Learning Benefits of Teaching Methods Used in Informatics at the Secondary School Level: Evaluation and Implications

Said HADJERROUIT
Faculty of Technology and Science, University of Agder
Kristiansand, Norway

ABSTRACT
Informatics education is still in its infancy. It lacks an extensive research base of materials like the one published for mathematics education. This work is a contribution to the development of a didactics of informatics in secondary schools. It focuses on teaching methods in relation to their effect on learning informatics. It uses a theoretical model that classifies the methods according to the type of learning they are supposed to foster: behavioristic, constructivist, or socio-cultural learning. The main goal of this work is to investigate which teaching methods have worked best for the students to learn informatics. To achieve this goal, a survey questionnaire with open-ended questions is designed to ask 52 students in one class about their perceptions on the learning effect of teaching methods.

Keywords: Behaviorism, Constructivism, Informatics, Teaching methods, Socio-cultural learning theory.

1. INTRODUCTION
According to research studies (Armoni, 2011; Dagdilelis & Xinogalos, 2012; Hadjerrouit 2009a, 2009b, 2008; Kumar, 2006), a prerequisite for effective teaching is that teachers master a broad range of teaching methods and strategies and know how they can apply them in different situations to promote learning. Teaching methods differ considerably both from a theoretical and practical point of view. In addition, teaching methods must be adapted to the students’ and teachers’ characteristics, as well as to the subject matter being taught in authentic educational settings.

2. TEACHING METHODS
The most important theoretical background and ideas of this work are the following teaching methods numbered from 1 to 8. The survey questionnaire is closely connected to the teaching methods listed below:

1. Classroom teaching with the blackboard and / or overhead projector
2. Demonstration of software tools
3. Self-learning: reading study material and solving exercises
4. Project work over several weeks
5. Group work
6. Individual work on programming or similar tasks
7. Homework assignments and asking friends, siblings, or parents for help
8. Student presentations of solutions in classroom

These are classified according to the type of learning they are supposed to promote in educational settings. According to McGonigal (2005), teaching is considered as a transformation process from learning theories to teaching strategies. Teaching methods can be categorized as methods that promote behavioristic, constructivist or socio-cultural learning.

The behaviorist learning theory assumes that the human mind is a passive recipient of knowledge, and since it is not possible to observe or measure what is happening inside the brain, researchers focus on external behavior that can be observed (Driscoll, 2000). Teaching methods that promote behaviorist learning are those that focus on teacher-directed instruction, systematic training, and repetition. The following methods are associated with methods that foster behaviorist learning:

1. Classroom teaching with blackboard and / or overhead projector.
2. Demonstrations of software tools

The advantage of these methods is that they are practicable and easy to use in classroom and ensure that the students "go through" the curriculum. The downside may be that there is little personalization, that students develop little understanding of the subject matter but only repeat the knowledge they are supposed to acquire, and that all must follow the same progression regardless of conditions, interests or needs.

Constructivism frames learning less as the product of passive transmission than a process of active construction whereby the learners construct their own knowledge based upon prior knowledge (Piaget, 1971; Steffe & Gale, 1995; Taber, 2011). The constructivist model calls for learner-centered instruction, because individuals are assumed to learn better when they are forced to explore and discover things themselves. Constructivism as an educational philosophy has been introduced in informatics education (Ben-Ari, 2001). Teaching methods in informatics that encourage constructivist learning are the following:

3. Self-learning: reading study material and solving exercises
6. Individual work on programming or similar tasks

The advantage of these methods is that there is a high degree of activity in which students make their own discoveries through problem solving. It is also easier to add up to differentiated tasks. A disadvantage may be that students cannot get an understanding of the problem if they do not find the correct solution.

The sociocultural perspective can be seen as a correction of constructivism. Whereas in the constructivist paradigm learning is assumed to occur as a learner interacts with the study
material, learning in the socio-cultural perspective is understood as a social process in which learners exercise their knowledge through discussion, collaboration, and interaction with the social environment (Vygotsky, 1978). Like constructivism, sociocultural learning has been introduced in informatics education (Ben-Ari, 2004). Typical learning methods that foster sociocultural learning are:

4. Project work over several weeks
5. Group work
6. Homework assignments and ask friends, siblings and/or parents for help
7. Student presentation of solutions in classroom

The advantage of such methods is that knowledge is acquired through collaboration. Disadvantages of group and project work are timeliness and efficiency. It can be difficult to evaluate individual members, and it does not necessarily promote independent learning and being able to stand on its own.

