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Abstract

In the natural sciences, particularly in physics, attrition phenomena have a strong international similarity: it is not unusual to find that 40-50% of the students terminate their studies prematurely. Drawing on a discourse analysis perspective developed by James Gee new insights into why students decide to terminate their undergraduate physics study were reached. The data was obtained from interviewing a purposeful sample of seven former Swedish physics students, probing into the experience of learning as rooted in social-identity formation. The 'introspective' discourse model presented here illustrates how decisions to terminate studying can be reflectively considered, across a broad range of student profiles, through the use of a logic of causality that is much less about the experience of the education environment, and much more about personal agency, than previously anticipated or described in the literature. The discourse models are discussed in terms of implications for the informing of evaluation praxis.

Introduction

On average, the fraction of formally qualified people who commence, but do not finish tertiary level physics studies in Europe lies in the area of 50% (European Commission 2004). To address this problem, it is necessary to research into reasons for attrition.

In this paper we report findings concerning the way a group of former students related the logic of causality (i.e. how they appear to make sense of the events) that in their retrospect opinion led them to decide to leave the physics programme at a traditional Swedish research university. Studies of Scandinavian youth cultures make us expect that this way of reasoning can be encountered by anyone engaged with evaluating praxis, and we argue that in order to gain insights into aspects causing attrition, one will benefit from taking into account the finding reported here.

First we describe how the notion of communities of practice can be used in realizing issues of students leaving as processes of exclusion. Secondly we define attrition and thirdly we introduce Gee's construct of *Discourse models* (Gee 2005). Finally we bring out excerpts from student interviews to exemplify and illustrate the way interview participants consistently turned reflections on reasons for leaving inwardly. We suggest that using this realization as an analytical lens, causes and problems inherent to the institutional contexts can be accessed even though they are not explicitly stated by interviewees. Due to page-number

51

limitations we do not, however, bring to the fore considerations on interview method and study setup. For the interested reader we refer to a more elaborate report of the study of attrition (Johannsen 2007).

Student communities of practice

Lave and Wenger (1991) describes the transformation of the successful learner's developing identity as ranging from being one of *legitimate peripheral participation* in a community of practice to becoming that of an experienced member of the community. Later Wenger (2003) elaborated on the membership of a community of practice as conditioned by a *shared repertoire*. This shared repertoire consists of resources for the negotiation of meaning such as routines, words, tools, ways of doing, stories, symbolic gestures and artefacts, and concepts produced or adopted by the community (*ibid*). The shared repertoire of a community, as for instance the community of first-year physics-students, is far from unambiguous or pre-established. A new student will on the day of arrival at the university enter into a community of new physics students, but this community can also be perceived as a community of legitimate peripheral participators in the larger community of physics students. This community, in turn, is to some extent applying for membership in the community of physics practitioners. This membership is not guaranteed by graduation, but will, to significant extent be conditioned by graduation.

In all community-spheres negotiation is taking place. New students are allowed to participate in negotiation at, at least one level (the community-sphere of new students), but at others, they must adapt to pre-established norms. For instance issues concerning the objective of different courses and the decision of whether such objectives are met by the students (i.e. through assessment) are decisions made by teachers. Even though rationales are often explicitly stated in course- and programme-descriptions, much information is implicitly rooted in and carried by modes of teaching conveyed-in-action by the teachers and in the structure of the study programme. Since practice is often different in different courses at different times, these differences give rise to a certain dissonance between ways of seeing the discipline (Rump and Ulriksen 2005, Ulriksen To appear). Each student must figure out ways to either reconcile or dismiss this dissonance, either alone or in the negotiation of membership with different communities – for instance by talking to more experienced students, in discussion with peers or by imitation.

Returning to Wenger's (2003) social theory of learning, the ability to comprehend and navigate among what is considered 'correct' behaviour in a physics education setting is very similar to mastering the 'shared repertoire' of a community of practice. Yet Wenger insists that becoming and being a member of a community is an ongoing negotiation of meaning because the shared repertoire 'reflects a history of mutual engagement and remains inherently ambiguous'. Wenger (2003) continues (p. 83): "ambiguity is not an absence of or a lack of meaning. Rather, it is a condition of negotiability and this is a condition for the very possibility of meaning."

