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Are Future Teachers Methodically Trained to Distinguish Good from Bad Educational Software?

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Abstract: *In the era of information technology and general digitization of society, invasion of every kind of software is evident. No matter how laudable is the existence and development of educational software, taking into account its role, its quality and whether it achieves the desired goal is very important. In addition to programming experts it is necessary to include educational experts in certain fields when developing educational software. Those who should take an active part and be able to distinguish good from bad educational software are certainly teachers. Especially as they should be the most competent persons from which parents will seek the advice and opinion when searching for appropriate educational software.*

Keywords: educational software, mathematics education, pre-service teachers

At the Faculty of Education of University of Bihac next to students of primary education, future IT teachers in primary and secondary schools are educating. During their studies, these students are learning about modern programming technologies and they acquire skills to create modern, multimedia and interactive applications. These skills in combination with knowledge in Educational Psychology, Didactic and Teaching Methods students use within the course of Educational programming applications to produce high-quality educational software. At the end of study, they are supposed to be able to make educational contents and applications for the purpose of teaching IT, as well as for the needs of fellow teachers from other areas.

The main goal of our study is to verify whether pre-service primary school teachers have obtained sufficient training in teaching methods to be able to differentiate the good from the bad educational software. Students

of IT had the task to create educational applications for primary mathematics: Multiplication tables through fun and games. When completed, applications have been shown to students of primary education and they have been asked questions regarding the methodological correctness of these applications.

Initial results of the study show that pre-service primary education teachers tend to accept educational applications without critically reviewing them. In fact, only after the students' attention was focused on the possibility that applications were not based on a proper methodical approach to build the concept of multiplication, students started to notice all the deficiencies of presented applications. Then they provided the correct models that should be built in applications.

The concept of computer games can be used when designing educational software that would enable interesting and motivating teaching and learning. One may raise the question of the importance of educational software games in education and whether all of them are proper and correct. The research results show that educational games, though fun, can maintain or even improve the educational effects on students.

Efficiency of software games with aspect of educational goals

There is many computer software intended for children for educational or entertainment purposes, which is available for use at home or at school (Brody, 1993). Such applications should be designed to be interactive, multi-media and with content and user interface that are interesting to students and that will retain students' attention until it is needed. However, it is essential that educational applications are methodically well designed and do not contain material errors in terms of educational content. Common criteria about the quality of such applications include: high-quality presentation of relevant content, using appropriate language, visual appearance, and various forms of interaction, as well as the reaction of computer to the action of the child, which will vary according to the response that the child is given (Khalifa et al., 2000). Among all, program compatibility with a variety of machines and operating systems is of great importance. Also, such software should be clear and easy to use. Trained teacher is a very important factor in the whole process. Its role is essential when selecting suitable educational software (Squires & Preece, 1999). As the emphasis on education, the teacher should evaluate the usefulness of a particular software and its impact on learning. Continuous training of teachers should enable teachers to acquire skills in the use of educational software and estimating its value (Bitter & Camuze, 1984).

Jones (1993) points out several essential characteristics of a good software for children:

1. It should be easy to install, and should be easy to print and save the one's work.
2. The student know he can stop and restart the software.
3. Student should be able to figure out what computer asks him without the help of teachers. The teacher's role should only be to provide instructions for student and not to be with him during the use of application.
4. The software should not only offer answers, but to ask the student, analyze and inform the student about the accuracy of his answers. If a student wants a computer should offer correct answers, and from that student could learn a lot.
5. For better results in learning, it is important that the response of the program to the correct answers is more interesting than response to false answers. Otherwise, student will give wrong respond on purpose just to see the attractive display.
6. Use multimedia to visually and narratively describe and demonstrate methods for solving tasks that are the subject of learning.

Beside aforementioned, we will underline following features of good software for children:

- Allow the user to correct typing errors, if the program does not allow corrections when the user mistakenly enters or chooses the wrong answer.
- Documentation describing the application should be available and should clearly describe the procedures and actions, in order to avoid students' wandering, trying out and speculating. Clear instructions are key for each software package.
- The instructions for downloading and installing the software should be unambiguous and detailed and easy to follow.
- The display should be pleasant, and without excessive details.
- Incorrect choice must not to bring down the system. In this case, the software should respond with a sound signal, or by refusing to accept the answer.
- The user interface should be interesting and carefully constructed to follow the procedures the end user in the controlled manner.
- The software appropriate to the age group for which it is intended and usable independently of the ability of those for which it is written.