3. DATA COLLECTION AND ANALYSIS METHODS

Both quantitative and qualitative methods were used to collect data: Survey questionnaires, informal discussions and observations of students’ activities in classroom. The questionnaire (5-point Likert scale) consisted of a number of teaching issues in which students had to decide to what extent they strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree with the statements, and three open-ended questions that enable them to describe in their own words what they like, dislike or want changed with the teaching methods. To evaluate the results of the questionnaire, the mean and standard deviation were calculated, and a synthesis of the qualitative results was elaborated. In addition, informal discussions and observations have been used to get a more complete picture of students' views of the teaching methods.

4. SUMMARY OF RESULTS

There was considerable variation in students' learning outcomes in relation to the different teaching methods. First of all, it is surprising that students rated blackboard teaching as the method that gave them one of the greatest learning. The teacher found that almost all students showed interest in the topic being taught (Web design). The teacher posed questions to the students to enable them understand the nature of Web design and showed examples of Websites they were familiar with. The teacher also related the current theme to the subject matter that the students have worked on before (HTML-coding). In addition, the teacher got feedback from the students that the topic was interesting and presented in an engaging way. This might have contributed to the quality of blackboard teaching method that got a high score.

Students also benefited from two teaching methods that support socio-cultural learning, namely project work and students’ presentations. In both cases, the students received an introduction in theoretical issues and the tasks they had to solve. They also received guidance during project work and tips on where to find more information about the problems and challenges they faced. In presenting their work to the class, the students worked in small groups, and had therefore some prior knowledge about what their peers did. As a result, in presenting their work they were able to link the acquisition of new knowledge to prior knowledge.

Furthermore, students perceived positively the use of demonstration of software tools. Since this method was closely connected to solving problems on their own, it is not surprising that the students placed it on the top of the methods that foster learning. As one of the students commented, it is good for young people to practice shortly after the teacher has shown how it is done. For this method to work well, however, it is recommended to design differentiated tasks.

In contrast, students' experience with group work was rather negative. This may be due to the task that should be solved (making a guide for Web editors). In the preceding lesson, the students had been demonstrated features of the software and worked independently on tasks related to those. They may therefore felt they did learn much from working in groups, and, as a result, the method was given a low score.

Likewise, self-learning received a rather negative score. The students were not motivated to read user manuals, follow a video-lecture, or use instructions, even though the teacher used purposely a guide that was easy to understand. This was later used as an example of why user manuals should be short and illustrative. However, there was little difference in perceived learning outcomes when students read the "bad" user guide and the "good" one.

Finally, as the results reveal it is not realistic to expect from most students to learn informatics by doing homework and asking friends, siblings, or parents for help. The informatics subject uses specialized applications and is based on relatively complex logic. As a result, “ordinary people” who are not educated in informatics or are not employed in software-related jobs have a few opportunities to help students.

Summarizing, the results show that project work seems to be the best method to teach informatics. However, the emphasis on the benefits of constructivist learning is not supported by this work. On the contrary, the results confirm the importance of teacher-directed instruction (McGhee-Richmond et al., 2007). Moreover, demonstration of software tools, programming exercises, and simulations are very important. Finally, it appears from the results that students spending their time doing project work over several weeks, and being instructed by teachers seem to make better progress in learning informatics than those who are expected to learn on their own.

5. CONCLUSIONS

There are few similar research studies on teaching methods in school informatics like the one presented in this article. This research study shows the importance of teaching informatics using various and innovative methods. It also highlights the importance of connecting learning theories to didactical concepts and teaching methods. But still, the didactics of informatics is still in its infancy. Hence, research studies are needed to build a base of materials like the one found in mathematics education. This can be achieved only through the iterative and continuous cycle of experimentations and evaluations in various educational contexts.

6. REFERENCES


