

Penetrating a wall of introspection: a critical attrition analysis

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Abstract This paper presents a critical analysis of student discourse on attrition as it unfolds in interviews on early departure from higher education. A synthesis of relevant studies and modelling done in the field shows that essential aspects affecting attrition and retention can be effectively conceptualized and acted upon in terms of the interplay between student and institution. These aspects were used in combination with James Gee's notion of Discourse models to design a unique framing for interpretation of interviews aimed at bringing out new causal dynamics that lie in this interplay. To illustrate this interpretation, Aristotle's notion of four causes is used. The analysis presented is a study of interviews with seven former physics students about their early departure. This framing of the analysis was necessary because the students' description of how they understood their actions did not explicitly reveal interplay between student and institution. These details lay behind a 'wall of introspection' that otherwise posed a serious challenge to the use of student testimony as direct means to identify and address issues of early departure. The results are used to discuss research implications.

Keywords Attrition and retention · Higher education · Interview analysis · Ability · Physics

Dansk sammenfatning

Gennem tiderne har mangen et studie og undersøgelse bekræftet professorer såvel som studerende i deres mistanke om, at de studerende der droppede ud, var dem der havde valgt det forkerte studie. Det er ganske rigtigt, at dette er den mest nærliggende begrundelse man

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kan give, hvis man som studerende begyndte på et studie man endte med at beslutte sig for at forlade. Det vil dog være en fejltagelse at slutte, at årsagen til beslutningen er den samme som begrundelsen for beslutningen. Ikke desto mindre er det, det der sker, når en mere målrettet vejledning af nye studerendes studievalg anbefales på baggrund af frafaldsundersøgelser der konkluderer at problemet skyldes forkerte eller misinformede studievalg. Sådanne konklusioner misser pointen: givet, at en studerende opdager at han eller hun har valgt det forkerte studie, findes der en oplagt mulighed for at undersøge hvilke oplevelser der havde indflydelse på beslutningsprocessen undervejs i uddannelsesforløbet. Den mulighed forpasses, hvis begrundelse og årsag forveksles.

I denne artikel tager vi udgangspunkt i en række studier af frafald, vedholdenhed og læring på videregående uddannelser, og begrunder at hvis man vil forstå den proces der leder frem til en beslutning om at droppe ud af et studie, må man tage højde for at det at *være* og *blive* studerende er et komplekst samspil mellem ét individ og en institution, som i sin tur udgøres af en række individer (herunder de studerende der måtte falde fra), kulturer (herunder fagkulturer) samt en lang række dybt forankrede vaner og traditioner. Inden for rammen af sådan et perspektiv vil det være forkert at sige at uddannelsen var forkert til den studerende, ligesom det ville være forkert at sige at den studerende var forkert til uddannelsen. Hvis noget var forkert, så var det *situationen*. Dette perspektiv udnytter vi til at foretage en grundig analyse af syv interviews med tidligere fysikstuderende, der havde valgt at forlade fysikstudiet ved Uppsala Universitet i Sverige.

I interviewene bedes de studerende begrunde deres frafald. Men analysen såvel som interviewet tager sit omdrejningspunkt i, at de begrundelser der gives også har en baggrund. Det vi finder ud af er, at dette omdrejningspunkt har et forskelligt fokus afhængigt af perspektiv. Interviewerens fokus tager udgangspunkt i et ønske om at forstå de strukturelle betingelser omkring fysikstudiet der danner baggrund for frafaldets begrundelse. De studerende selv, tager udgangspunkt i sig selv. For at illustrere dette forhold benytter vi Aristoteles årsagsbegreb i analysen, og viser at de årsager de studerende bruger som baggrund til at forklare deres beslutning om at forlade studiet, har en væsentlig anden karakter, end årsager der kan knyttes til strukturelle betingelser omkring fysikstudiet.

Konklusionen er, at hvis ikke man gør sig det klart, når man undersøger årsager til frafald, så er udbyttet i bedste fald en for simpel forståelse for de årsager, strukturelle såvel som individuelle, der måtte kunne knyttes til frafald fra videregående uddannelser.

Although research on attrition and retention has convincingly pointed out the issues that are at stake, decades of research has yet to sufficiently expose the specific and actual mechanisms in relation to content, curriculum and modes of teaching that drive early student departure in ways that can be used to effectively implement measures to approach the problem at the institutional and departmental level.

Generally little is known about international attrition or drop-out rates as they pertain to the number of students who opt to leave different fields of study at different universities. The Organisation for Economic Co-operation and Development (OECD) reports an overall 31 percent rate of non-completion among students who enrol at tertiary level education for their first degree across all universities in the OECD countries (OECD 2010). The organization also remarks that Science and Technology are among the disciplines with the highest attrition rates (OECD 2008). Concerning all levels of science education, primary through tertiary, an independent expert group set up by the European Commission deems attrition rates in the science and technology disciplines “unacceptably high” (European Commission 2004, p. 181). The expert group goes on to describe how tertiary science and technology education in most universities characteristically adheres to a prevailing

paradigm that “is poorly suited to the needs of a knowledge-based economy, where original thinking and creative work are expected of the many rather than the few” (European Commission 2004, p. 104).

This same concern regarding the quality of education is also raised by physics education research. When B. H. Briggs (1976) devised and carried out a small scale survey at the University of Adelaide in Australia, he found that students who chose physics do so because they are interested in the subject. Students who do not find physics interesting, do not ascribe this lack of interest to the subject itself, but to the way it is taught. Nearly 30 years later in North America, this same relationship between a decline in students’ interest and students’ experience of physics instruction prevails (Perkins, Gratny, Adams, Finkelstein, and Wieman 2005). One might interject that if groups of students systematically lose interest in physics after they have taken part of a physics course, their expectations of these physics courses might have been naïve at the outset. And indeed such a link between students’ interest in physics and their attitudes towards what physics learning entails (i.e. novice-like through expert-like) exists. But since a negative shift in these attitudes is commonly observed as a general result of physics instruction, one would expect it reasonable to link students’ attitudes with their choice to continue in physics. Although such a correlation is found, the effect size is small (Kost-Smith, Pollock, and Finkelstein 2010). In fact, Lauren E. Kost-Smith, Steven J. Pollock and Noah D. Finkelstein who worked to find and characterize a pattern in gender differences related to physics retention, performance and attitudes find this to be true for all these factors. They conclude that “this pattern of disadvantage [towards female students] suggests a systematic culture in which males are privileged over females. [...] Understanding that retention, performance, and attitudes and beliefs are some of the mechanisms by which a cultural bias is maintained and reinforced is a first step towards alleviating the gender disparities in physics” (2010, p. 15).

