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Reflective Teaching in Computer Science Education

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Abstract: Teaching Computer Science in most of the higher educational institutions is done by teachers who have not been professionally trained in pedagogical practices to teach science. There exist many concerns in the quality of Computer Science education given in institutions even today as teaching in higher education has always been overlooked right from the past. Here an attempt has been made to bring out the relevance of the famous reflective teaching methodology in teaching Computer Science. Various techniques that can be used to make teaching effective in Computer Science Education have been elaborated here.

Key words: Reflective teaching · Reflection-in action · Reflection-on-action · Microteaching · Observation

INTRODUCTION

The term reflective teaching has been in the science and engineering literature for a while now. The relevance of this approach has been attested by a series of studies [1]. Though various proposals and papers in this aspect have been published in journals and discussions on it are being conducted in conferences worldwide, the effective implementation of these strategies in teaching subjects like computer science in universities and other engineering/technology educational institutions is yet to be a reality. In this context the importance of reflective teaching practice in the area of computer science education is stressed here.

Reflective Teaching Model: Reflective teaching refers to the process of learning to challenge and explore our own teaching practices [1]. A teacher, involved in higher education is an individual with own background and experience. He brings certain beliefs, assumptions, knowledge, attitudes and values to teaching. Also the process of teaching takes place in a social setting that has its own unique characteristics, opportunities and constraints. Reflective teaching means exploring the implications of these entire complex factors with the intention of understanding and improving our practice [2].

The Reflective Teaching Model (RTM) was proposed in the mid 1980s to promote quality teaching. It is grounded in the theories of constructivism and metacognition [1]. The model provides a framework for educators to systematically observe experience and reflect upon teaching and learning and thus learn to challenge and explore their own teaching practice.

RTM in Computer Science: Computer science has always been a challenging discipline to teach. Improper teaching may lead to students' hating the subject which includes computer programming. An efficient teacher on the contrary can significantly enhance their analytic and problem-solving skills thereby paving the way for them to become good programmers. Rather than developing only the theoretical knowledge in a student, a great depends on how a teacher helps in developing the skills required to make a student an efficient programmer. Reflective teaching methodology is a strategy a computer science teacher can espouse to move in this direction. Prior to using reflective methods, a teacher who attempts to change his/her teaching through reflective practices has to find precise answers for the following questions [3].

- General Overview of You as a Teacher
- Why do you teach?
- What do you find rewarding about teaching?
- What are the basic principles that underlie your teaching?
- What are your standards or criteria for effective teaching?

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Your Style of Teaching:

- What is unique about your teaching?
- How do you establish rapport with your students?
- What are your expectations for your students' intellectual accomplishments?

Teaching Goals:

- What do you wish for students to learn?
- Within what sort of context do you teach?
- What sorts of skills do you deliberately attempt to teach in your classes and why?
- How do you evaluate whether you've accomplished your teaching goals?

The answers to these questions gives a clear picture in a teacher's mind about the purpose of teaching, methods needed for successfully performing it and also the reflective practices to be used. The various methods a teacher can employ to change their teaching through reflective practices include reflection-*in*-action methods as well as reflection-*on*-action methods [3-4].

Reflection-*in*-action Methods: Reflection-*in*-action is what we reflect constantly as we teach, responding to ongoing situations in the classroom as they arise [2].

Continuous Observation: It the simplest way of understanding the perception level of your students. While you are explaining a computer program to the students, you see the students' eyes glaze over and you readily see that the student is no longer actively engaged. You could understand that the execution flow of the program being explained and the changes the program does in the values of the declared variables or actions the program initiates during its execution is not being accurately visualized in the student brain by your explanation. You have to stop the proceedings and start it all over again with an explanation which could create in the brain of a student the visualization of what happens in the main memory, processor and other computer resources as the program proceeds its execution and modifies the variables. Sequencing of your explanations has a major impact in the understanding of the concepts in the students. Use of educational teaching aids is handy to perform this activity. If this is done successfully, the students will start responding to you with the accurate answers while you explain each iteration of the functions used in the program example. If so, you are successful in explain the working of the program. Give another problem of relatively same complexity for which they have to develop an accurate solution which has to result in an efficient program. This exercise must be followed by giving problems which demands high problem solving skills of the student. Ask them to find optimal solutions for it and bring it in the next class.

