Motivational Processes

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Abstract: A motivationally intelligent tutor should determine the motivational state of the learner and also determine what caused that state. Only if the causation is taken into account can an efficient pedagogic strategy be selected to find an effective way to maintain or improve the learner's motivation. Thus we argue that motivation is more constructively thought of as a process involving causation rather than simply as a state. We describe methods by which this causality might be determined and suggest a range of pedagogic tactics that might be deployed as part of an overall pedagogic strategy.

Keywords: motivation, pedagogy, feelings, expectancies and values

1 Introduction

Many scholars attest to the complex interplay between the cognitive and affective issues in learning [e.g. 1]. To the extent that tutors are concerned that learners stay engaged with the learning task, they are interested in how this interplay affects motivation: motivation is, after all, the impulse that drives the learner to exert effort in learning. The multiple bi-directional relations between the cognitive, the metacognitive, the affective, the meta-affective and motivation are complex [2]. Indeed analysis of the interplay of affect, self-assessment, competence, value judgements and effort show a wealth of interconnections which depend both on the individual history of the learner, but also on the current learning context [3]. In a similar vein, the expectancy-value theory of motivation maps links between the learner's cultural milieu, their expectations of success, the achievement choices that they make, their affective memories, their interpretations of their experience and many other factors [4]. While it may be helpful to identify the instantaneous motivational state of a student, the literature points to the idea that motivation is more productively viewed as a process that was operating long prior to the educational interaction, that continues to unfold during the learning, but that has causative antecedents in earlier learning experiences as well as consequences for future learning. There is a dynamic element to the way that the learner negotiates their perceptions of their learning experiences, their feelings and the impulse to exert or not to exert effort in learning. The process operates over different timescales. At the granularity of an individual lesson, or episode within a lesson, how the student reacts to success, failure, help or hint (say) will be driven by the kind of parameters identified above. Over longer timescales, the relationships between these driving

parameters can themselves change, e.g. as the learner develops their capability as a self-regulated learner [5].

In order to help manage this complexity, we choose to label instantaneous motivational states in terms of their main characteristic affective component. Thus we can say, as a kind of shorthand, that a student is in the motivational state of being bored (say), if the main affective dimension of that state is boredom. Of course, how an individual student reacts to their motivational state of boredom depends on other factors. For example, some students may be spurred into finding adaptive ways (such as setting themselves more challenging work) or mal-adaptive ways (such as gaming the system) to reduce their boredom. Others may simply acquiesce to the boredom and disengage altogether. That different learners become bored for different reasons and then go on to deal with that boredom in different ways supports the idea that motivation should be regarded as a process that unfolds in an individual way.

Much effort has been devoted to developing methods to determine the instantaneous motivational and affective state of the student: from self-report, from facial expression, from posture, from skin conductance, from pressure on the mouse, from language, from behaviour and from other clues [see e.g. 6, 7-13]. In terms of developing a pedagogy to make use of this information, various positive and negative affective states (and cycles of states) have been identified as important in education including anxiety, boredom, confusion, delight, disappointment, enjoyment, flow and frustration [see e.g. 14, 15-18]. Whilst positive states are generally desirable, learning will often involve some negative episodes, especially of confusion or frustration when hard problems are encountered, or of anxiety when anticipating difficult issues ahead.

There is limited scope for making the best choice of pedagogic response based on an analysis of the current state of the learner only. So this paper explores ways that this analysis can be augmented in order to assist the tutor. The rest of the paper is divided into three sections. The first develops the notion of motivational processes through the idea of trajectories of states. The subsequent section looks at methods by which the tutor might gather information about the cause(s) of a particular motivational state. The following section then outlines various pedagogic tactics for dealing with the cause(s) of (negative) motivational states.