Gender disparity is just one expression of how cultural biases impede the participation of any particular group. In any endeavour of original thought and creative work, such as physics, cultural heterogeneity is much preferred over homogeneity (Hazari, Tai, and Sadler 2007). And it all points back to students’ experience of physics instruction: their experience of content, curriculum and modes of teaching.

Guide for reading this paper

This paper has two parts. One part consists of a critical overview of relevant literature, a theory section and a methods section. The other part consists of an analysis of interviews and a concluding discussion.

In the first part of this paper we characterise an appropriate framework for conceptualizing the dynamic linkage between students’ experience of their physics instruction and their choice of leaving. To do so we briefly outline the general field of higher education research into student retention and attrition and argue in favour of a research perspective that focuses on interactions between student and institution. In the next section of this part, this research perspective is tied to a discourse analysis framework suitable for assisting the interpretation of seven qualitative interviews that were carried out to gain knowledge of how students’ experience of their participation in university physics education led them to decide to leave the physics programme early. We also describe how the interviews were carried out.

In the second part we analyse and discuss this analysis of interviews we performed with seven former physics students who had decided to leave the physics programme at a

traditional Swedish research university. The analysis and discussion is aimed at illustrating how the causal dynamics regarding the interplay between student, content, curriculum and modes of teaching are embedded in the interview discourse instead of explicitly present in conversation as one would have hoped for. We show how the embedded dynamics manifest as a type of ‘introspective discourse’, but illustrate how this discourse can be interpretatively perceived as an issue of the premises of the interviewers’ questions and the premises of the respondents’ replies. To assist in illustrating these premises and their difference, we draw on Aristotle’s four causes.

The reasons we do this, is first, that we find it important to point out that students in interviews might make use of introspective discourse, and we want to show that this particular discourse can be perceived of as mirroring an existing institutional discourse on attrition and learning in general. That is, when students say that they were ‘unable’ (to meet disciplinary demands) for instance, it might actually be so, but it might also be that the particular make-up of the institutional setting allows for, or even encourages this type of discourse. If so, it would be a discourse that is focused on the individual as a stable configuration to be tested rather than on the individual as a developing learner. Such a discourse is not unheard of. In fact, US medical schools for example have a long tradition of using introductory chemistry, biology and physics courses (Barr 2010) to identify the students “who are apparently intellectually or emotionally unable” (Mullin 1948, p. 164, also cited in Barr 2010). The interviews we analyse here reveal that the same sentiment saturates the interviewed students’ justifications for leaving their physics studies.

Second, by explicitly and rigorously probing discourse on attrition for subtle hints that give evidence to certain aspects of interaction between student and institution it is possible to gain a nuanced and contextually rooted understanding of attrition. We find it important to illustrate how such a rigorous analysis can be performed, and why this type of analysis yields results that are not possible in student interview analysis that does not take such measures.

The third reason for bringing out and emphasizing the causal dynamics that resides in ‘introspective discourse’ is to argue that if substantial emphasis is put on the unmasking of implicit relational aspects with regards to student and institution that are also part of student discourse on attrition, then we gain a better, more nuanced outcome of student interview interpretations compared to what resides at the apparent, explicit level of student testimony.

We end the paper by discussing research implications for the general field of higher education research on attrition and retention and consider how the results add to the field of physics education research.

The need for linking attrition to student-institution interactions

The following is a brief overview which serves as an argument for a strand of research into attrition and retention that is informed through a focus on students’ interactions with the praxis and content of teaching and learning. For a recent and more complete review of theoretical and empirical trends in research on attrition in higher education with special emphasis on Science, Technology and Mathematics we refer to Lars Ulriksen, Lene Møller Madsen and Henriette Tolstrup Holmegaard’s review (2010).

We take as the outset of this overview an on-going discussion about the issue of remedying early departure through better integration of students and especially how to interpret the notion of better integration. The source of this discussion is Vincent Tinto’s

longitudinal model of institutional departure (Tinto 1975, 1993) sometimes called Tinto's interactionist model (cf. Braxton, Vesper, and Hossler 1995). Here, Tinto emphasises the importance of academic and social integration to student success in higher education. The model has been paramount to most research carried out within the field (Braxton, Sullivan, and Johnson Jr. 1997) but has also been subject to both critique and numerous modifications, most of which addresses aspects related to the non-traditional student (cf. Bean and Metzner 1985).

The critiques often seem to depart in a reading of Tinto's emphasis on the need for strengthening students' involvement with their own education through integration into the institution in ways that equates to enforcing academic and social assimilation. We find, however, that there is hardly basis for assuming that enforced assimilation is an integrated part of Tinto's interactionist model. To this end Ulriksen, Madsen and Holmegaard (2010) point out that "what permeates the model is that attending university is a process of socialisation, and as such it is to be regarded as an interactional process between what the students bring with them and the culture they meet" (p. 215).

Very much in line with this sentiment, Jill Lawrence (2005) brings together her interpretation of strands of research into attrition and retention and adds to this a perspective on student transition, which she calls 'the student perspective'. Together, these perspectives equates to a type of re-conceptualization that "challenges universities to identify the (often less explicit) discourses and institutional practices involved in transition and retention" (p. 30).

Below, we briefly present results from a selection of studies on attrition and retention. We find the threefold categorization, introduced by Lawrence (2005) useful and refer to these as 'the assimilation strand', 'the institutional services strand' and 'the interactions strand'.

The assimilation strand

Lawrence (2005) refers to this strand of research as a strand that aims to bring information to light that will allow researchers and institutional planners to better assimilate all students into the (definitive) institutional setting. The focus tends to be on identifying student traits such as attitude, ethnic background, social status, sex etc. that predict retention or attrition.

Often the studies are large scale statistics surveys that aim to uncover attitudes and/or abilities that correlate with student retention (cf. Cabrera, Nora, and Casteñeda 1993). Results reveal that ethnicity, socioeconomic standing, and education generational status (i.e. the level of parental education) are important factors related to student attrition and retention (Pascarella and Terenzini 2005). Evidence also suggests that these factors together with income, physiological gender, academic access (e.g., outcome and quality of primary and secondary education) are severely entangled and not readily separable into distinct groups (Tinto 2006–2007). Specifically, physiological gender has received considerable attention, but appears not to be a convincing predictor of dropout in literature. Instead the possibility of gender-specific *attraction* to certain programmes (i.e. the pull-out rather than push-off) may have some explanatory power in the landscape of attrition (Mastekaasa and Smeby 2008). In other cases, local ways of *negotiating* gender appear to substantially influence non-completion (cf. Hasse 2002).

