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INTRODUCTION

Educational researchers and practitioners have long lamented the chasm between education and real-world experiences or issues. *Authentic learning* has become an increasingly popular means to mitigate this gap and entails "learning knowledge and skills in contexts that reflect the way the knowledge will be useful in real life" [1, p.2]. Authentic learning is thus an umbrella term for a wide gamut of instructional approaches aiming to help students to see the relevance of what they are learning, such as project-based learning and problem-based learning. A salient feature of authentic learning in vocationally oriented courses is the strong emphasis on "preparing students to be practitioners in their chosen field" [2, p. 14]. To this end, students tackle real-world problems, characterized by a high degree of complexity and ambiguity, and more generally engage in professional practices [3].

Much previous work has focused on developing models for authentic learning. Based on a review of this work, Borthwick et al. [2] identified three widespread models for authentic learning: the *apprenticeship* model [1], the *simulated reality* model [4], and the *enminding* model [5-6]. They note that

> In the apprenticeship and the simulated reality models, there is an assumption that the "real world" represents the profession and the student needs to be, in some way, placed into this world either through a form of apprenticeship or by bringing in simulated activities to the classroom. In this way the specificity of the student is largely ignored as the authenticity comes primarily from the link to professional activity and the student is expected to move seamlessly from their subjective position into the world of the profession (p. 16).

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By contrast, the enminding model accentuates the importance of the *student* perspective, in the sense that "student learning is given similar emphasis to that of the real-world context" [5]. More specifically,

> learning experiences are perceived as authentic when they engage students' lived experience, and students can find meaningful connections with their current views, understandings and experiences and 'newer' views, understandings and experiences they meet as they learn in and about a 'real-world' or authentic community of practice (Ibid. p. 240).

Clearly, these "newer" or disciplinary views may challenge students' prior views, and what students see as *meaningful* activities – a hallmark of authenticity [7] – may differ from the disciplinary view. While the occurrence of such *tensions* between student views and disciplinary views seems to be largely overlooked in contemporary models of authentic learning [5, 8], there are empirical studies showing that students and teachers do not necessarily agree on what they deem authentic [9, 10]. In such a situation, teachers are tasked with finding appropriate ways to bridge the gap between student views and disciplinary views. This involves *dialogue* and *negotiation* [11] to help students to understand why and in what sense activities are indeed meaningful. There is, however, a dearth of empirical accounts of how this negotiation process between teachers and students can play out in authentic learning environments; to wit: what specific strategies teachers use and how students respond to these strategies in terms of being meaningful learning experiences.

The purpose of this paper is to shed light on the *negotiation of authenticity* through a case study based on a course that aims to engage engineering students in authentic software development. Employing an ethnographic approach, we sought to address the following research questions:

- What strategies do teachers employ to manage tensions between ways of working that they and their students deem meaningful?
- What strategies result in students agreeing or disagreeing on what are authentic or meaningful learning experiences?

The findings of this study should therefore be germane to teachers wishing to provide their students with authentic learning experiences. In addition, the study builds on and extends the enminding model of authentic learning by elucidating the importance of tensions and negotiations.

1 METHODOLOGY

The software engineering course studied here serves around 50 bachelor students from two different educational programs, industrial engineering and computer science, at Chalmers University of Technology, Sweden. During the course, students work in teams of 5-6 on software design projects, implementing agile software development methods. In their projects, students launch a software application in collaboration with an external stakeholder. That is, they do not only write code that could be managed and adjusted in a compiler, but actually build a program which work towards a backend integrated in the stakeholder's software system and provide an interface for users of the application. Scrum methodology [12] is used, and the projects are therefore undertaken in iterative one-week sprints, each encompassing planning, building, reviewing and reflecting upon progression. Five to six such sprints are undertaken. In each sprint review, students present their tentative design and concepts to representatives from the external organization which the students are to deliver customer value to – and get feedback from. This feedback is meant to be used to move forward. The project constitutes the major learning sequence of the course, complemented with three introductory weeks focused primarily on workshops

introducing how to work and how to think when using scrum methodology, and setting up a coding environment to work in. Moreover, the final week is spent on writing a project report.

