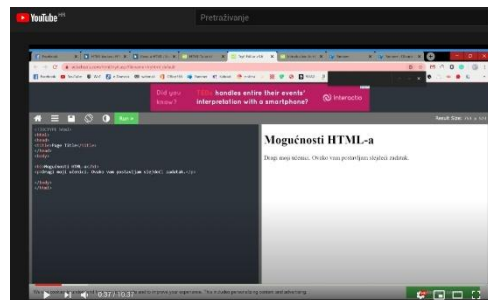

Figure 5. Video lesson on Youtube platform.

Figure 6. Students website on Wix.com.

C. RoSiL – Robotics Simulation League

Robotics is an interdisciplinary research area between computer, mechanical, electronic and information engineering. Therefore, robots are ideal tools for teaching Informatics and Technical culture in primary schools. During the regular lessons, students build robots and learn the basics of mechanics, connect wires to sensors and actuators and learn the basics of electrical engineering and at the end they make programs for the robots learning basics of computer science and informatics. In distance learning most of those activities are not possible to perform: students do not have real educational robotics kits at home. In order to counteract this problem, Croatian robotic association [12] started an online robotics simulation league (RoSiL) for primary school students (fourth to eighth grade). Each student performs individually, from her / his home. They do not need robots, only a computer or a tablet with Internet connection. The simulation software that is used is Miranda [13] and it is translated to Croatian language. Students program in Scratch-like language. New written and video lectures and new assignments are given every week. Each lecture introduces new commands that should be used in the assignments. Students have the whole week to solve the assignments. Their last solution will be visible to judges. The judges will grade performance of the robot (efficacy, efficiency and duration) as well as a code that students wrote. 145 students participated this year as well as seven students from elementary school Ivana Cankara.

An example of the assignment is given in Fig. 7. The robot needs to reach Goal as accurately as possible. The robot is not perfect and has a random noise during the drive to make it more realistic and more difficult at the same time. Students need to include that in their solutions. At the beginning of the League assignments are easy, so even beginners can program the robot. Each week assignments are more difficult to keep students in League, to inspire them and help them to grow in programming.

Figure 7. Robotic Simulation League RoSiL uses Miranda Software [13].

D. Survey and analysis

The aim of the survey was to determine students' experiences in distance learning and to gain insight into the issues that students encounter. The data were collected using an anonymous online survey, which is created with Google Forms service. The survey was distributed through the education social network Yammer. The students of the elementary school Ivan Cankar Zagreb, from 5th to 8th grade, participated in the research, who were also the target group. A total of 181 students participated in this survey. Table I. shows the distribution of students by grade.

TABLE I. DISTRIBUTION OF STUDENTS BY GRADE.

Grade	Number of participants	Percentage
5th	45	24,86
6th	47	25,97
7th	47	25,97
8th	42	23,20
Total	181	100,00

In the survey, students assessed their own experience in distance learning. The first question was the assessment of dealing with distance learning, ranging from 1 (I can't deal with it) to 5 (I can completely deal with it). The arithmetic mean of the respondents on this question was 3.93, with a standard deviation of 0.90 and a mode of 4. This means that the students gave themselves a very good grade in managing with distance learning.

Furthermore, students were asked if they agreed with the following statements on a scale from 1 (strongly disagree) to 5 (strongly agree). Table II shows the results.

Results are showing that students prefer classical learning, they do not think that the tasks are more complicated than what they are used to. The vast majority do not think that they have difficulties in meeting the set deadlines and that their concentration at home is the same as in class.

Furthermore, we see that the vast majority of students are considered completely independent when working in distance learning, and at the same time that some teachers assign too many tasks. Most students think that teachers are well prepared for leading online lectures and that students spend too much time solving assignments.

Table III. shows the results of how much time students spend daily on assignments. In the table, we see that most students spend 3 to 6 hours solving assignments, which roughly corresponds to the daily schedule of a student spends in school.

TABLE II. STATEMENTS ABOUT DISTANCE LEARNING AND ANSWERS OF STUDENTS IN PERCENTAGE.