Partly as a reaction to these types of studies, Elaine Seymour and Nancy M. Hewitt (1997) interviewed nearly 500 students, leavers and non-leavers alike, across science, mathematics and engineering majors in both private and public colleges in the US, who all earned good mathematics results on their Scholastic Assessment Test. They conclude that

it is not possible to distinguish leavers from non-leavers with respect to “individual attributes of performance, attitude, or behaviour, to any degree sufficient to explain why one group left, and the other group stayed” (p. 30). Instead Seymour and Hewitt point at individual coping strategies as key to persistence. Similar to Tinto’s conclusion above, the authors find that leavers and non-leavers are not different types of people. Thus, the general sentiment is that “students persist in their studies if the learning they experience is meaningful, deeply engaging, and relevant to their lives” (Lardner and Malnarich 2008, p. 32).

Essentially this strand of research tells us that among students who have the formal qualifications to succeed in higher education, no generic student-type exists with respect to socioeconomic status, gender, academic access, performance, attitude, or behaviour that is more prone to leave than others. Thus, the assimilation strand does not point out an unmistakable group of students that are especially susceptible to any mechanisms inherent to the institution that exclude them. Instead studies like Seymour and Hewitt’s point toward a conceptualization of retention and attrition in terms of coping. One way forward is to seek knowledge that can help us better anticipate and react to students’ difficulties. This is the institutional services strand.

The institutional services strand

Integral to this strand is the assertion that students increasingly exhibit different motivational strategies in studying. Accordingly a realization is emerging that institutions must be equipped to cater learning strategies that are appropriate to the students individually (cf. Zepke and Leach 2005). One might say that the institution needs to find ways to accommodate the students.

In the previous section, we saw that it was not possible for Seymour and Hewitt (1997) to identify one distinct group of students who have the formal qualifications to succeed, that are more prone to leave than others. This does not mean that a distinct group of students that is more prone to leave than another does not exist. It does, but is already classified as different to the main group: as non-traditional students. Depending on context these classifications might involve notions of underprivileged students, adult learners, Hispanic, women, etc., of whom, for various reasons, it is expected that they will be in need of special considerations (Haggis 2006). This is where institutional services come into the picture. Traditionally, such services take the form of, for example, financial aid, child-care services or academic counselling (cf. Nora, Cabrera, Hagedorn, and Pascarella 1996).

As such, the strand is not as much focused on attrition, as it is on retention. Mantz Yorke and Bernard Longden (2004), for instance, point towards a student-interest perspective (that is, a perspective that focuses on what students need, rather than on what abilities they might lack) for providing information that can be employed to support students to stay in higher education. Later they used this perspective in devising and interpreting a UK questionnaire survey with a free response option (Yorke and Longden 2008). Students’ reasons for leaving turned out to be poor quality learning experiences (e.g., large lecture halls, lack of contact with academic staff, feelings of indoctrination), difficulties coping with academic demands (some perceived of them as too hard, others too easy in terms of structure, apparent level of difficulty, etc.), and realizing that the choice of field of study was wrong (motivating their initial ‘hasty’ choice with external pressure or based on their secondary education interest and performance, and also misinformation). Such results are, as mentioned in the introduction, echoed in the interview discourse that we analyse in this paper but also internationally. For example, the results of both Monika Appel (2007) in

Sweden and Elizabeth Godfrey, Tim Aubrey and Robin King (2010) in Australia are remarkably similar to Yorke and Longden's findings listed above.

The problem is that issues pertaining to attrition or retention are not penetrated sufficiently in ways that allow for an understanding of interacting causes that link attrition to teaching and learning, or even university and student. If we focus on the question of wrong choice, for instance, which a UK-government report identifies as the most prominent of reasons for attrition (Davies and Elias 2003), the authors link this reason to being unaware of the advice- and support-mechanisms that were already in place. Similarly, a small scale Danish questionnaire survey that focuses on students' interests concludes that "the departments cannot do anything to address a number of the causes for early departure. The results suggest that a number of students enrol in a trial-like fashion, but either they do not have the interest or they are more interested in another area" (Andersen and Laursen 2003, p. 65 own translation).

Generally the decision of leaving is presented as an issue of different manifestations of (or perspective on) students' inability to adapt to the immediate educational circumstances. Zepke and Leach (2005) review more than one hundred research studies on retention and achievement in higher education and provide a comprehensive list of initiatives that prove to vent students' difficulties adapting, through institutional adaptation to an increasingly diverse student population. Among these, they mention induction programmes and supplemental instruction specifically targeting at-risk students and high-risk subjects (i.e., specific courses) respectively and the provision of accurate and comprehensive pre-enrolment advice. They recommend offering peer mentoring services, the establishing of academic learning communities (as do for instance Catherine Engstrom and Tinto 2007) and a general focus on quality of teaching. Especially this last recommendation must be emphasized. Otherwise a closed circle seems to form between the assimilation strand and the institutional services strand: in realizing the needs of the students, the institution can accommodate these needs by successfully supporting students assimilating to institutional requirements.

The interactions strand

We note that a salient characteristic of both the assimilation strand and the institutional services strand is that the specific teaching and learning environment and the educational programmes in general seem to be 'black-boxed'. They are taken for granted and considered invariable. The only variable left is the students (who need to be assimilated if they do not assimilate naturally), or the sets of institutional services that supplement invariable teaching activities to provide the extra support some students need in order to assimilate.

What we miss in these research strands is a focus on the aspects of academic integration that relates to students-institution interactions—including curriculum content and structure, and teaching and learning. In line with Tinto's interactionist model, Lawrence (2005) aims for inclusion and argues that the purpose of a focus on academic integration would be to link transition, attrition and retention with "engagement and mastery of mainstream university discourse/literacies" (p. 30). Tamsin Haggis (2006) extends this sentiment, and reminds us to integrate in this focus a perspective that aims to sustain and avoid corrosion of the positive aspects of mainstream university discourse.