Data was mainly collected through 23 hours of classroom observations and semi-structured interviews with ten students and the two teachers. The two teachers were interviewed before the course started. From this, a tentative understanding of the course and the teachers' perspective on what makes it challenging for the students was attained. The classroom observations included occasional and colloquial interactions with students regarding their projects and with teachers regarding how the course was moving along. The observations were recorded in field notes. Ten students, spread out amongst the project teams, were interviewed after the course had finished regarding their perception of the learning experience. In addition, formal course evaluation documents were surveyed, including minutes from course evaluation meeting, to gain further insight into students' challenges and how teachers potentially wanted to adapt to these. A follow-up meeting was held with the two teachers eight months after the course had been given, recorded in meeting notes.

The data was analyzed in terms of strands of negotiation between what students and teachers deemed and enacted as authentic. For example, this manifested in teachers talking about what students do which teachers did not consider in line with what was prescribed by the methods they introduced – and students arguing that the tasks or processes set out by teachers were not realistic or meaningful. The analysis of these negotiations was inductive, i.e. no a priori assumptions were made regarding their nature. Rather, a general inductive analysis [13] was used; that is, after coding the data, the codes were sorted and sifted in an iterative way to identify themes in the data.

2 FINDINGS

In this section, a general sense of the course seen through the eyes of the teachers and the students will firstly be given. Secondly, two strands of negotiation are outlined. Both strands describe what strategies the teachers used to manage tensions between what they and their students deemed meaningful ways of working, and whether these strategies resulted in students agreeing or disagreeing.

To the teachers, the stated "core of the course" was to teach students how to deliver real customer value through using agile software development methods. In this, they felt they faced major challenges in bridging students from the habits of mind built up through their previous courses. They talked about how the students had been trained as solitary "hackers" rather than collaborative "engineers". This included for example students seeking technical finesse rather than solutions that just does the job, being overly fearful of failure and not resourceful in seeking help from others. Accordingly, the teachers used the preparatory lectures and workshops to introduce "newer", disciplinary, habits of mind, and to let students try these out. They also built in several opportunities for students to engage in structured reflection in order to systematically improve their way of working – which they hope would lead to students developing meta-cognition and subsequently more purposeful choices and priorities when taking on software processes. They expressed further how the external stakeholders were crucial to the course, as without them the students would not be put in the complex and difficult situations where agile methods are most applicable.

In general, the students seemed very excited to (finally) take on a project which was more "real" than they were used to. They talked about meaningfulness and a sense of accomplishment in seeing that they could contribute. Moreover, in line with the teachers' perspective some noted that they could not have learned what they were

supposed to learn if they had worked on a less realistic project. However, they also attested to how the course had been very challenging, which some found rewarding but which seemed to make others quite frustrated. The more frustrated students questioned whether the course was designed in a good way, talked about how they had not learned what was intended and suggested changes that in their eyes would have made the course more meaningful for them.

2.1 Customer orientation

One of the concrete challenges expressed by the teachers was that students tended to take instructions and problem descriptions too literally. That is, instead of trying to inquire, listen and figure out what would be valuable for the customer, they took their first interpretation of what the customer had said and tried to implement that. Instead, the teachers wanted students to develop a habit of trying to understand what the customer "actually" wanted. Furthermore, they wanted students to negotiate customer demands and propose concepts which they believed they could implement with the time and resources they had, delivering something valuable to the customer but not necessarily living up to everything that the customer wished for. The teachers described how this was harder for the computer science students than for the industrial engineering students, who "get the message of customer value much easier".

In the preparatory lectures and workshops, the teachers explained and argued for this "new" way of working. For example, during a workshop that was meant to simulate the project activity, one of the teachers role-played a customer and told students to ask him "why-questions rather than what to do-questions" and encouraged them to negotiate the demands he put on their products. Moreover, the teachers repeatedly expressed that if the students worked too many hours in order to deliver more than enough, they were lowering their "pay-rate" and the value of their work.