Statment	Percentage of scale				
	1	2	3	4	5
Distance learning is better than traditional teaching.	35,36	29,83	15,47	9,94	9,39
Assigments in online teaching are more complicated.	9,94	22,10	22,10	29,28	16,57
It's hard for me to meet deadlines.	24,86	29,28	17,13	16,02	12,71
I don't have the concentration to work at home.	34,81	23,76	15,47	18,23	7,73
I am completely independent in my work.	3,87	19,89	14,36	31,49	30,39
Some teachers send too many assignments.	10,50	9,94	14,92	26,52	38,12
Some teachers did't hadle online enviroment well.	24,31	18,23	24,86	17,13	15,47
I spend too much time on assignments.	14,92	14,92	17,13	24,86	28,18

Hours spend on assignments	Number of participants	Percentage
1-2	11	6,08
3-4	71	39,23
5-6	59	32,60
7-8	30	16,57
>8	10	5,52

In the last part of the survey, students were asked about the most common problems they encounter in online classes from 1 (never) to 5 (often). Figures 8, 9, 10, 11 and 12 show the distributions of the responses obtained with respect to a particular problem.

About 25% of students stated that they regularly, and 38% of them often encounter technical difficulties (Fig. 8). Only 3% stated that they had never encountered technical difficulties in distance learning.

36% of students said they never encountered a lack of technical support from teachers (Fig. 9). And about 6% said they regularly face a lack of technical support.

Fig. 10 shows students' responses to the frequency of self-organization problems. 16% of them stated that they never encounter problems in self-organization, and about 7% of them regularly encounter problems in self-organization.

12% of students said they had never encountered a problem with handing over assignments. And at the same time, 12% of them regularly have problems with the assignment deadlines (Fig. 11).

Finally, 25% of students had never encountered a problem with teacher's feedback (Fig. 12). And only 7% of them regularly encounter a problem around feedback.
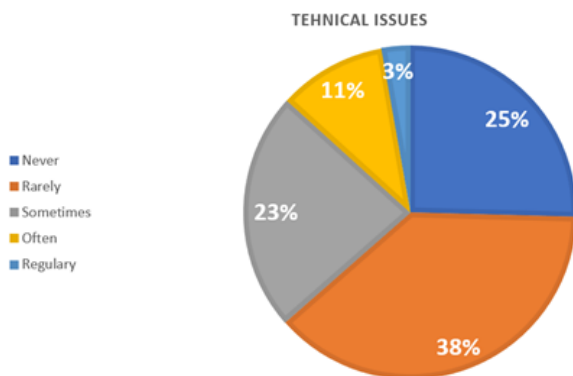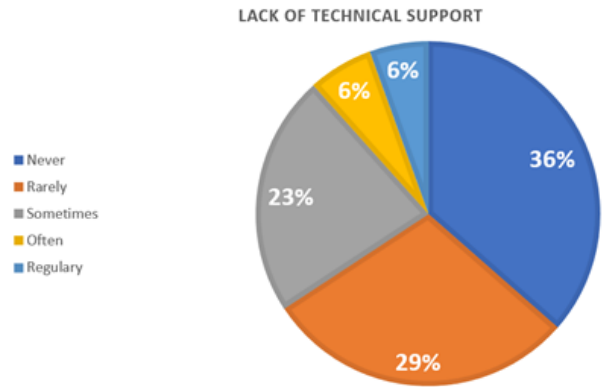

Figure 9. Problems related to the lack of technical support.
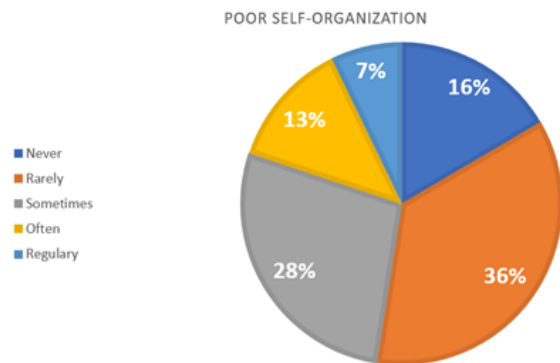