William G. Tierney (2000) suggests that one way to improve the university's fit to the environment is to define, affirm and incorporate practices for negotiating academic identity within the institutional culture. But this is significantly easier said than done, as Wolff-

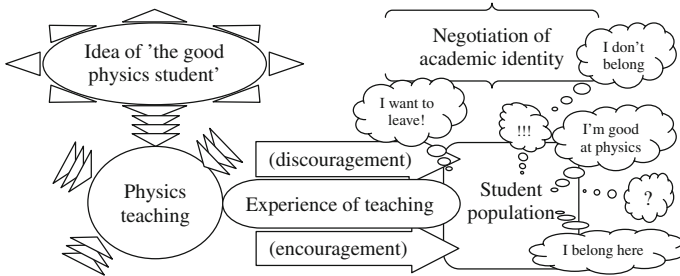


Fig. 1 An illustration of how the idea of ‘the good physics student’ influences physics teaching. Students experience this teaching, and part of this experience is encouragement and discouragement. Students use such experiences when they negotiate their academic identity. Part of this negotiation is to negotiate feelings of belonging and of being ‘a good physics students’

Michael Roth and Yew-Jin Lee (2006) make abundantly clear in their case study analyses of learning communities.

At an initial stage, another of many approaches is to linger at mapping the constraints already experienced in contemporary higher education and work at (re)clarifying how attrition and retention (and learning in general) link to the negotiation of an academic identity and the experience of teaching and learning. An illustration of how this link might be envisioned with respect to university physics education is suggested by Fig. 1.

An aspect of the culture of any educational practice is ideas about what is implied, when we talk about good, bad, mediocre, etc. students (Ulriksen 2009). In the introduction to this paper we describe how researchers in North America have found evidence that the culture of physics education at their institution is systematically biased against women in various ways. Such a bias is of course unintentional, why it seems safe to presume that other kinds of unintentional cultural bias exist which target student types who are not necessarily all female. Seymour and Hewitt (1997) confirm this presumption.

To decide which bias is unintentional and what bias is preferable, one needs to know what biases exist and what the effect of such biases might be. With regards to science and technology education, we already know the effect to be “unacceptably high drop-out rates in many European countries” (European Commission 2004, p. 181). It is an empirical question to investigate what kind of bias that causes these attrition rates, and for the physics community to decide, what aspects of this cultural bias are acceptable and may even be considered intentional. In Figure 1, such a decision could thus add to or constitute an intentional explication of a clarifying link between students’ ‘Negotiation of academic identity’ and ‘What a good physics student is’. Such a link may help address unintentional bias and ultimately alleviate unintentional attrition. Initially, however, important knowledge can be gained from asking how the students themselves make meaning of the link between their negotiation of an academic identity and their participation in university teaching and learning activities. This is what we do in this paper.

We analyse a set of interviews with students who opted to leave the physics programme at a Swedish university with the purpose of clarifying how these students’ experiences of studying physics relate to what they tell about the reasons for their decision to leave. This approach differs from the integration strand as delineated here, in this overview, in that we take the students’ motivational strategies as they relate to their perceived experiences of learning into consideration. It also differs from the institutional services strand in that this perspective does not assume a complete correspondence between reasons for leaving and

educational experience. Instead we approach student interviews about leaving as a source for clarifying how the educational experience *links* to the reason for leaving. The aim is thus to identify issues which can be addressed at the institutional level by, for example, modifying the curriculum and/or the teaching and learning environment in order to give future students a different, and hopefully better, educational experience.

In the next section, we tie this overview to a discourse analysis framework and thus describe an interpretative perspective that allows for approaching such a clarifying linkage.

A discourse analysis framework for interpreting attrition linked to student-institution interaction

Tinto (2006–2007) remarks in one of his later papers and also in his book (1993) that attrition is not the complementary opposite of retention. One cannot assume what might be the impact of learning and teaching practices on stayers from research into the impact of experiences on leavers. To move forward in our effort to increase retention, it is necessary to assume a perspective that “delineate[s] the organizational context within which effective practices and programs arise and endure” (Tinto 2006–2007, p. 7). If Tinto is right in pointing out that we cannot assume the impact on stayers from the impact of experiences on leavers, is this an impasse? Do we have to be pragmatic and leave research on attrition behind and instead focus research on ‘what seems to work?’

Not necessarily, but it does mean that we need to be careful not to draw hasty conclusions and expect to be able to render practices effective by scrutinizing ‘what did not work.’ We thus briefly look at how perspectives on teaching and learning (i.e. research into the organizational context of practices at institutions of higher education) have developed.

Haggis (2009a, b) reviewed four decades of student learning research in a selection of UK and US based higher education journals. She concludes that cognitive psychological learning theory (focusing on the individual) “has developed at the expense of [...] other approaches” (2009a, p. 34). For this reason, we need to look beyond the enculturation of our field and “step into the unknown” (Haggis 2009b, p. 388). In an earlier paper on “Pedagogies for diversity”, Haggis (2006) distinguishes between forms of such dominant research in a way that is very similar to the distinctions made by Zepke and Leach (2005) and Lawrence (2005), which was used in the previous section. Here, Haggis identifies research on teaching and learning that either locates the problem “within the student” or as an indication of a “need to improve conventional teaching methods” (Haggis 2006, p. 523). But also, she identifies a third branch that draws on results from research on adult learning that argues for a move away from individuals focused research to allow for a broader perspective that takes into consideration not only the discourse and power relations, but the process of discourse and power relations specific to the disciplinary contexts (2006). An example of such an approach to delineating teaching/learning situations is John Biggs and Catherine Tang’s (2007) conception of outcomes-based teaching and learning designs.

It appears, that no matter how we turn and twist the issue, whether we look at the issue of attrition emphasizing the perspective of those who leave or are in danger of leaving (as was done at the beginning of this paper), or we look at the issue of learning emphasizing the perspective of those who stay, we hear a call for a focus on the interaction between student and institution. A focus that is contextually and disciplinarily rooted—or situated. Maintaining such a focus on attrition thus holds promise for gaining knowledge that is also valuable for informing and supporting retention.

To recapitulate the previous overview: to move forward in researching attrition it is necessary to consider the interplay between student and the specific disciplinary context that this student decided to leave. In the next subsection “Interactions”, we identify an analytical framework suitable for analysing interviews with such considerations in mind and in the subsection that follows we introduce Aristotle’s four variations of cause in order to illustrate how students’ experiences link with causes for leaving.