Drawing on Bourdieu's notion of symbolic violence – the unavoidable social reaction to individuals' break with non-negotiable norms of social conduct (cf.

Bourdieu 1990, Jenkins 2002) – we might understand better the processes of attrition as a form of social exclusion leading students to decide to leave their studies. Behaviour of individuals found to be indications of a lack of mastery of the shared repertoire is to some degree rendered 'meaningless' relative to the behaviour of the community. Hence we perceive of exclusion or self-exclusion (because of course norms of social conduct is a matter of perspective) as the consequence of recurring breaks with norms of social conduct of the institutional culture. That this notion is not a mere theoretical construct is plentifully supported in literature. For instance Tobias (1990) who found that young people avoid science subjects, not because they lack in talent, but because they are *different*, Seymour & Hewitt who found that talent notwithstanding, students not of a traditional white male personage had greater chance of leaving than other student-types and Hasse (2002) who found that for physics students to include other physics students into their work, certain behavioural 'codes' had to be shared among the group.

Thus perceiving attrition as the result of a cultural incommensurability (that of the institutional context, and that of the individual student's) we decided that interviewing students who left their studies prematurely was one viable way of gaining insight into what 'breaks' with norms of social conduct drive the exclusion-process of large fractions of new physics students.

Defining attrition

Taking departure in Tinto's (1975) theoretical synthesis of dropout from higher education, we felt an important part was missing. Tinto stresses the necessity for distinguishing between students that leave higher education entirely, and students who merely transfer to other educational programmes within institutions of higher education. If not, he argues, it leads "state planners to overestimate substantially the extent of dropout from higher education" (*ibid,* p. 90). Admittedly, such a perspective might be fruitful at a societal level, but it is also a cause for confusion: Based on OECD (2004) 'survival rate' indicators (output divided by input) Langen and Dekkers (2005) find an inverse relationship between university survival rates (Sweden 48%, Netherlands 69% and the UK 83%) and tuition fees and provisions for student support. Implicitly the authors suggest that the lower the socio-economic consequence of changing education, the greater the tendency of educational 'restlessness' (cf. Hovdhaugen and Aamodt 2005). Conversely OECD (2008) find it difficult to see how increasing the tuition fees can serve as incentives for students to finish their studies quickly. Instead OECD links the low "proportion of students who enter a tertiary programme and leave without at least a first tertiary degree" (*Ibid,* p. 92) in Denmark to no tuition fees and a high level of public subsidies for students. Though be it not the place here to argue that both of the above views might both have justification in their own right, the examples serves to show that Tinto's original concern for 'state planners' might be somewhat misdirected: at any rate we may expect statistics to be used according to political purpose.

Dropout, such as Tinto's (1975) model seeks to explain, will inevitably lead to a notion of attrition between systems inside the institution (i.e. between programmes) as a form of transition. We take on the view that a missing part of

Tinto's model can be introduced by defining attrition as the phenomenon of 'students starting a given programme and then leaving it for something else'. If for no other reason, we take on this view to be able to include in studies of attrition a majority of able and talented students who leave educational programmes anywhere.

Discourse analysis

Our main premise when engaging with interviews was that attrition is a result of an incommensurability of cultures - that of the individual leaver's and that of the institutional context. In the case of retention, for the stayer to become a member of a community of practice, the person will also have to learn to share the values of that community or system of relations. "Learning thus implies becoming a different person with respect to the possibilities enabled by these systems of relations" (Lave and Wenger 1991, p. 53). Becoming a different person is constructing a different identity – a process. So in order for a person to become a member of a community, the person will have to embrace the shared repertoire to be able to participate in the practices of the community – but until values are shared, until the intrinsic process of personal transformation is recognized as adequate, and until an access to the ways of knowing in the community is provided, this participation will be peripheral. In the case of schooling this peripheral participation is legitimate. In other words, even though a student is not a capable physicist, participation in physicist activities is often encouraged, and education is often designed in a way that encourages students to *mimic modes of disciplinary discourse* (Airey and Linder 2006). Thus being a member of a community of legitimate peripheral participators, such as a student body, can in itself be considered a community of practice as previously noted, characterized by distinct sets of shared repertoires.

