Abstract - The paper presents Ruse University students’ point of view about using Android application development environment MIT App Inventor in different levels of education. The research was done via the survey method. A questionnaire was made for the purpose. It consisted of 21 questions, merged in several parts: personal information about the respondent (age, gender, speciality, year of education, mobile devices possessed, programming skills and experience), students’ opinion about the qualities of the environment, its user-friendliness and which level of education it is most suitable for. The final part of the questionnaire included 2 open questions and the answers had to contain the advantages and disadvantages of MIT App Inventor compared to other programming environments. Within three consecutive years – 2016, 2017 and 2018 – a total number of 73 students (11 women and 62 men) from Computer Systems and Technologies master program were asked to answer the questions. The analysis of the results from all the three years shows that, according to Ruse University students, MIT App Inventor is most appropriate for use in a bachelor degree of education, followed by a master degree and a secondary school.

Keywords - education, mobile application, programming environment, survey

I. INTRODUCTION

The rapid and widespread penetration of computer and mobile technologies into industry and everyday life requires more and more people to have computing thinking and skills. On the one hand, modern students use almost constantly smartphones and tablets, and on the other hand they have difficulty or do not have a particular interest in studying programming. It is therefore useful to add student and student addiction to mobile devices for introduction to computer thinking by including the MIT (Massachusetts Institute of Technology) App Inventor mobile development environment in the learning environment. This allows learners to program and test their applications using their mobile devices, increasing their motivation and the desire to learn new knowledge.

This report presents masters’ students at Ruse University viewpoint about using MIT App Inventor programming environment at different levels of education.

MIT App Inventor [1] is a visual on-line environment that uses the block-programming paradigm that even enables users who are not familiar with programming languages to develop quickly mobile applications running Android OS. The environment consists of two basic modules - Designer for User Interface Development and Block for Block Programming.

Developing mobile applications as opposed to developing PC applications requires either a mobile device emulator or a real mobile application testing device. App Inventor provides both options, but for full testing mobile devices should be used if mobile applications use any sensors (camera, compass, GPS, acceleration sensor, etc.).

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II. LITERATURE REVIEW

The literature review shows that scientists’ research can be divided into several main groups depending on the level of education where App Inventor is used.

Researches about using App Inventor in the primary education:

- S.-W. Kim and Y. Lee have conducted a study [2] on the possibility of including App Inventor in the national curriculum for primary school students in South Korea. The results show that the use of this program does not improve the ability of small students to creatively solve problems, and that more time is needed for learning.
- P. Voštinár describes in his report [3] a mobile application that can be used for mathematics training in converting Roman to Arabic numerals. According to the author, the application can be used as an example of programming for mobile applications in primary school.

Researches about using App Inventor in the secondary education:

- In USA, a study [4] was conducted whether App Inventor is a suitable platform for providing computational thinking. The results show that App Inventor is an affordable and powerful platform that can provide a very good introduction to programming.
- S. Grover and R. Pea present in their report [5] a workshop curriculum that includes the training of high school students in programming and
introduction to the functional concepts of computer science, with students developing mobile apps with App Inventor.

- S. A. Nikou and A. A. Economides, in a study [6] among 38 high school students in Greece, point out that using Scratch and App Inventor in learning leads to an increase in intrinsic goal orientation, task value, control of learning beliefs and self-efficacy.

A big part of researches are about using App Inventor in the higher education:

- E. Sperti, M. L. Chang, P. Gestwicki, and D. Wolber [7] stated that ten years ago, twelve different colleges and universities in the USA used App Inventor in a wide range of computer science courses.

- The author B. MacKellar made a study [8] of using App Inventor in the Healthcare IT Course at St John's University, Queens, USA. The students of the course were commissioned to develop mobile applications in the field of health care, after which a study of their opinion was conducted. The main conclusion of this study is that App Inventor is suited for students with no programming experience to quickly begin developing mobile apps, and for experienced students offering many opportunities to engage them in the development.

- In Qassim University, Egypt, authors M. Amasha and S. Al-Omary made comparison [9] between using the Blackboard Learning Management System (LMS) and a mobile application developed with App Inventor. 114 students were surveyed, and analysis shows that student learning outcomes improve when using mobile applications, and that the students prefer to use mobile learning applications rather than LMS as they feel more engaged.