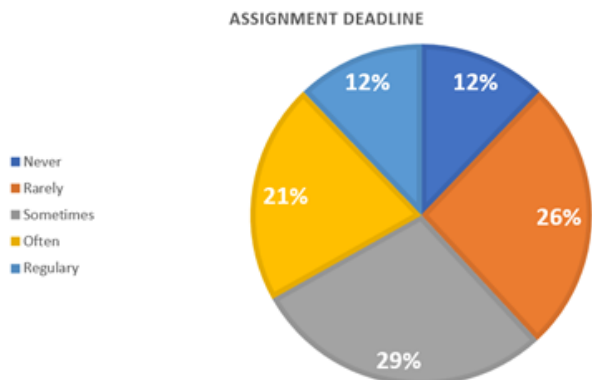
Figure 10. Problems related to the poor self-organisation.

Figure 11. Problems related to assignment deadline.

Figure 8. Problems related to the technical difficulties.
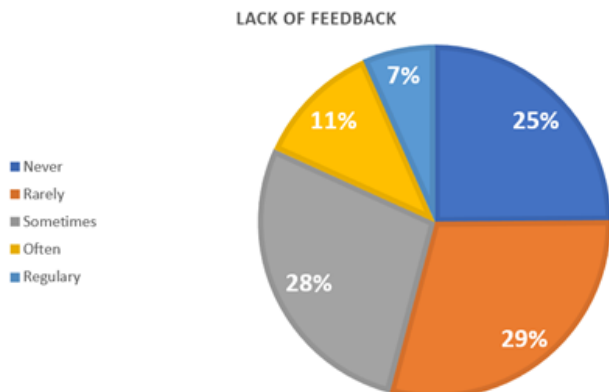

Figure 12. Problems related to the lack of feedback.

Problems which occurred during distance learning are easily solvable. First, we need to enable all students to have equal working conditions, which would solve problems with technical difficulties. With distance learning, students learn what it means to have a deadline, and at the same time learn to organize better. They said that in the beginning of distance learning everything was in chaos, and they were very desperate. But with time, they gained experience and they started to cope with the situation.

One of the problems is lack of feedback, which sometimes happens, but the majority of students stated that distance learning gives them more feedback on a personal level, which they usually do not get in classical learning.

III. CONCLUSION

In this paper we described the online lessons for two STEM subjects: Technical culture and Informatics. For both subjects, distance learning was a great opportunity for students to apply their theoretical knowledge into practical tasks. Results of their work showed that they like this kind of learning more than just learning theory. Although we do the same thing in classical classes, maybe we should orient the learning a little more on practical work and less on theoretical tasks.

One of the phenomena we have noticed is that students who are shy and distant from others are much better at presented form of learning.

The transition to distance learning was overnight, but the results of the survey show that distance learning is possible if we provide all students with equal (technical) working conditions, give them valid feedback and give them adequate support and guidance.

REFERENCES

[1] Office 365 za škole, Retrived from, https://office365.skole.hr
[2] Zoom video comunications, Retrieved from https://zoom.us/
[3] Teams - Online virtual Classroom, Retrieved from https://teams.microsoft.com, 2020.
[4] Yammer. Retrieved from https://www.yammer.com/o365.skole.hr/#/home 2020.
[5] Škola za život, "Preporuke o organizaciji radnog dana učenika tijekom održavanja nastave na daljinu", Retrieved from https://skolazazivot.hr/ , March 2020.
[6] The James Dyson Foundation North America. Challenge Cards. Retrieved from https://www.jamesdysonfoundation.com/resources/challenge-cards.html. 2020.
[7] Scratch, retrieved from https://scratch.mit.edu/about. 2020.
[8] Niederhauser, D.S. & Stoddart, "Teachers' instructional perspectives and use of technological software", Teaching and Teacher Education 17, 15-31, 2001.
[9] Kahoot, retrieved from https://kahoot.com/schools-u/. 2020.
[10] Vural, O.F., "The impact of a question-embedded video-based learning tool on e-learning", Educational Sciences: Theory and Practice, 13(2). 1315-1323. 2013.
[11] Wix.com, retrieved from https://www.wix.com/. 2020.
[12] Croatian robotic association. Robotics Simulation League. Retrieved from http://ar.hrobos.hr. 2020.
[13] Irai. Miranda - Universal software for STEM robots simulation. Retrieved from https://www.miranda.software. 2020.