Interactions: discourse models

James Gee (2005, 2011) has developed a framework that is specifically intended for analysing and understanding interactions between individuals and the structural, as constituted by for instance culture or institutions of education. In this framework, one creates oneself and is created in discourse. Gee (2005) explains: “We continually and actively build and rebuild our worlds not just through language but through language used in tandem with action, interactions, non-linguistic symbol systems, objects, tools, technologies and distinctive ways of thinking, valuing, feeling, and believing. [...] We use language to get recognized as taking on a certain identity or role, that is to build an identity here-and-now.” (pp. 10–11).

If a student is interviewed about his or her choice of leaving, we might thus think of the way causes are ascribed to choice as part of an identity created for the occasion. Characteristic of this identity creation, among many other things, are ways in which the account of such a choice is made meaningful. At the same time, these ways also reveal characteristics of the culture in which such discourse is meaningful: “discourse (and language in general) is a part of culture: because culture is a framework for acting, believing, and understanding, culture is the framework in which communication (and the use of utterances) becomes meaningful.” (Schiffrin 1994, p. 408). Since the interview situation is not culturally self-contained or isolated, the creation of identity for the occasion does to some extent link back to the culture of reference, to the topic of conversation. What makes Gee’s sociolinguistic framework interesting in this respect is that it is especially well suited for getting at this reciprocity of meaning, identity and culture that is sketched in Deborah Schiffrin’s quote above, and that which binds it together. In an earlier edition of his book, Gee (2005) referred to this reciprocity as “Discourse models”. He now calls this reciprocity “figured worlds” to stress that we are talking about “ways in which people construe aspects of the world in their heads” (Gee 2011, p. 76); but also he does so to better retain his discourse analysis toolkit’s kinship with the wider field of discourse-research that Dorothy Holland et al. work represent (cf. Holland, Skinner, Lachicotte Jr, and Cain 2001). Here, we still use the term ‘Discourse models’ because we want to emphasize our analytical approach to interviews: the stories that students relate in interviews are subjectively meaningful to each student individually, but to us they represent a conglomerate of situational experiences that students link to make meaning of the experiences. This way of linking, resembles modelling, and to approach this coherence- and meaning-making as a type of modelling, allows us to ‘get at’ the situational experiences—which first and foremost is the purpose of this paper. Gee characterize the Discourse models in this way:

“Discourse models” 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, though we should keep in mind that all theories, even overt theories in science, are simplifications of reality that are meant to help us understand complicated realities by focusing on important things and leaving out some of the details. (Gee 2005, p. 61)

The analytical lens that we employ here by making use of Gee's notion of Discourse models (the capital 'D' is meant to signify that language-in-use-discourse, is 'melded integrally' with the ad-hoc creation of identity), allows us a conscious explication of these 'background subtleties' and theories that make attrition meaningful to those students who leave. But not to those alone. These theories, as previously argued, per the reciprocity of meaning, identity and culture, are also *indicators* of the culture they refer to. Even the aspects that are left out to form these theories are important referential indicators. This in turn means that one cannot infer cause directly from interviews on early departure, as appears to be the approach in many studies in 'the institutional services strand'. An extra analytical layer is needed to manage and characterise both the referential indicators that are explicitly present in interviews and those that are made apparent in their absence. The focus of the analysis in this paper is to link students' characteristic modes of Discursive modelling of causal relations regarding their choice of leaving to the interplay between student and institution. To thus specify and characterise modes of reasoning that are present or evidently absent we turn to Aristotle's characterization of causal relations because it explicitly deals with this schism. Consequently it is an appealing characterization for illustrating students' characteristic modes of Discursive modelling.

Aristotle's four causes

When we speak of intentions and causes (e.g. as when we speak of choice and of changing one's mind) we tend to rationalize subjectively although intention and cause is usually manifested externally in action and interaction (Hineline 2003). Each of us individually are all socially intertwined in motivation, and as to what is which, there is a natural basis for confusion: "for each individual 'sees the *other* do the same as it does; each does itself what it demands of the other, and therefore also does what it does only in so far as the other does the same' (Hegel 1807/1977, p. 112)" (in Roth and Lee 2006, p. 28). For this reason it can be necessary to have a framework to compare against, when attempting to sort out the mangled logic of causality that is more often than not our stories. To this end we have chosen Aristotle's four causes, as gathered from Thomas Aquinas' commentary on Aristotle's *Metaphysics* (1272/1961). They are:

1 causa materialis which concerns the cause of a thing, without which it would not be. That is, a goblet of silver, for instance, is not at all a goblet of silver, without the silver. Conversely silver is not destroyed by being moulded into a cup. That is, silver (among other things) is the material cause of the silver cup, and also that which makes a silver cup a subset of cups. Aquinas emphasises that the material cause is an intrinsic quality pertaining to the thing we want to explain the cause of. According to Peter R. Killeen (2001), who is a psychologist, material causes are what neuroscientists are concerned with when they explain cognition of various kinds by pointing out how physical components of the brain interact.

2 causa formalis which concerns the cause of a thing that makes us recognize it as just such a thing. It is the characteristics of the thing pertaining to its likeness to the exemplary or ideal version of the thing. In terms of the silver cup, we might talk of its metallic gleam,

its shape or maybe a certain pattern around the edge that we have come to identify with fine metal cups. As such, the formal cause is very much connected to ideas extrinsic to the thing itself. Killeen (2001) suggests that Newton's laws are perfect examples of how the formal cause is emphasized in explanation of terrestrial movements. Devoid of any apparent material causes, such as hooks and eyes, Newton described the reason for the planets' apparent behaviour with a mathematical 'model of gravity'—and here, gravity is the formal cause of the planets' movements, neatly formalised as a mathematical model, a theoretical description of interaction that does not have a material designation.

3 causa efficiens which concerns the cause of a thing that makes it begin being or do, come to rest or move. Most often the efficient cause lies in the activity that is associated with the thing. With respect to the silver cup, the need for a place to pour wine might be its efficient cause. But also the silver smith who made it or the chieftain who supplied the silver for the making of the cup might be associated with its efficient cause. "Efficient causes identify the early parts of a sequence that are essential for the later parts," says Killeen (2001, p 137), and interprets this as "the contemporary meaning of *cause*" (Killeen 2001, p. 136).