- The App Inventor was successfully used by the Technical University of Cluj-Napoca, Romania, not as a learning environment, but as a tool for the development of mobile applications in the field of mathematics, which could then be used by students [10].

- At the Jackson State University, USA, an innovative educational module is used in the existing Emergency Management Technology course. The report [11] describes the design of the module, which includes use of App Inventor. The purpose of the module is to motivate course students to be interested in computer technologies and to provide them with a broad foundation for computational thinking.

- A. Soares and NL Martin, in their report [12], look at the results of a study with 40 students enrolled in the Android Application Development course during the 2013 and 2014 spring semesters. App Inventor application development is used in the course. The course requires that students have basic programming skills. According to the authors, the positive responses to the study support the practice of using App Inventor in teaching not only beginners but also advanced programmers. The paper also shows that App Inventor can be used to support the teaching of more advanced computing concepts.

- A. Soares in another report [13] examines the opportunities and challenges of teaching Mobile Application Development with App Inventor at Midwest University, USA. The report shows that App Inventor has great potential to be used to teach advanced computing concepts such as Software Engineering, Information Assurance and Security, Data communication, Database Design, and more.

The literary review shows that App Inventor can be successfully used in both secondary and higher education for teaching of beginners and advanced programmers. App Inventor is still not suitable for use in primary education.

III. RESEARCH METHODOLOGY

The survey was conducted using the questionnaire method. For this purpose, a questionnaire was developed. It includes 21 questions, merged into five parts: Part 1 - personal information about the interviewed (age, specialty, gender, course, owned mobile devices, programming languages that they have knowledge of and experience in programming). The next three parts are about students' viewpoints according to the technical implementation of the environment (Part 2), the friendliness of the environment (Part 3) and in which educational degree App Inventor could be used (Part 4) and include questions with possible answers in the five score Likert scale. Respondents had to indicate their agreement / disagreement by choosing one answer from 1 = “I strongly disagree” to 5 = “I strongly agree”. Part 5 of the questionnaire includes two free-answer questions that students had to say about what they think are the benefits and disadvantages of App Inventor over other programming environments.

For three consecutive years, 2016, 2017, and 2018, a total of 73 students (11 women and 62 men) of the Master's program in Computer Systems and Technologies were surveyed. The survey was implemented three times with different students for each of the years. This target group was selected for a survey as the students are in their last level of education, they have experience in using App Inventor as a part of the training in the Mobile Technology course. At the same time, Master students have a viewpoint about educational process at all previous levels of education, they use different programming environments and languages (C ++, C #, Java, PHP, JavaScript, etc.) and can make comparisons and reasoned suggestions on where to use App Inventor, and what are its advantages and disadvantages compared to other development environments.
IV. RESULTS

The questionnaire included a question about student-owned mobile devices. The results of the responses are shown in Fig. 1. Over the past three years, the most commonly owned mobile devices are smartphones (between 80% and 100%), followed by laptop computers (between 45% and 73%). The sum of the percentages exceeds 100 because many respondents have indicated they have more than one device. The analysis of the questionnaire results (Fig. 2) shows that 31 students (42.47%) have only one mobile device and most often it is a smartphone (27 students, i.e. 36.99%). Two mobile devices have 42.47% of students, while three and more devices have 15.07%.

The next question explored what programming languages the students use. The purpose of this question was to find out how the students appreciated their knowledge of programming languages and thus adequately assess the capabilities of MIT App Inventor. The results are shown in Fig. 3. The most common programming languages which students use are C++, Java, and JavaScript. PHP and Object Pascal are found in other programming languages. Very few students have programming experience with Objective-C (less than 5%). In this question again, the sum of the percentages exceeds 100, as many respondents have indicated they have more than one programming language.

The question of how many years the students are involved in programming was also studied. The answers given by the students were in the range of 1 to 10 years, with great differences, which explains the large standard deviation (SD). Fig. 4 shows the average results and the standard deviation for the three years. It can be seen from the figure that the most experienced (average 4.09) had students who were trained in 2018 and the smallest ones – these trained in 2016. The highest standard deviation (2.71) is seen about students from 2017 (there are students with 1 year of experience as well as with 10 years of experience).

