Some Challenges for AIED Systems in Taking on Long Term Mentoring

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Abstract: Many AIED systems have been developed that help learners in terms of their motivation over the period of a single session or problem-solving episode. This paper sets out some of the challenges facing designers of AIED systems for mentoring learners over much longer periods. These include (i) understanding the learner's value system and their reasons for engaging in the learning; (ii) the ability to introduce new material and conclude material for a single session in the context of the overall learning journey; (iii) the ability to track and react to the learner's motivational trajectory over a much longer period than simply short term frustration (say) with a particular issue; (iv) the ability to help the learner keep track of their progress over a long period – including their progress in learning how to learn and learning how to self-motivate.

Keywords: Mentoring, learning, motivation, meta-cognition, meta-affect, meta-motivation.

1 Introduction

Historic work on motivation, as applied in Artificial Intelligence in Education (AIED) systems, was based on a model that tried to detect the learner's evolving motivational state and then react to it in a motivationally sensible manner, either by adjusting the learner's tasks, the feedback on the learner's work, or the manner in which the tasks were offered [1-3]. More recent work in this area within AIED has expanded its repertoire of emotions associated with learning [4] and developed methods both to detect emotions [5] and behaviours symptomatic of poor motivational states, such as gaming the system [6], boredom, frustration, confusion and engaged concentration [7], as well as to react to them in sensible ways [8].

Despite these advances, the temporal focus continues to be largely on short term events during a single lesson or episode of problem-solving, with little concern for how that lesson or episode was initially pitched or introduced in the first place [9], how it might be best summarised at its conclusion, or how it fits into the longer term issues associated with the whole course or module, or indeed with the learner's long term educational goals. In many ways these kinds of issue are regarded as the responsibility of the human teacher and not the AIED system that has only temporary charge of a little bit of learning.

2 Longer Term Mentoring

Designing AIED systems for longer term mentoring raises a number of extra issues beyond those already being tackled by current AIED systems. Rather than simply reacting to the learner's motivational state, systems for mentoring need to be more proactive in the way that they help the learner deal with new learning experiences and reflect on past experiences. The need for this can be seen, for example, in the concern about the drop-out rate of students making use of MOOCs as a consequence of their largely unmentored form of learning [10].

First is the issue of the greater investment of time and energy of the learner in seeing a whole course or longer period of study through to a successful conclusion. More care is needed at the start for discussing with the learner about whether what is proposed is the right course of for them. This immediately brings in the issue of the learner's goals and values, as well as their expectations (whether accurate or not) of what the outcome will be and what the process will be like [11]. Understanding the learner's value system and why they want to engage in a long-term piece of learning is crucial to mentoring. One only needs to consider the discussions one has with prospective PhD students to know that they can be profoundly mistaken about what they will achieve, how their experience will unfold and how they will feel at various stages.

Second, while AIED systems currently concerned with motivation try to deal with frustration and confusion in the short term, these issues are magnified in the context of longer periods of study. We have all faced setbacks to our creativity – the blank sheet of paper syndrome or loss of self-confidence in the face of lack of progress. Over the long term becoming demotivated can gel into something more difficult to deal with – losing heart with respect to the value of one's long term goal or of one's ability to reach it.

Just as expert human teachers include among their goals "first, to sustain and enhance their students' motivation and interest in learning, ... and second, to maintain their pupils' feelings of self-esteem and self-efficacy, even in the face of difficult or impossible problems" [12], so PhD supervisors will often spend considerable effort helping their students manage their "bumpy" motivational trajectory over three or more years. However, two advantages of working over longer time-scales are that one does not always need to react immediately to issues and can advise a student to take time out from a difficult task in order to regain emotional and motivational equilibrium.

There are predictable issues normally associated with learning a new skill or concept; for example that performance in the short term can be impaired while the new skill or concept is gradually integrated successfully with what was already known or achievable. The degree to which this kind of setback is managed successfully depends in part on the learner's own theory of learning [13]. Over the longer term it can become harder to believe that repeated mistakes are productive and that determination and the willingness to keep trying will always win out. Here the mentor can help the learner to reflect on their own experience, drawing their attention to past successes in similar circumstances, for example.