Mimicking practice, or legitimate peripheral participation, has often been compared to learning a language by including in the language the idea of a shared repertoire. Thus, learning to become 'discursively fluent' (Airey and Linder To appear) might be an appropriate metaphor, also for characterizing and tapping into the process of identity formation and adaptation necessary for legitimizing the membership of the student community.

Gee (2005) has developed a type discourse analysis methodology especially suitable for understanding aspects of legitimate peripheral participation. It provides a coherent analytical framework within which discursive transactions captured in the interview can be analysed. Gee's discourse analysis differs from the more theoretically dogmatic discourse analysis frameworks by also calling for the inclusion of those of the aspects of communication that does not solely relate to the language-in-use (Ibid). To distinguish Gee-like approaches to discourse analysis Gee denotes the situated discourse 'big D' Discourse. Such broader models of discourse analysis is intended to go beyond 'what is said' and purposefully include what is 'known about', thereby revealing a range of issues allowing them to be factored into the interpretation of the ways, for instance, students respond to their circumstances (Case 2007).

When interviewing students about the reasons for leaving, the students will relate how they made sense of their choices. In such sense-making they will draw

on their experience and the result will be a personal interpretation that lends logic to the causality of the experience of studying and of deciding to leave. Ways of interpreting the world to make sense of it, is what Gee calls Discourse models. They "are 'theories' (storylines, images, explanatory frameworks) that people hold, often unconsciously, and use to make sense of the world and their experience in it. They are always oversimplified, an attempt to capture some main elements and background subtleties, in order to allow us to act in the world without having to think overtly about everything all at once. In this sense they are like stereotypes […] meant to help us understand complicated realities by focusing on important things" (Gee 2005, p. 61). In this paper we focus on insight into how seven students who left the physics programme at a traditional Swedish research university (henceforward referred to as physics*) model their personal explanation for leaving physics* without graduating.

Students making sense of leaving

The intention with the seven interviews was to document aspects of the experience of studying physics* that led the informants to the decision of leaving. The intention was also to carry the learned experience from one interview to the next and thereby forming ideas of institutionally rooted reasons for attrition that could be tested against the interview participants as a working progress. Most prominent of such experiences however, was that the interviewer had a feeling of being denied insight into those of the interview participants' experiences of studying physics* that were experienced as inherent to the physics* context. This denial took on a form of a kind of 'wall' of introspection. Almost every of the participants' experienced difficulties had to do with *something about themselves*, rather than *something about physics*. For example, one informant told that she stopped because she lacked the interest and the abilities:

I just realized that I wasn't interested in physics anymore. I was so bad at physics, I didn't pass that many exams, so I had to leave.

The student appears to have reached the practical limits for continuing her studies: no interest, no ability. But we would have liked to know why she was 'bad at physics', 'not good enough' and why she lost her initial interest. Her answer seems to lie in the domains of interest and ability. If we take her second statement as explaining the first; her story is somewhat more clear: She was initially interested, but because she lacked the experience of success (she did not pass that many exams) her interest died away – thereby confirming the well established connection between interest and experiencing success (cf. Biggs and Tang 2007).

At another instance the student who was interviewed did not feel she ever started studying physics*:

I left physics before I even got there. I took the brush-up course in mathematics, and realized that this was how it was going to be for, well only for like a full year, but it still seemed too much.

So maybe she was not that interested in physics anyway, but wondering what was so bad about her first impressions that it killed what remained of her interest she explains:

I was interested in the subject, but not that much really. Plus there was the competition. Three or four girls in the programme had already been working with meteorology for the military. They got their education paid for, and since I figured there weren't that many jobs in meteorology, and since the pay was really bad – like seriously awful – I lost interest completely.