The results of the students' answers to the questions in part 2 are given in Table I. It gives both the mean values and the standard deviation (SD) for each of the three years as well as the average averages for all years. The analysis of the results shows that the highest degree of approval amongst the students is the assertion that App Inventor programming is easy, and the second is claiming that web-based architecture is a very good solution. The lowest score is the assertion that the environment offers enough resources to develop the design of mobile applications. This statement also has the largest dispersion, i.e. students have indicated different responses on the Likert scale.

The results of the answers to the questions of part 3 are given in Table II. Here, again, the highest approval is obtained about the question is it easy to use App Inventor (for students from 2016 and 2018). The least approval (but still above 4) suggests that students will recommend the use of the App Inventor to other users. Interestingly, according to the students of the 2017 class, this is the most approved issue. The standard deviation analysis shows that the answers with the highest approval have the least standard deviation.
Table III shows the results of the answers to the questions in Part 4. Apparently, students believe that App Inventor should be taught in a bachelor's degree, followed by a master's degree and a secondary education. The least approval comes to the assertion that App Inventor should be taught in primary school, and again here the standard deviation is very high, which shows a great variety in student responses.

The results of Table III were analysed according to the students' gender, the number of mobile devices they owned, their programming experience and the number of programming languages they used.

The Fig. 5 shows the results of the students' opinion, relative to their gender, about the level of education that is best suited to use MIT App Inventor. Both men and women believe that this environment is best to be used in the bachelor's degree. Men believe that the next level where App Inventor must be used is a master's degree followed by secondary education. Unlike men, women give the same assessment (4.18) of the possibility of using this environment in master's degree and secondary education. Women's results of all responses are higher than those of men, and the standard deviation is less.

The Fig. 6 shows the students' viewpoint about the level of education where App Inventor can be used depending on the number of mobile devices they own. For students who have one or two devices the most appropriate is the bachelor's degree, followed by master degree and secondary school. There is a difference in the group of students who have three mobile devices - they think that App Inventor should be used primarily in secondary school, followed by bachelor and master degrees.

The Fig. 7 shows how programming experience influences students' viewpoints of where to use App Inventor. Interestingly, students with the least experience as programmers believe that this environment should equally be used in both secondary and bachelor's degrees. The opinion of students with more experience is that the environment should be used in the bachelor's degree,
followed by master's degree and then secondary school. The results show that when the students have more experience in programming, the average result of their choice is higher.

The Fig. 8 shows how fluency in programming languages affects students' attitudes of using App Inventor. The results show that, regardless of the number of programming languages they know, students believe that this environment should be used first in the bachelor's degree, followed by the master's and then in the secondary school. It can be seen that the more programming languages the students know, the higher are the ratings they give to the statements.

V. CONCLUSION

The analysis of the results from all the three years shows that, according to Ruse University students, MIT App Inventor is most appropriate for use in a bachelor degree of education, followed by a master degree and a secondary school. These results confirm the findings of the literary review.

The study shows that according to the gender there is not much difference in the students' opinion about where App Inventor can be used. Both men and women think that first of all it should be used in the bachelor's degree. The women are more categorical in giving higher ratings and less deviation than the men.

The analysis, depending on the number of mobile devices owned, shows two different results. Holders of one or two devices believe that App Inventor is best to be used in the bachelor's degree, while the holders of three devices find that it best suited to secondary school.

Depending on programming experience, there is also a difference into the results. Students with less programming experience (1-2 years) believe that App Inventor can be used in the secondary school as well as in the bachelor's degree by giving the same ratings. Students with more experience point out that this environment is best to be used in the bachelor's degree.

The analysis shows that the number of used by students programming languages do not affect their opinion. The students point out that App Inventor should be used firstly in the bachelor's degree, followed by the master's degree and after that the secondary school.

All results show that according to the students, App Inventor is the most unsuitable for use in primary school.

REFERENCES


[12] Soares and N. L. Martin, “Teaching non-beginner programmers with App Inventor: survey results and