4 causa finalis which concerns the cause of a thing pertaining to its purpose, that for the sake of which it exists or 'does.' As with the efficient cause, the final cause is strongly associated with activity. Different though, is an insistence that a final cause is meaningful, to some extent intentional. The final cause of a silver cup might be that it completes the idea of a good bottle of wine. Much of the causality that natural science deals with traditionally assumes to avoid issue of inherent purpose. If explaining the purpose of gravity, for instance, one soon wanders into domains assumedly irrelevant to science and not at all in line with the process of thinking scientifically—for we do no longer think that the stone is falling because it is *supposed* to rest on the ground, nor that the planets want to go anywhere in particular. However, one often turn to final causes in practical explanation of science: for instance when working with circuitry utilizing the principle of the path of least resistance (implicitly assuming that electricity wants to, or is supposed to 'run' as easily as possible), or pointing out that a giraffe has a long neck so it can reach high foliage (Killeen 2001).

In the context of this paper, we use Aristotle's four causes as a form of analogy: as an illustration that assists understanding a characterisation of what conversation-paths are accessible with respect to explorations of what went ahead of the events that interview participants offer as reasons for leaving their studies. We acknowledge that it can be problematic to talk about causes in relation to human action, because hopefully we are all individuals who are able to act in the world, individuals who can always rationalize and give reason for our actions. It surely is different to give reason for one's action compared to saying that someone or something caused our actions. Using Aristotle's four causes to contrast students' explanations for leaving, however, allows for a coherent way of illustrating the analyses of student Discourse, which in turn allows a different understanding of the interviews. Thus, Aristotle's causes are utilized to illustrate, contrast, link and characterise Discourse on attrition.

Below we make *our* Discourse model explicit through an analogy. Often "the acorn and oak tree" paralleled with "the boy and the man" is used to illustrate *causa finalis* (cf. Cohen 2009). We relate the notion of the two to all four causes. But instead of using the latter notion in terms of 'boy becomes man', we think 'physics student become physicist' (no gendered connotation intended) by metaphorically retaining an implicit notion of personal development, here limited to the scope of physics education. Thus, we introduce the metaphor used in this analysis (Table 1).

Table 1 An illustration of our use of cause, exemplified by the analogy of an acorn that grows into an oak-tree and a physics student that grows into becoming a physicist

Aristotle's causes	The causes that an acorn realizes its potential to become an oak tree	The causes that a student realizes his or her potential to become a physicist
1. Causa materialis: the material cause <i>matter</i>	The acorn, within which a seed is constituted in ways that can allow for it to mature	The student, constituted in certain ways that align with that which is needed to study physics. Abilities, capacities
2. Causa formalis: the formal cause <i>form</i>	The tree (as an idea or concept). The biological imperative: acorns develop into trees	Physics as an educational discipline (as an idea or concept). The disciplinary imperative: through education you become a physicist
3. Causa efficiens: the efficient cause <i>moving</i>	The right conditions for growth (sunlight, rain, nutritious soil, etc.)	Good teaching and learning conditions. Programme structure, teaching and learning environment
4. Causa finalis: the final cause <i>end purpose</i>	Becoming a mature oak tree	Becoming a physicist

If a man plants an acorn, but an oak does not grow, the frame above will be a useful way to approach ascribing causality to the failure. Some aspects of cause will be more interesting to the man than others, however. If the acorn was just a bad acorn (material cause), he will get a new one and see what happens. But if the conditions in front of his house prove unsuitable for oak-growth (efficient cause), this will be of special concern to him, since such a realization is of consequence to all his attempts to grow oaks in his front yard.

The same goes for research into attrition. Naturally—and especially from the interactions perspective on attrition—we recognize that all causes in one way or another apply when a student leaves a university programme without graduating. But as educators and researchers into education, the efficient cause is the one that is most interesting simply because it is the aspect of cause that is concerned with conditions that we can best control. Also, efficient causes concern aspects of cause that most readily inform issues of academic and social integration, which according to Tinto (1993) are all-important factors in attrition and retention. Note, however, that the research strands of ‘assimilation’ and ‘institutional services’ seem to focus mainly on material causes: who, how, and what the students are.

In the next section, we describe how interviews were performed, and with whom.

The interview as a critical on-going investigation of the interview itself

The students who participated in the interviews we analyse here all studied in a physics programme at a traditional Swedish research university where attrition rates exceeded fifty percent. Parts of the interview study that are reported on elsewhere (see Johannsen 2007), entailed rigorous analysis of individual students’ test results throughout a rather big spread of cohorts.

To allow the possibility for comparing narratives across situated experiences, the first criterion for selecting interview participants was that they started at different years and had performed differently while they were in the programme. In total, seven students were interviewed separately. Based on their grades and time in the programme three of these were students that we had loosely categorized as ‘low achievers’ (they had stayed in the programme for ½ a year, 1 and 1½ years respectively), one was a student that we had

categorized ‘average achiever’ (who had stayed in the programme for 1 year), two were students categorized as ‘high achievers’ (who both stayed in the programme for 1 year) and one student had switched just short of study-start immediately after the preliminary activities, and had thus not ‘achieved’ at all.

As the purpose of the interviews was to get more detailed knowledge about the story behind our statistical analysis, the learned experience from one interview was intentionally carried into the next. In praxis, this meant that the interview participants were effectively invited into a room for reflection on retention and attrition. In this room each interviewee was treated as an expert-informer on the subject, but still reflectively confronted with the cumulative understanding of the phenomenon that the interviewer had attained during other interviews.

To some extent the interview-form can be likened to what Steinar Kvale (2006) has termed a “one way dialogue” (p. 484) in the sense that the interviewer had a set agenda, questioned the interview participant and expected of the participant to answer these questions elaborately. But given our analytical frame, attempts were made to depart from this one-way dialogue and instead actively confront the interview participants with assumptions that were made during the interview—implicitly and explicitly by both interviewer and interview participant. To some effect this is a very different approach to interviewing than is commonly used in standard ‘life-world’ interviews (cf. Kvale 1983). Here, the interviewer will prompt the interviewee to *describe* and continue to describe his or her experiences in depth. The interviewer will never explicitly ask of the participant to reflect interpretatively upon such descriptions because interpretation, parallel to a medical doctor’s diagnosis, is something that is carried out at the researcher’s sole discretion outside of the interview-space, possibly in collaboration with peers (Kvale 1983).