Here, the issue of not starting the actual physics* illustrates this 'wall' of introspection. The loss-of-interest decision to leave in terms of competition and job-opportunities illustrates that she in a very concrete sense had commenced the studies but changed her mind due to her experience when starting at the university. Despite possible implications of the external, the logic of causality is pointed inwards and the reason for leaving, she insists, is the 'complete loss of interest'. Thus, we started exploring the notion that maybe this mode of introspection was a way for the students to make sense of their experiences.

The introspective Discourse model. We remember Gee's notion of Discourse models as 'theories that people hold and use to make sense of the world'. They are group constructions "that become a resource that an individual may call on to guide his or her actions" and moreover explanatory models that individuals draw on when making sense of experience (Gee and Green 1998, p. 123-24).

Consequently the 'wall' of introspection might be our way of noticing aspects of an 'introspective' Discourse model, by which the participants attempt to make sense of the logic of causality that led them to decide to leave physics* - leaving out the 'details' of extrovert circumstances. Plus, one might argue that when you invite people to speak about themselves – as we in our interview with a design that focus on past and present experiences – talking about themselves is exactly what they will do.

However, the interviewer actively introduced issues that might turn the conversational response in more extrovert directions. For instance, one student told that he needed a break, during which he worked, because he felt the pace was too high.

I just felt that I can't keep up that speed for so long. I needed more time to let it sink in. So it felt kind of pointless at the end I think.

It was suggested that a hypothetical situation in which the pace had been different, could have made him stay. But this prompted the following response:

No, I don't think so because I didn't take the decision that I'm gonna stop studying. If the pace hadn't been so high, it wouldn't have made any difference, because I think it would have been the same anyway. I would have started working and just slowly drifted away.

It appears that even though he had a problem with the pace, his leaving was still very much embedded in a Discourse model dictating that 'things just happen as they do', instead of the notion as we saw previously, that the decision of leaving can be prompted by 'not being good enough'. In other words, needing 'more time to let it sink in', is not translated into action, for example by planning to take longer to complete the studies and thus effectively taking less courses per semester. When asked, studying at a lower pace was decisively not an option for this student.

A Discourse model in two parts. As we explore the notion that the students we interviewed made use of an 'introspective Discourse model' to explain why things were as they were, the model appears to have two distinctive parts. Overtly the interviewees make use of an interpretative social language (or a theory) that says that if something goes wrong, it must be because of 'something within the self'. But further, this 'something within the self' is related by students as if it allows for events to 'just happen that way', or as if it is an issue of ability resulting in not 'being good enough' to stay in physics*.

The 'not being good enough' part. To us it appears that the inferences the participants drawn from the introspective Discourse model are very stable and conclusive. At one instance the interviewer suggested that the feelings of inadequacy conveyed by one participant during an interview, could be a cause of frustration; a frustration that could have been directed outwardly in what could be well-deserved criticism of physics*. As is apparent from the excerpt brought underneath, this was not a popular notion:

> *I wasn't angry because the pace was too high or because I didn't understand it. Then you just think: 'maybe I should study something else.' It's not some-one else's fault.*

The 'it just happens that way' part. We have already described how this part of the introspective Discourse model can be manifested. But what is really interesting is that it appears that this part can also be used to strengthen the 'not being good enough' part. Another leaver explains:

> *Gradually I worked more and more and more and studied less and less. And then it got pointless. When you come over a certain line or boundary, it gets pointless to go [back] to university at all because you are already so far behind that you can't catch up. So leaving physics was a gradual process for me. But when I did study, I did manage ok*
> .

What she says is that she drifted somewhat from the studies ('it just happens that way') but whenever she considered taking up the studies, it seemed too big an obstacle ('not being good enough') to be worth the effort ('it just happens that way'). Here it is also suggested that one of the more 'well-known' excuses for under-performance ('I could if I would') has its root in the introspective Discourse model: 'I could if I would' implies that since 'I do not, it is because I won't'. The same self-reflection explicitly modelled extrovertly might sound: "I

could if I would. But I do not, because the content simply fails to motivate me". Unfortunately such is seldom the case – it might even be naïve to expect of students to have such insights into their own motivational dynamics. Therefore evaluation of reasons for underperformance or attrition will have to be interpreted accordingly. We find it an imperative for the evaluation process that Discourse models used by the students informing the evaluation are allowed for and taken into consideration.

