Analysis of Qualities of Effective Teachers and Issues on Designing Educational Robots

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Abstract: This paper provides a theoretical analysis of the feasibility of developing a robot that could take the role of an effective teacher by examining qualities and roles of effective teachers in the classrooms. .

Keywords: effective teachers; robot design; human robot interaction; educational robots; instructional technology.

Introduction

Robot technology is increasingly used in classroom settings not only for learning *about* robots but also for learning *from* robots. [1]. However, robots are mainly used as teaching assistants and educational media rather than as a fully autonomous teacher. This study reviews the qualities of effective teachers and the factors that affect student-robot interaction.

1. Modeling Effective Qualities And Teachers' Roles

To approach the problem of designing a robot as an effective teacher and to have an organizational pattern, we categorized the roles and qualities of teachers according to representative literature and examined the qualities that a teacher needs to exhibit to support the role. By integrating the roles and qualities of effective teachers, we formulated a model that links effective teacher roles and commonly expected teachers' qualities (Figure 1).
Roles are represented in blue boxes, sub-roles are in orange boxes, and the matching qualities are represented in yellow boxes. The labels for yellow boxes, which are effective teacher qualities, are given in the legend.

2. Available Robot Technologies for Education

Robots were used in different educational aspects [2]. Educational robots could be used as learning materials; learning companions; and teaching assistants [3] under the classification of "robot subject instruction", "robot assisted instruction" and "robot managed instruction" [4]. The teacher robot may fit in the last category. Learning language with robots is the most widely discussed scenario in research studies [5].

To understand the value of using robots in education, the robots' impact on the cognitive processes of learning should be evaluated [6]. Perhaps, the most unique attributes of robots are their automaticity and physical presence [7]. Robots can listen and talk [8], show facial expression and gestures [9] and affect children's perceptions [20] to have a

social presence for supporting instruction [11]. Also, existing intelligent tutoring solutions may be implemented into robots to personalize learning much like a human tutor [12].

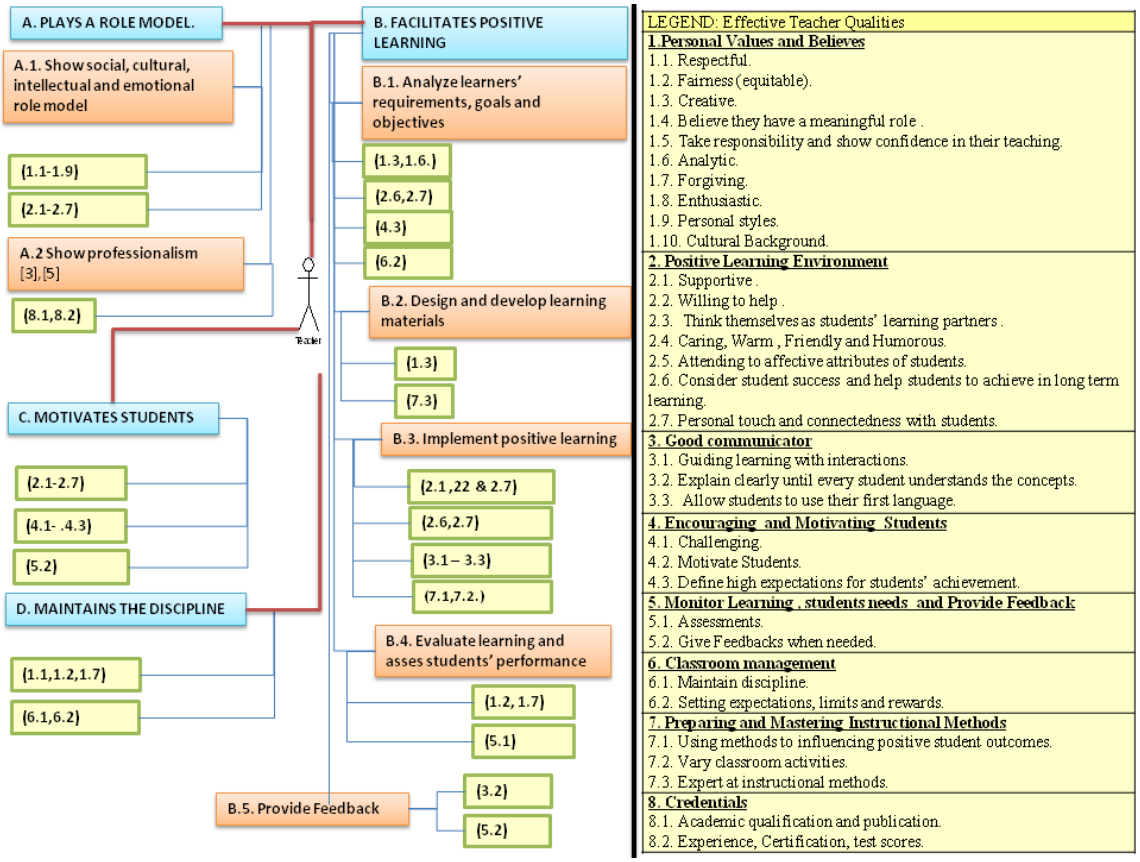

Figure 1. Effective Teacher's Roles and Qualities

2. Analysis of Teacher Roles and Issues on Robot Design

This section discusses to what degree the attributes of effective teachers as listed in Figure 1 can be implemented in an autonomous robot.

Plays a role model: It is generally possible to implement social feedback that approximates human performance on a robot. As these values consider mainly the output modalities of the robot (e.g. in terms of language, movement, sound) the designer has full control over the robot's behavior. Some qualities such as fairness are difficult to implement due to a lack of clear definition and not because of technical constraints. Superficially robots seem fair to all individuals, but in real life there might be situations where the definition of fairness is not as clearly defined as the performance rating. More problematic are the qualities those require human reasoning, such as being creative. Naturally, a robot is limited to its software and knowledge base.

Facilitates Positive Learning: Robot can seemingly create a positive learning environment. A Robots can be considered supportive simply due to its availability to students and its role to help. Robots also can be indefinitely patient to explain the same concept as many times as the students needed. Robots can also be programmed to provide alternative explanations. A shortcoming though is that robots could not create new learning content on its own. It is a question of degree to which detection needs to be implemented. It is an empirical question to what degree a teacher needs to be able to read the emotional state of a student to be considered an effective teacher.

Motivating Students: Robots have the potential to motivate students by giving

emotional responses, dynamically selecting the order of learning content, by giving encouraging comments and by providing reward mechanism. Physical embodiment of robots may make them an authentic and engaging device. Robots may monitor students' performance and give feedback similar to computer based adaptive leaning systems.

Maintaining Discipline: Robots may follow and react according to a set of rules. It can set limits and deliver punishment and reward in class. Next to implementation issues there are ethical and political aspects. Being an authority figure might be a controversial topic to implement in a robot. There is a need for further research in this area in order to understand the social acceptance of robots as authority figures in classrooms.

3. Conclusion

This paper reviewed studies on qualities of effective teachers and the possibilities to use robots for education. Following the analysis above, the two teacher roles of being a role model and a motivator can be considered feasible with the current technology. The role of maintaining discipline mainly faces ethical and political issues, rather than implementation issues. Further investigation is needed to determine how much authority should be given to a robot. One of the main questions that remain is the degree to which a robot should perceive unconstrained input such as emotions and subtle behavior cues of students. But even these difficult tasks are becoming increasingly robust to be employed in an educational application. The question of long term interaction effects needs further investigation. An aspect that is often ignored is the challenge to integrate all qualities in a single platform which is necessary to conclusively measure the effectiveness of robotic tutors.

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