During our interviews, participants *were* asked to engage interpretatively with any assumption caught by the interviewer in order to co-construct with the interviewee a “logical space of reasons, of justifying and being able to justify what one says.” (Sellars, et al. 1997, p. 76). To such an end this one-sided request for deeper reflection gives the interview a character of a critical investigation of the on-going interview. The interviewer validates tentative analyses together with the interviewee. At the same time this validation serves to sharpen attention on certain areas of interest which the interviewer and interviewee can duly react to, thus allowing conversation of a quality that is both important to later analysis, but also important to help empower the interviewee as informant. As Svend Brinkmann (2007, pp. 1123–1124) argues in this respect: “We come into being as reflexive human participants when we are prompted by others to give accounts, account that are given meaning by reference to a social dimension or normativity [out of which] a knowing subject emerges”. To this end, the interview protocol was designed to ensure that a broad spectrum of themes were discussed (ranging from background—place of birth, school and interests, choice of physics and possible alternatives to studying physics, to themes of developing an identity as a physics student—feelings of belonging, being a student, perceptions of other students and of physicists in general). On average, the interviews were performed in 1 hour and 10 minutes (ranging from 30 minutes to 1 hour and 45 minutes).

All interviews were conducted in English because the interviewer was Danish and the participants Swedish. This choice ensured that both interviewer and interviewee were almost equally conversationally proficient. Thus, the citations used here are not translations, but verbatim transcripts of the conversations. As will be evident in the text a peculiar type of English develops between Scandinavians who speak English with each other. Instead of a distraction, it should be considered characteristic of the interview Discourse that is utilized for this study. All names used are pseudonyms.

The interview data have been analysed in various ways and for different purposes several times. For this paper, the interviews were analysed thematically (see Braun and Clarke 2006)—at certain stages using ATLAS.ti, which is a computer software designed to assist qualitative analysis. This process of thematic analysis began already while interviews were conducted. The interviewer expected that the interviews would revolve around aspects of teaching and learning experiences related to the informants' decisions of leaving. Instead students typically seemed to reason introspectively when they explained their decision. Consequently, the first round of coding the transcribed interview-data was about identifying introspective reasoning. The next step in the analysis entailed sorting this introspective reasoning into particular 'types' of reasoning. One 'pile of typical reasoning' grew surprisingly large, and on discussing the nature of this type of introspective reasoning we realized that the type of causation used here, was characteristically similar to Aristotle's description of the material cause. Consequently the whole dataset was revisited using ATLAS.ti to code for all of Aristotle's four causes.

In the next section, we utilize the outcome of the last stage of the thematic analysis of the interviews to bring out some of the other possible interpretations these interviews offer by introducing the extra layer of illustrative interpretation that Aristotle's four causes offer, and contrast these to the interpretations that are overtly accessible in the interviews. The purpose of bringing out this contrast is to show how the 'integration' and 'institutional services' strands in research on attrition and retention fall short in relation to finding reasons and cause for attrition.

Introspective discourse on reasons and causes for choosing to leave

The interviews that are analysed here were planned based on the premise that students' decision of leaving the physics programme is a decision based on experiences of participating in physics courses and on interaction with peers and teachers in the programme. During the interviews the interviewer soon felt that students resisted talking about such external conditions that might pertain to their interaction with the institutional setting of the physics programme. Instead they crafted their arguments introspectively on aspects of their selves—mostly pertaining to what they were personally lacking relative to physics learning. In terms Aristotle's four causes, this means that only one type of cause was applied by the students to describe their choice of leaving the physics programme: the material cause. Continually the students somehow managed to waylay the conversation to make it about themselves, their own lack of interest or lack of hard-headed endurance instead of allowing conversation to run along the lines of, for example, the ways teaching was performed or ways in which physics-problems were or were not presented in engaging ways. As mentioned in the previous section we soon realized that this was a particular phenomenon, characteristic of the way these students position themselves in relation to their decision to leave. A phenomenon, which to the interviewer would resemble a discursively impenetrable wall of introspection. The students would readily talk about how and why they could not meet institutional requirements, but resisted speaking about ways in which the institution did not meet their needs.

This situation is perceived as evidence of a certain kind of sense-making or logic that is evidently infused with the Discourse particular to these interviews. This logic is one that we will penetrate in the next subsections. First, it is identified. Second and third, two central particulars of the Discourse are presented and analysed.

It is important to note that when we penetrate the logic and challenge the students' reasoning, we do not do so claiming that the causes the students give are 'wrong' nor that suggestions of other possible (e.g. efficient) causes are more 'valid' or that there is such a thing as one 'objective' causal explanation. On the contrary. We believe that the *purpose* of the explanation is very important, and that it determines which types of causes are meaningfully emphasized. For the students, it is important to construct an explanatory framework that supports their identity building and meaning-making—which becomes the premise of their replies. For us it is important to construct an explanatory framework that can support quality development of educational programmes and other types of institutional support in order to better facilitate academic integration—which in turn was the premise of the type of interview-questions that were posed.

Material cause: destiny

Characteristic of all the interviews is that students kept to an explanation for their departure that was contained within their self-story—i.e., a story contained through introspection. Below is an example of this introspective theme that was approached by the interviewer from a variety of angles placed externally to the student, trying to look for different types of causes, during the interviews, but which inevitably led to the same family of conclusions, namely those that has to do with something internal, something within the self:

I: was there like an incident or something that happened?

Susan: I just realized I wasn't interested in that. I was beginning to be more and more interested in languages, and less and less interested in physics. **(5.1.1)**

In Susan's case, her final conclusion is that while she found herself gradually becoming more attracted to studies in the humanities, she also found her interest for physics diminishing. This explanation is very much in line with Arne Mastekaasa and Jens-Christian Smeby's (2008) find, from which they posit that instead of focusing on explanations for female students' drop-out from male-dominated programmes, one would instead benefit from asking "why they are so strongly attracted to the female-dominated ones" (p. 200). So let us briefly revisit Susan's story.

Susan's story is one of solitude. She started studying physics, forming a tight group with a few people she knew from home. But they were quick to leave the programme and the city, and she was left to her own devices. These did not suffice. She did not look for new friends in the programme, and on her own she soon had difficulties finding meaning and purpose in her studies. This left her wondering, and as she remembers, she started studying physics because of a deep philosophical interest.

When Susan ascribes cause to her decision of leaving (transcript line 5.1.1) she does it with reference to some type of interests-alchemy that transforms one kind of interest into an entirely different interest. Contrary to Mastekaasa and Smeby's (2008) suspicion, Susan's argument is not crafted around an experience of neither push nor pull. It is crafted around a perceived change within herself.