This approach encourages learner-centered instruction where the students are asked to take responsibility for their own skill development and which helps them gain confidence in their ability to learn and use the programming language.

But it is not always so obvious when this approach is not working. Even when the student is exhibiting my-eyes-glaze-over (humorously called MEGO), a preceptor might fail to notice and continue to drone on [4].

Prompt Feedback Through Questions: You have to seek feedback from the students frequently. Instead of merely asking "Yes" or "No" questions, ask the student to tell you what he or she got out of an explanation or ask, "What did you think was most important in what I just told you?" or "If you had to summarize this case in 1 minute, what would you say?

Reflection-*on*-action Methods: Reflection-in-action usually happens very fast, perhaps even spontaneously. It can be transient and quickly forgotten. It is only after a teaching event that there is time for in-depth reflection. This is called reflection-*on*-action [2].

Maintaining Teacher's Diary: It is a personal way of keeping one aware of what happed in the class. Your own thoughts and reactions when you delivered the lecture can be described. Your observations about the students, how they reacted to your questions and examples. You are likely to begin to pose questions about what you have observed. Diary writing does require a certain discipline in taking the time to do it on a regular basis [5].

Peer Observation in the Classroom: You require the help of your colleagues to carry out this activity. Invite one of them to come into your class to collect information about your lecture. This may be with a simple observation task or through note taking. This will relate back to the area you have identified to reflect upon. For example, you might ask your colleague to focus on which students contribute most in the lecture, what different patterns of interaction occurred or how you dealt with errors [1].

Recording Lessons: Audio or video recording of class room lecture while teaching provides very useful information for reflection. We may not see or be aware of all the things happening in the class. How well your talking goes about? Are information and explanations clear? How much time do you give out to student talk? How do you respond to student talk? Video recordings can be useful in showing you aspects of your own behaviour. Where do you stand? Who do you speak to? How do you come across to the students? [2]

Microteaching: This is a method where before you actually teach to the students, using the lesson plans developed for the lectures, prepare two to three demonstrations similar to those you will be delivering in your laboratories and workshops and deliver it before a peer audience and video camera. You will learn how to present the content you developed. You can assess your presentation skills, use of teaching aids and multimedia production, voice and articulation, questioning and feedback style [9].

Student Feedback: You can also ask your students what they think about what goes on in the classroom. Their opinions and perceptions can add a different and valuable perspective. This can be done with simple questionnaires or learning diaries for example.

Case Discussions: You could have discussions on a regular basis where several teachers from the Computer Science department come together to discuss teaching vignettes and to explore various perspectives about teaching.

Teacher Portfolio: A portfolio provides a means for reflection. It offers the opportunity for critiquing one's work and evaluating the effectiveness of lessons or interpersonal interactions with students or peers. A teacher portfolio is a collection of work produced by a teacher. It illustrates his or her talents. Teacher portfolios are constructed by teachers to highlight and demonstrate their knowledge and skills in teaching. What is actually included or related in a teacher portfolio depends on how the portfolio will be used. A portfolio may include some or all of the following [6]:

Teacher Background
Class Description: Time, grade and content.

Written Examinations: National Teacher's Exam, State licensure tests.

- A personal statement of teaching philosophy and goals.
- Documentation of effort to improve one's teaching: seminars, programs, etc.
- Implemented lesson plans, handouts and notes.
- Graded student work such as tests, quizzes and class projects.
- Video/audio tape of classroom lessons.
- Colleague observation records.
- Written reflections on teaching.
- Photographs of bulletin boards, chalkboards or projects.

A teacher portfolio is a document created by the teacher that reveals, relates and describes the teacher's duties, expertise and growth in teaching. Each assertion in the portfolio is then documented in an appendix or a reference to outside material, such as videotapes or lengthy interviews. The size of a portfolio varies, but it is typically two to ten pages, plus appendices.

The methods elucidated above if adopted and implemented would definitely help a teacher to make computer science teaching more interesting and effective.

CONCLUSION

The aim of this article was to reflect the importance of reflective teaching in an era which craves for "Quality Teaching" in higher education. A myriad of methods to be employed in teaching computer science were explained. These methods could be effectively incorporated by teachers to accomplish excellent teaching standards and also make the teaching-learning process an interesting exercise.

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