From Verbalization in Problem Solving on Computational Thinking Tasks to the Abstraction of Block Programming Concept under Scratch

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Abstract. Bebras challenge was introduced in Algeria since 2018, both of number of participants and schools are increasing, they use digital and pen and paper version, all student's categories are concerned by the challenge from 6 to 18 years old. Computational thinking is taught in the school one or two hours for each class during the week. The first-year students use only paper and pen activities. The second year, middle school students (11 years) participate to an experimentation, to prepare them in programming using Scratch, the teacher asks students after they find the solution to describe each (raisoning) and actions of the activity, we collect these steps on paper. This method is used by experimented persons which is usually automated step by step how they achieve the solution, they verbalize the solution. Most of the students find difficulties in writing their steps even the solution is correct. In this paper we analyse students' verbalization and we highlight the impact of this action on Scratch block. We used the concept of scheme of Vergnaud to analyse students' activity.

Keywords: Computational thinking, verbalization, scheme

1. Introduction

Bebras is an international initiative aiming to promote Informatics (Computer Science, or Computing) and computational thinking among school students at all ages. Participants are usually supervised by teachers who may integrate the Bebras challenge in their teaching activities. In Algeria, many schools attend the challenge even they don't teach computer science.

The experiment take place in middle school in Algeria, It should be noted that teaching computer science in Algerian curriculum is only present in secondary school education for two years. However, the mathematics curriculum in middle school presents activities in Excel. To prepare students to use the digital technologies, the school has introduced computer science in all classes using one hour per week.

Since 2018, the content of the courses was changed and was focused on Bebras tasks to introduce computer science concepts.

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2. For scheme to verbalization in Bebras computational thinking problem solving

In our experiment, we use the concept of Vergnaud's scheme. Schemes are mental structures that evolve as students acquire new knowledge and skills. Applying this theory, we examine how students approach computational thinking problems, what schemas they use, how those schemas evolve, and how teachers can guide them to develop more advanced schemas. This allows a better understanding of how students learn and solve computational thinking problems. The principle of verbalization in problem solving related to computational thinking describes out loud between students then writing each reasoning (procedure, goals and action of the students' activity) it allows to concretize thoughts, actions and reasoning.
According to Vergnaud (1991) conceptual field theory, characterizes situations as tasks "any complex situation can be analyzed as a combination of tasks". Any solvable problem can be defined as an initial situation with a goal to achieve. Vergnaud (1991) describes "scheme" concept and encompasses it around its constituents: its goal, subgoals and anticipations, rules of action for taking information and controls, operational invariants (concept-in-act and theorem-in-act) and possibilities of inferences, which he generalizes through the organization of the activity.

3. Verbalization

The student (in computational thinking) describes aloud then transcribes each reasoning (procedures, goals, problems) and action of his activity. This technique makes it possible to concretize thoughts, actions and reasoning. For its implementation, we consider verbalization in activity where student expresses out loud each reasoning and action carried out during his activity (real or remembered) then a cooperative verbalization where two groups compare their intermediate transcriptions to refine transcription of the solution. Faced with a task or problem solving in computational thinking, and to help students making their verbalization, we use some questions: Verbalize thoughts (what to do, what is/are the goals), verbalize his actions (how to do, what are the procedures), verbalize and justify his actions (why his actions and not others, what about the evaluation and the solution). (See table 1).

Task name	Description : be brief,- use short sentences
Verbalize your thoughts (what to do, what are the goals?)	
Verbalize your actions (how to do, what are the procedures) "	

Verbalize and justify your actions (why these actions and not others? What about the evaluation of the solution?) "	

Table 1: Model table to guide students in their verbalizations

4. Methodology

A class of fourteen students divided into two groups took part in the experiment during a term (one hour per week). The students are asked to solve Bebras tasks by performing their written verbalization at the same time. All classes solve the same tasks. In the second step, two groups from the class confront and discuss their verbalization to refine it. The students follow a canvas pre-established by their teacher, however they are free to fill it or not. For each task, the teacher collects three paper where the verbalization is refined. Institutionalization is conducted by the teacher using student transcriptions, he often proceeds to modify their transcription by conditions or by changing the initial state of the solution. Students discover by themselves the concepts of scratch block programming. In the experiment students, try to write on paper their steps to choose the correct solution, we can see that this step start just after they find the solution, they do that at first orally, discuss together and valid the solution.

This task allows teacher to introduce algorithmic concepts, notion of variables, affectation, loops, and condition. The finality of the verbalisation is to make a bloc program under SCRATCH. All Bebras tasks are a multiple choice questionnaire (MCQ), the experience has shown that students often explain easily their steps for choosing the right solution but they do not present steps to eliminate the other options. The teacher then guide them with the opposite approach, by asking them for the same task: “Which of these answers are wrong and why?” ". This approach encouraged the students to provide a global solution to the task.

Task name	Description : be brief,- use short sentences
Verbalize your thoughts (what to do, what are the goals?)	على والعثور الصحيحة العصا على العثور منا نطلب الصحيحة الساعة We ask us to find the correct stick and to find the correct hour

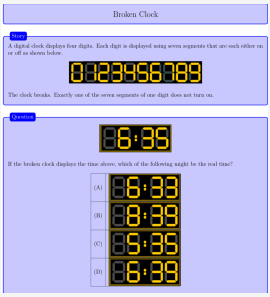
Verbalize your actions (how to do, what are the procedures) "	برقم رقم ذلك من التحقق سنحاول We'll try to check number by number
Verbalize and justify your actions (why these actions and not others? What about the evaluation of the solution?) "  	إذا كانت العصا المفقودة في الرقم6 ، فستعطي 8 لكننا نجد 08:33 أو 8:39 والتي لا تساوي6:35 لذلك لا يعمل، نتغير ربما نختار من بين 3 ونجد 6:95أوه!!!!!، هذا خطأ مرة أخرى ننتقل بعد ذلك إلى الرقم5 ، حيث يمكننا تجربة ، 9 أو6 ، ويكون الرقم 9 هو الصحيح If the missing stick is in number 6, it results 8 but our findings are 8:33 or 8:39 which is not equal to 6:35 therefore it doesn't work, we change. We might choose 3 this will result in 6:95 ohhh!! it also not correct we will then choose 5 and we will try 9 or 6 this will result in 9 which is correct

Table 1: Model table to guide students in their verbalizations

5. Conclusion

The experimentation of the verbalization of the solution to approach the programming with the Scratch blocks was initially a difficult task for the students, the cooperative work by discussing the solutions between peers however made this work quite motivating, the students reached at the end to present fine, abbreviated transcripts and even sometimes to use the same vocabulary in the different tasks. Institutionalization using student's verbalization favors access to the abstraction of the blocks of Scratch.

References

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