In literature, it is noticeable that requirements relating to the validity of the contents and proper methodical approach to these contents are not stated as the requirements that define a good software. However, if the last two requirements were not fulfilled, then other requirements cannot contribute to the learning process. Teachers should be able to recognize if an application meet those requirements and use it in teaching process or suggest students to use it when learning.

Method

At the Faculty of Education of University of Bihac next to students of primary education, future IT teachers in primary and secondary schools are educating. During their studies, these students are learning about modern programming technologies and they acquire skills to create modern, multimedia and interactive applications. These skills in combination with knowledge in Educational Psychology, Didactic and Teaching Methods students use within the course of Educational programming applications to produce high-quality educational software. At the end of study, they are supposed to be able to make educational contents and applications for the purpose of teaching IT, as well as for the needs of fellow teachers from other areas.

Using the fact that on one side we have those who should be able to make methodically good educational software and on the other side we have those who should know to evaluate if a particular educational software is methodically correctly created, a survey is conducted. IT students themselves choosing the theme *Multiplication table through fun and games* have created the educational applications of mathematics. In the process of creating applications, students did not receive any help from researchers. Three applications have been chosen for demonstration to students of elementary education: *Multiplication by 10, Multiplication by 8, Multiplication by 3*.

In the first step, 12 students of primary education and 16 IT students have been asked to point out what features should have good educational application. Secondly, three applications have been demonstrated to students of primary education. Students were asked to evaluate applications and afterwards, in semi-structured interview, to answer questions about the methodological correctness of these applications:

- Identify educational goal of application.
- Do you think that the educational goal would be achieved if the students use application without help from adult?
- You previously mentioned good features of educational applications. Which of these qualities you notice on each of demonstrated applications?
- Is there something you would change in any of application? What should it be?

Results and discussion

In the responses to the question of what distinguished good educational application, both groups of students stand out following features:

- minimal teacher assistance, i.e. after the first use the same can be used independently,
- access the menu should be simple and easy to understand,
- graphical interface should be attractive and simple,
- the program should be comfortable to use,
- graphics must be meaningful, allowing children to enjoy,
- to achieve that the children themselves want to return to the program after a while,
- teacher or child should be able to choose the appropriate level of difficulty,
- the program must respond to the action of a child,
- themes must make sense for children,
- should be appropriate to children's age
- the program should keep a record of the activities of the child.

However, the responses of students from the two groups differ in the emphasis on the most important feature of educational applications. Students of primary education pointed out two important features of a good educational application: a mathematical correctness and methodical way of developing and representing of mathematical ideas. Each of 12 students of primary education ranked those two characteristics as crucial. On the other hand, none of 16 IT students did mention those two features.

When assessing applications, students were guided by the questions and they referred to their answers about features of good educational application. All students of primary education agree that observed applications meet the most of requirements for good educational application. Also, it is clear to students what is the educational goal of these applications. All of them suggest that precise and correct symbols should be used, referring to sign for multiplication. However, although they noted mathematical accuracy and methodical approach as crucial features of educational applications, students themselves did not noticed shortcomings of these qualities in observed applications. In repeated demonstration, and during semi/structured interview 10 students find out that the most important requirements are neglected in two applications.

In the application *Multiplication by 10*, that teaches multiplication by number 10 (Figure 1), future primary school teachers have noticed an irregularity with animations and representation of multiplication. Multiplication is incorrectly presented (animated) as division of 10 candies to the 10 boys, each boy receiving one candy (10 : 10 = 1) (Figure 1). The same error in the representation of multiplication is repeated in each subsequent step (20 : 10 =2, ..., 100 : 10= 10) .