At the end of the course, many of the students expressed that this was indeed a new way of thinking for them. Some, especially among the computer science students, said that they had struggled a lot with understanding what the customer "actually" wanted, but that it had felt rewarding to do so. One student expressed that it had been inspiring and important to be told that they should not work overtime to deliver above and beyond. Another noted that they had had to make difficult decisions regarding what to deliver to the customer in the end, because of the time constraints, and that the introductory workshops had helped in daring to go against wishes from the customer.

Accordingly, even though students could have ended up wanting clearer instructions for what their final software applications were supposed to look like, it seems that the teachers were successful in helping students instead process the information they got about customer demands and arrive upon a solution which they themselves believed in and could motivate. The teachers had argued for a new way of working, which students ultimately seemed to find meaningful.

2.2 Technical concerns

When describing their design of the course, the teachers emphasized how students were supposed to learn the technical tools needed to finish their project self-directedly and how learning to learn technical skills was an important outcome of the course. They also attested to how students found this "hugely frustrating". Here, a stated difference to students' previous software development courses was that this course was more focused on applying what they already had learned.

To bring home this point of view, teachers mostly related to technical detail as something that the students themselves had to figure out, often encouraging students to ask each other for advice. For example, at an introductory workshop one of the

teachers explained to the students that many of them had asked him about what database they were supposed to use – and that the only thing he was concerned with was that their product worked. He moreover questioned whether they would actually need to implement a database at all. Technical concerns were generally positioned to only have instrumental value, in how it could deliver value to the customer. In terms of technical content delivered, the course featured a few introductory sessions to some main tools used when launching a software.

As the course progressed, technical difficulties seemed to be the main challenge for many students. Especially some of the industrial engineering students expressed concern over not having the appropriate software skills to take on the project. One student noted that some of them had taken an interest in programming in previous courses, while others “didn’t even know what to google”. More than finding it very difficult, some of the industrial engineering students said that they were not interested in learning more about coding, because they felt they would never use it in their future careers. This challenge culminated in some student groups not being able to present their work live at the final launch event organized by the teachers together with the external stakeholder, because of a version change in the stakeholder’s system.

Some of the students started to question the course design, specifically arguing that it would have felt more meaningful to build an application without integration into a “messy” existing platform. For some, this frustration did not seem alleviated when they were interviewed after the course had ended, one student noting that the technical difficulties had taken all the fun out of the course, and another how it had been impossible to learn anything when nothing worked. The teachers had argued for why self-direction and integration into an existing platform was necessary to properly get the feeling of a real-world project, but here not all students agreed about the meaningfulness of the course design.

3 DISCUSSION

With a view to create authentic and meaningful learning experiences for students, this study set out to explore how teachers manage tensions between ways of working that they and their students find meaningful.

According to the teachers in the case studied here, students come with a set of habits of mind [14] which are inefficient when taking on a real-world software development project. Accordingly, even before the course started, there is potential for conflict between what teachers and students deem meaningful in relation to disciplinary work. Wanting to transform students’ habits of mind, the teachers’ ‘negotiation strategy’ included devising a real project for student to work on, to show the limitations of their habitual way of working. Moreover, teachers pre-empted and prepared students for this confrontation by providing alternative strategies through the introductory workshops – which students could then try out in their projects. In general, this seemed rather successful, seeing that many students found the course challenging, but only a few expressed this in terms of frustration with the teachers or the course design.

The negotiation of authenticity was especially salient in two aspects of the course design. The first, regarding customer orientation, illustrates seemingly successful negotiations, where teachers managed to bridge between the way in which the computer science students had previously worked with software development and the “newer” perspective that the teachers espoused. The bridging attempts designed by the teachers were rooted in a detailed understanding of how courses in software engineering were usually taught, and the way in which the computer science students intuitively acted as they entered the course. Here, the teachers seemed to properly

take into account the “specificity” of this student group [2], in terms of understanding their habits of mind and designing introductory activities to make them explicit and offer alternative ways of working.