Discussion

Based on our experience with interviewing seven students about their reasons for leaving physics* it appears that young people invoke introspectively modelled reasoning when relating the logic of causalities leading them to take the decision of leaving physics*. However, Seymour & Hewitt (1997) reported from their North American based study of attrition, that a staggering percentage of leavers ascribed their choice, to having experienced *'bad teaching'* – which is obviously an extrovertly modelled reason for leaving. Clearly reasoning by introspection is *not* a universally encountered phenomenon with regards to education evaluation. But it may very well be a Scandinavian phenomenon. Descriptions of youth culture in Scandinavia trace interest-driven reasoning on choice back into the object of Scandinavian subject-centred schooling (cf. Troelsen 2000, Schreiner and Sjøberg 2005, Rødseth and Bungum 2007). For Sweden and Denmark respectively, the object of schooling has been described in essence to be 'making persons out of pupils' instead of 'making pupils out of persons' (Frykman 1998) and by recently changing the old question '*What* do you want to *become* when you grow up?' into '*Who* do you want to *be* when you grow up?' (Illeris, Katznelson et al. 2002). Therefore we find reason to believe that the introspective Discourse model is also put to use outside of the physics* education context – at least in Scandinavia.

Roughly at the same time as this study was performed, another report on attrition was prepared at the same university detailing reasons for leaving with the purpose of understanding and preventing attrition (Appel 2007). The author and her associates had interviewed students who had studied law, social sciences, computer science and education and reached by and large to the same conclusions as did the students we interviewed, when we conclusively asked them if they had any suggestions for ways to make students stay in physics*. However, we found it necessary to use our insight into the introspective Discourse model as an interpretational lens to reach more locally oriented constructive suggestions for understanding and preventing attrition.

The introspective Discourse model as interpretational lens. We strongly recommend that education researchers and teachers involved with evaluation practice take into consideration that young people might make sense of their experiences making use of introspective reasoning, as was found in this study. If this is the case, and if evaluation statements are taken at face value, important and useful feedback may be missed, and the only outcome of individually based interviews on attrition may be related to the youth culture rather than related to external issues that can be addressed by the institution.

We give one last example which elucidate the problem of taking introspectively derived statements at face value:

It would have been nice if someone noticed that I had problems at the end of the first semester, but no-one did. But there's no way anyone could have. I mean, you have different teachers in every subject.

In response to such a claim, you could surely intercede (among so many other things) that it is a (collective) responsibility for teachers to notice students if they do not learn. Introspectively modelled, such a conclusion, that the student was neglected by her teachers, is not viable, why the researcher's conscientious interpretation is necessary.

Conclusion

We have argued for conceiving attrition as the failure of an individual to be admitted into the legitimate peripheral participation of the community of physics learners. Also, that this failure of admittance takes on the form of exclusion, either by the community or by the individual as self-exclusion or rejection. Gaining insights into attrition can thus be done through interviews purposefully probing into each student's experience of the logic of causality that led to the choice of leaving. Based on our experience of interviewing students who left the physics programme at a traditional Swedish research university, we found that for the purpose of interpreting student interviews, one must take into account the two different modes of introspective modelling: attrition *'just happens that way'* or that leaving was necessary because the student was just *'not good enough'*.

We conclude this paper expecting that young people in Scandinavia may invoke introspective Discourse modelling in situations were they are asked in retrospect to relate their impression of the logic of causalities that led them to decide to leave any university education programme.

Consequently we strongly recommend for researchers and teachers involved with any evaluation practice involving student testimonies, to take into consideration that young people might make use of introspective reasoning. Therefore interpretation needs to be performed accordingly if one wishes to gain insight into issues concerning attrition external to the individual student that might be addressed at the institutional level.

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