2 States, trajectories and motivational processes

The underlying model of most tutoring systems is based on the idea that the student passes through a sequence of motivational states which have both a cognitive and an affective dimension. To an extent the trajectory of these states is determined by the content and the conduct of the academic work that is being undertaken. However the history of that person as a learner and influences outside the lesson can have a large effect, such as a row with friend before the lesson or a sequence of prior awkward interactions with that teacher. A second important determinant of motivation and thus of the trajectory of states is the effect of the many parameters identified earlier, such as self-assessments and value judgements. For example, a context-specific distinction is often drawn between mastery and performance orientated learners and the difference these orientations have for the learner's expectation of, and particularly interpretation of, error and setbacks [19]. So it is not just a matter of what the learner

is trying to achieve, it is also a matter of the way that they see themselves as learners and the degree that that perception influences how much effort they are willing to put into the business of learning. Other traits and personality variables [see e.g. 20] also affect the unfolding trajectory of states.

Given the above it is perhaps best to think of the learner's motivation as a complex process that interacts with events during learning in ways that are sometimes quite hard to determine, even for observant human teachers. The tutoring system must thus act as a diagnostic tool in part attempting to determine the current state of the student, but also attempting to unpick the causality that might have led to the current state or the current behaviour [see e.g. 21]. To make matters harder, some learners are adept at masking their affective states, particularly when it comes to maintaining "face" in front of their peers. It is also the case that even human teachers find it difficult to decide on the affective state of their students, partly because of masking, and partly because academic affective reactions can be quite nuanced [22].

3 Gathering data

We suggest that there are several ways to try to get a better sense of what drives a particular student. First, this would involve extending the scope of the logging of interactions, e.g. via learning diaries, as described by Zimmerman [5]. Such logs contain data about affect (whether gathered through self-report or by less intrusive methods) and these would be integrated with performance data. It is helpful to have a record that extends backwards over several sessions so that the tutor has the chance to detect repeated patterns of cognitive and affective interaction. The tutor would then also be able to refer back to both positive and negative episodes, their precursors, and their consequences as part of its tutorial strategy [23] in a manner not unlike ELM-ART working at the cognitive level [24]. Some steps towards this extension of the logging have been undertaken [25]. Van Zijl adapted a version of the EER Tutor [9] to employ diagrammatic self-report to record the learner's affective valence (i.e. whether they felt positive, negative or neutral). The system was augmented with motivational rules that used this data along with performance data to refer the undergraduate student to past successes.

A second way of understanding better what drives the learner is to engage with the learner *about* their experience of learning. While a full natural language dialogue about the learning domain is hard enough [see e.g. 26], interacting about the learner's experience of grappling with that domain is likely to be harder, though a menu-based interaction can be helpful [27], especially when tackled by pairs of students. Both at the outset of a lesson and again at the end, the pair can be asked questions about their expectations and values and how they anticipate their experience (or how it worked out in fact). Each learner could be responsible for making the entry on behalf of their peer. This might reduce gaming and lead to a discussion about how to interpret the menu options and whether the choice of answer was correct, see [28]. Even if the tutor ignored this input, there should be metacognitive and meta-affective benefits for the two learners in thinking about and articulating their expected and actual cognitive and affective reactions to the learning. This greater insight into their own

motivational processes should help them then deal with any motivational inadequacies of the tutoring system itself [29].

4 Pedagogic Tactics

Useful detailed empirical work on identifying pedagogical tactics has been undertaken by observing skilled teachers, e.g. [30], or more specifically their responses to particular states, such as use of an "off-topic" comment in response to a student who is happy or confused [31]. However we argue that it is not enough simply to identify the current affective state of the student (e.g. frustrated) in order to determine an appropriate course of pedagogic action [32]. Pintrich [33] suggests that the motivational literature has explored two broad areas in addition to Feelings which drive motivational processes. These are associated with Expectancies and Values. Even taking a narrow view of these two areas leads to contrasting remedial tactics.