The second aspect, regarding technical concerns, illustrates seemingly less successful negotiations, where some of the industrial engineering students were left questioning whether doing a real project was a meaningful activity in relation to their level of competence and interest. To these students, the problem was not that they solved inefficiently, which is what would be implied by the teachers’ habits of mind explanation. Rather, they felt they had no way to solve issues at all and that they were left with too little guidance. Compared to the clear view of what the computer science students struggled with, the teachers did not seem to have an equally deep understanding of what was difficult for the industrial engineering students. The teachers did emphasize that technical tools need to be learned self-directedly, highlighting an important difference between this course and previous ones. They did not, however, seem to provide simulated experiences where alternative strategies could be tried out by the students before taking on their projects. At the very least, what teachers considered to be the proper strategies for learning technical tools self-directedly was not made as clear to the students. Accordingly, one could question whether the teachers sufficiently regarded the specificity of this student group, in terms of their readiness for taking on such a complex task [16].

The tensions highlighted in these two aspects of the course design are different in nature. One regards the way in which students can come to an authentic learning environment as “veterans” of a certain activity (software development), having been taught to use the tools of the trade in a way that is misaligned with what is to be enacted in the new course. The other regards students coming as “novices”, with less proficiency in using the tools of the trade in any way. It seems that in order to achieve perceived meaningfulness in all aspects of the course design, the teachers would have had to better account for the latter perspective.

The study highlights the relevance of two constructs – tensions and negotiations – to models of authentic learning [1, 4, 5, 6, 8]. Accordingly, we argue that agreements and disagreements on meaningful activity should be considered *dynamic* rather than static. This, seeing as students can gain new experience during a course through which *i)* habits of mind are made explicit and/or transformed (veterans rethink), and through which *ii)* learner readiness increases (novices start to participate). Such experiences necessarily impact what students consider meaningful activities.

Accordingly, to further develop models for authentic learning, we call for more longitudinal data on what student and teachers deem meaningful activity in authentic learning environments. That is, rather than studying students’ and teachers’ perspectives on authenticity at a single point in time, future investigations should focus on how they change over time, and through interaction. In this study, students voiced their perspective primarily through interviews after the course was over. Future research designs on this topic should consider also interviewing students before and, more deeply, during an intervention. Furthermore, checking back with students a longer period after an intervention could unveil how and to what extent they find meaning in it after gaining new experiences of disciplinary work.

In the specific course design studied here, *epistemological* tensions seemed more salient than *ontological* ones. That is, rather than disagreeing on whether the project was indeed real (authentic in terms of correspondence with professional software development practices), the cause for disagreement seemed to be whether the activities were meaningful for the students’ learning. Accordingly, while we agree with

previous work highlighting how authenticity is in the eye of the beholder [10, 15], we call for further investigations of differences between teacher-student or student-student perspectives from both an epistemological and an ontological perspective on authenticity – clearly demarcating or integrating the two.

For teachers wanting to employ authentic learning, or struggle with the tensions that emerge as students meet real-world problems, the take-away from the current study definitively lies in the way in which how the teachers managed to understand student habits of mind, how they intuitively reacted to the problems they were presented with. Specifically, they related frequently to the nature of students' previous courses and experiences. Accordingly, apart from "enminding" the course with a disciplinary perspective [6], their successful bridging attempts also entailed enminding the activities with the student perspective. Through this ethnographic study, we have provided one account of such an educational design, and we call for further conceptual and empirical work to elaborate on such a 'dialectic enminding'-model.

While this study was based on a single course, the tensions identified here, pertaining to habits of mind and learner readiness, could occur in similar project and problem-based learning environments. Some of the specific problems discussed by the teachers could be especially prevalent when students are tasked with creating products or solutions in collaboration with an external stakeholder. Organizing learning activities around interaction with external stakeholders seem to make students perceive learning experiences as real and meaningful. However, future studies should elaborate on potential challenges and learning difficulties students face in such learning environments.

4 CONCLUSIONS

This study addresses a gap in the literature regarding how teachers manage tensions between ways of working that they and their students find meaningful in authentic learning environments. Reflecting an epistemological turn in authentic learning research and practice, we conclude that the most effective strategies for managing such tensions are rooted in a solid understanding of students' previous learning experiences, specifically in terms of their habits of mind and their learning readiness. To enhance the value of the enminding model as a practical and explanatory framework, we argue for adding two theoretical constructs to the enminding model – tensions and negotiations – and we call for more and longitudinal research on these constructs.

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