Figure 1. Incorrect representation of multiplication by 10 multiplication

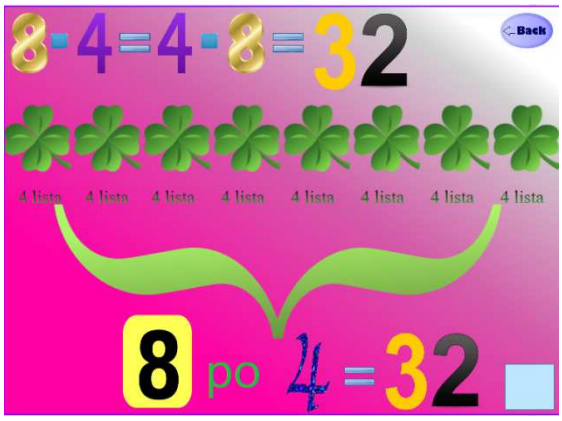
Students suggest right representation of multiplication: each of 10 boys have equal number of candies, grouping the numbers of 10 groups of candies we obtain product. The correct representation of multiplication by 10 is showed in Figure 2.

Figure 2. Correct representation of multiplication by 10

This representation is compatible with learning multiplication as repeated addition ($10 \cdot 1 = 1+1+1+1+1+1+1+1+1+1$), and in general $10 \cdot a$ means 10 groups of a elements.

In the application *Multiplication by 8*, students realize the inconsistency in representation of multiplication and learning multiplication as repeated addition. In some examples, appropriate picture is followed by statement *8 groups of 4 equals 32* which refer to addition of 8 equal addends, and then multiplication expression is given (Figure 3). In other examples link to addition is omitted.

Figure 3. Multiplication by 8



Furthermore, students point out situation that can lead to misconceptions. In each of examples commutative property of multiplication is written for given numbers even visual representations do not suggest why this property is correct (Figure 3). As illustrated in Figure 3, only 8 groups of 4 are shown and expression 4·8 indicates 4 groups of 8. Students indicate that symbolical representations should follow visual and suggest commutative property should be subject of a separate application which would offer students opportunities to make different arrangements of elements and make conclusions about commutative property.

Students evaluate application *Multiplication by 3* as the best. Multiplication is visually represented as union of sets with equal number of elements and symbolically represented as $3 \cdot a$, (a = 1,...,10). In Figure 4 one frame from application is shown, where $3 \cdot 2 = 6$, is illustrated with groups of 2 lightning bulbs appearing one after another in each of 3 trees.

Figure 4. Multiplication by 3

Finally, students look back on the possibility of using the applications upon suggested corrections. All of them find that children can use the applications independently but opinions are divided on whether the educational objectives could be achieved if the applications are used independently of the teacher. The math curriculum in Bosnia and Herzegovina stipulates that multiplication have to be comprehended as

repeated addition, i. e. represented as union of sets of equal number of elements. Multiplication table of numbers (for example, multiplication of number 2) should be teach firstly in joint activities of teacher and students. Creation of multiplication table by numbers should be developed by students. This is the reason why students of primary education think that the applications can be used independently, but after working with the teacher.

Conclusion

Educational applications offer a powerful format for the learning environment. Common criteria about the quality of such applications include: high-quality presentation of relevant content, using appropriate language, visual appearance, and various forms of interaction, as well as the reaction of computer to the action of the child, which will vary according to the response that the child is given. It is evident from literature that relevance of contents and methodologically correct path in presentation of content are taken for granted.

Results of our study show that students of primary education recognize the most of features of a good education application. Furthermore, they rank mathematical correctness and methodical way of developing and representing of mathematical ideas as essential characteristics of good educational application for learning mathematics. However, although they noted mathematical accuracy and methodical approach as crucial features of educational applications, students themselves did not noticed shortcomings of these qualities in observed applications. Only in repeated demonstration, and during semi-structured interview 10 students find out that the most important requirements are neglected in two applications. When those shortcomings had been identified students were able to give suggestions for improvement and also they were able to justify those suggestions.

Taking into account our findings it is important for teachers to have competences to recognize all features of good educational application, including those of mathematical correctness and methodical way of developing and representing of mathematical ideas in applications. Also, developers of such educational applications should collaborate with teachers in order to produce applications that will meet all requirements.

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