4.1 Expectancies

Various negative motivational states such as confusion, anxiety, frustration and boredom can be traced to negative expectations of either the experience of undertaking the learning task or its outcomes. So a student might be frustrated (say) because the work is too easy and their anticipation is that the remainder of the lesson is likely to lack challenge and interest. A sensible pedagogic response in this case might be to follow Keller's [34] advice and stimulate the learner's curiosity to increase their degree of engagement. A student might also be frustrated because the work appears too hard and they have little expectation of understanding it. Here the strategy might be to suggest easier work, if it is believed that the learner's sense of their own capability for the task in hand, their self-efficacy [35], is well-founded; or possibly to show by reference to their previous achievements that success is in fact likely, if their sense of their capability is too pessimistic. A learner may also be anxious that he or she will not be able to tackle a problem successfully, or that the work is too easy, or that there may be some public loss of "face". In dealing with this kind of issue, it is again helpful to try to determine whether the learner's expectations are accurate. This will need evidence from prior learning episodes to establish whether the learner has a tendency towards realism, optimism or pessimism (as one way to divide such judgements) in these matters [36]. Where there is a realistic fear of failure or other negative experience then steps can be taken to make the work easier, to scaffold it more densely or otherwise to reduce the chances of failure. Where the learner is pessimistic, the tutor can use the evidence already accumulated to reacquaint the learner with similar previous episodes that demonstrate past success. This could be augmented with changes to the task or to its scaffolding just as for realistic students. Where the learner is generally optimistic but is nevertheless in a negative motivational state, then more complex action may be needed involving exploration of exactly what the negative expectations are and why they have emerged in order to try to deal with them.

4.2 Values

Continuing with the issue of frustration, in the case of Values, a student might be frustrated because he or she has no interest in the lesson (irrespective of whether it is easy or difficult) and would rather be doing something else. Thus within the Values sphere, some negative motivational states can be traced to a mismatch between the values of the learner and the values associated with the learning task. Values include both the learner's goals as well as the value judgements he or she applies to different kinds of learning experience. In general terms there are three different ways to realign the values mismatch. The first is to ensure that the mismatch is not simply down to the learner's misunderstanding of what the values associated with the learning task actually are. If the learner has an accurate but only partial understanding of the nature of the task, it may be that this understanding can be augmented to align with his or values. For example, supposing someone finds themselves taking a mandatory statistics class for which they have little appetite, it may be possible to show how successful completion of the class will assist them in some area that they do value, but had not realised would be helped by a deeper understanding of statistics. The second way is to try change the learner's values themselves, and the third is to change the nature of the learning so that it aligns better to the learner.

It may be that the system is unable to determine the cause(s) of a particular negative motivational state. If that is the case there seem to be several possibilities. First the tutoring system could turn the issue over to the learner, and ask the learner to choose between the different remedial tactics available (as outlined above). Second it could rank the tactics in order of prior success for that learner, and if that data is not available, then in order of prior success for that class of learner. It could then try the most highly ranked tactic whilst monitoring the learner's reaction and move to the next most highly ranked tactic if things seem to be getting worse rather than better.

4.3 Meta level tutoring

In all cases the expected and actual trajectories of motivational state can be captured by the tutoring system for two purposes. First is their utility for potential use later when a similar situation occurs. The second is to open up the possibility of the tutoring system engaging in a meta-affective (discussion of the feelings experienced during learning) and meta-motivational tutoring (discussion of factors that impede or facilitate a learner becoming self-regulated [5]). By taking the learner back through an interaction and getting them to focus on the cognitive, affective and motivational trajectory he or she has traversed, there should be scope for developing the learner's insight into his or her strengths, weaknesses and strategies *as a learner* (i.e. developing the long-term motivational process mentioned earlier).

5 Conclusions

We have argued that a motivationally intelligent tutoring system should take account not just of the instantaneous motivational state of the learner, but also of the causative motivational processes that led to that state. Simply ascertaining that a student is

bored or frustrated (say) is not enough on its own to determine what best to do next. We have suggested ways in which learner logs could be used to counteract tendencies towards inaccurate self-assessment and to develop the learner's meta-affective and meta-motivational insight. We have outlined some pedagogic tactics, dividing them into those operating the area of Expectancies and those in the area of Values.

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