My own recent experience in learning Argentine Tango gave me some sharp insight into the frustrations associated with learning a brand new skill over a long period. Progress seemed absurdly slow. Steps that the teacher executed with ease were hard even to describe to myself, let alone mimic, yet in many ways they ap-

peared so simple. Steps that had been learned initially one way had to be relearned when new factors needed to be taken into account, such as holding my own body more upright or holding my partner more closely. And, of course, the mistakes were all too public: "I'm a professor, why am I finding it so difficult just to put one foot elegantly in front another". An important role taken by my teacher was precisely the mentoring role of helping me appreciate that I really had made progress when I thought I had not.

Third is the issue of the learner losing track of where they are in the whole process, developing tunnel vision, and neither being able to see the overall goal nor the role of the current activity in achieving it. One role for the mentor here is to occasionally take the longer view and help the learner appreciate what has already been achieved and what the best next step is. This issue of introducing and concluding new activities in ways that indicate the direction to be travelled and the distance already covered takes on greater importance as learning timescales lengthen.

3 Meta-motivation and Learning how to Learn

Longer term periods of learning often have aims that go beyond the material of the course, and these may well need to be explicitly mentored. First is the issue of learning how to learn, and indeed learning to enjoy learning [14]. One of the potentially valuable outcomes of the setbacks and disappointments mentioned in the previous section is that they form a bedrock of experience that the learner can, with help, exploit. For example, they can come to understand better how to engage in complex learning activities over a long timescale, what the likely problems and setbacks are that they may need to face, and how they can develop personal strategies that work for them in overcoming these disruptions.

Related to the above is the issue of meta-motivation, i.e. one's own understanding of one's own motivational processes. Meta-motivation involves both meta-cognition and meta-affect [15]. Those who acquire both the insight to understand their own inner motivational lives and the ability to regulate their degree of moti-

vation equip themselves well for most other learning journeys. Here the role for mentor is to help the learner reflect on what works for them in terms of strategies for self-motivation.

4 Motivational challenges

The main motivational challenge raised by working over the longer term is that the mentor needs to understand rather more about the goals and values of the learner, about their theory of learning and about their meta-motivational capability. Just pointing a camera at their face, instrumenting their heart-rate or skin resistance are not going to yield the sort of information needed to help the learner at difficult points in their learning. While to some extent one can use general exhortations to try harder or offer praise for achievements, these are just not going to be sufficient for the learner who has lost their way, and possibly also lost heart, in the *value* of what they are doing. This is a hard issue and probably depends on the ability to have some kind of interaction with the learner about *why* they are engaged in the learning and how they feel about their progress [16]. A second challenge is logging both the work done by the learner and their motivational trajectory over the long term, so that feedback to the learner can refer to earlier points in the learning: "Remember when you thought you could not solve that problem, but in fact you found a way – well I think we are at a similar point". This is easier to deal with in that it extends existing logging mechanisms. A third challenge for a long term mentor is to be able to anticipate difficulties for the learner before they occur and help the learner prepare for them. This needs different kinds of domain and student model whose focus is as much on learning process issues – fear of the blank sheet of paper – as on domain level outcomes. This would need tasks and potential learning experiences to be categorised in terms of their motivational consequences for different types of learner.

5 Conclusions

This paper has set out some of the challenges in building tutors that extend learning from a single session or a short sequence of

interactive sessions to a longer term mentoring role. These include (i) understanding the learner's value system and their reasons for engaging with the learning; (ii) the ability to introduce new material and conclude material for a single session in the context of the overall learning journey; (iii) the ability to track and react to the learner's motivational trajectory over a much longer period than simply short term frustration (say) with a particular issue; (iv) the ability to help the learner keep track of their progress over a long period – including their progress in learning how to learn and learning how to self-motivate.

The implicit model of mentoring indicated above is a development of ELM-ART [17], a system for teaching programming that referred the learner back, when facing a difficulty, to a similar previous problem. Some small steps in this direction in terms of referring the learner back to previous metacognitive and motivational states as well as to previous problem-solving have already been undertaken in the area of learning programming [18].

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