Left to her own devices, and to some extent isolated, it does not seem unreasonable that Susan looks within to find cause. Yet, a different student who was deeply involved with a great number of students in his year ascribes cause in much the same way. He also emphasizes that the students individually will have to come to terms with themselves if they want to succeed in the physics programme. Below the interviewer is attempting at introducing the notion that maybe the structural is also a cause for attrition, i.e. prompting an exploration of causes other than the ones pertaining to the students' themselves:

- I: but there's just the difference between physics here and a lot of other educations. I mean every second student don't make it. And that's really high, and I mean, that's peculiar
- Clas: I guess so. I don't think it's. I'm not a, I don't... I think it—every second did you say?
- I: mhm. Yeah fifty percent
- Clas: Fifty. That's good I think, hehe
- I: Yeah?
- Clas: yeah... if fifty percent of the people I studied with make it, then I... I must say I think that is good
- I: okay?
- Clas: You have to try if you are interested and they want to try it, but then, you can't... I feel that you can't just say that something is wrong with the education because you can't manage it. Then you are just meant to do something else. Because it is hard...
- Clas: I think that fifty percent, I mean a lot of people have to... try it to just come to the conclusion that you are not meant to study it, so... (5.1.2)

Here, Clas gives three reasons for attrition. One is personal interest, another is the inherent 'hardness' of the programme, and a third is something that resembles destiny, but which is obviously connected to his notion of how personal interest can be explored in interaction with the field to see "if you are interested". According to Clas, trying to see if you are interested is a permissible behaviour characteristic of learning physics at university. We are reminded of the "trial like fashion" of enrolment that Niels O. Andersen and Kjeld Bagger Laursen (2003, p. 65) identify as a central cause for attrition. Clas expands this notion and explains that since the field of physics is inherently harder than other fields, high attrition rates are inevitable when interest is explored in interaction with such a difficult field. But contrary to Andersen and Laursen, who believe that only some students do so, Clas is of the opinion that this sort of exploration is a type of behaviour characteristic of all students in his year, necessary for all to find out if they are "meant to study" physics.

The exact same concluding figure, although somewhat condensed, appeared in the interview with Anita, a third participant:

- Anita: the next autumn I decided to drop out. I didn't know what to study, but I understood that physics wasn't something I was meant to study—at least at that point. (5.1.3)

It is important to the interpretation of this quote that Anita hesitates at the end, adding "at least at that point." It is a strong cue to indicate that her outlook was different at a different time—a cue that speaks straight back to Clas' sentiment (transcript line 5.1.2) that whether you are 'meant to' study physics or not, is a conclusion you reach by confronting the discipline, and sensing your own reaction.

In an attempt to avoid introspection, by suggesting a new premise for the conversation, the interviewer attempted to approach the problem of attrition by invoking a third person perspective in the interview with a fourth participant. Below, Joanna was asked to reflect on experiences of a particular friend who also opted to leave physics early:

- I: Do you remember why he stopped studying physics?
- Joanna: I don't think we ever discussed it actually. We just... it just wasn't for him. (5.1.4)

Interestingly the resulting answer is that “it” did not suit Joanna’s friend, which could be considered an opening for discussing what aspects of “it” did not suit her friend. Notice however, how Joanna contains the finality of her explanation with the word “just”. The interviewer’s attempt at qualifying statements like these, most often resulted in exasperation on the student’s part. This exasperation is particularly obvious in this next quote, with which Clas finalized his interview:

- I: do you think that there’s anything we missed? Something that I should know?
 Clas: No, I don’t think so... Guess you asked the questions that you need. But... I don’t think, ehm... Oh, it’s so individual. Some people make it, some don’t. It’s just... You can’t say that there’s something wrong with the courses or with the pace, because some people make it. Maybe you are not meant to study that. Maybe they are... So I wasn’t angry because the pace was too high. Or because I didn’t understand it. Maybe... then you just. Yeah, think that maybe I should study something else. It’s not... someone else’s fault. Because some make it. (5.1.5)

As he indicates, and as was also illustrated by transcript line 5.1.2 previously, the interviewer has been introducing a variety of alternative causes to the ones Clas had been utilizing in explaining his decision to leave. Here, Clas uses this last chance to explain himself properly and emphasize the finality of his experience: some make it, some do not. If you do not make it, you are not meant to. If you are not meant to make it, you will not. This might be a sufficient explanation to both the students who stay, and those who leave; and also to Rhys Davies and Peter Elias (2003) who list “mistaken choice” among the most prominent of causes for attrition. But to an interviewer who attempts at penetrating the process and the interactions that lead students to reach such conclusions, insistence on this limited application of cause is unsatisfactory. If we compare with Aristotle’s four causes we understand why. It is because the students limit their explanation of cause to emphasizing the material cause.

Material cause: ability—to estimate one’s capability

Characteristic of the way students model their Discourse on leaving is their use of a notion of ‘ability’, which is another cause, but also a material cause. In this section, we will show some examples of the ways this notion is used by the interviewed students to construct causal relations between ‘ability’ and the decision of leaving. The examples are not chosen to further emphasize this find, but because they serve to represent various ways in which students talk about ability in relation to their experience.

We start with Thomas who had changed from studying in the physics programme to studying in the mathematics programme. As the two programmes overlap it is arguable whether such a slight shift actually constitutes attrition or if it is more an act of specialization. But listening to Thomas’ story it appears to be a matter of the former in that the shift is more an issue of having misinterpreted formal requirements than a question of a conscious choice.

Thomas started studying physics because he wanted to work with theoretical physics. He knew that he thus needed to also become an expert mathematician and opted for a strand of more advanced mathematics than the standard offered during the introductory years. In this strand, two introductory and compulsory mathematics courses had been merged into one (i.e. algebra 1 + 2), and a series of extra lectures were offered instead of problem-solving sessions. But Thomas had difficulties with this merged course, and gathered from his impressions of the physics course that he could prioritize mathematics

without seriously jeopardizing his chances of passing physics. As it turned out, he could not, and at the end of the year he decided to take a regular mathematics examination (i.e. algebra 1) instead of the merged exam. He passed the mathematics, but failed physics—and suddenly, instead of having passed more courses than required, as he had planned, he was now behind in his studies. To remedy the situation he tried to pass the algebra 2 course on his own. This did not go too well either. Thomas explains his take on the situation:

Thomas: pff, well, I, maybe I was just too self-confident. Like I thought I had an idea [a plan], so I just studied this book, I had no teacher. And at one end, well, I just thought I knew more than I actually did. (5.2.1)

Here, Thomas uses ‘having no teacher’ to characterise his situation. To explain the cause of deciding to take the examination without following the course a second time, he explains that (1): he made his decision because he was too self-confident, and (2): that this self-confidence arose from ‘thinking he knew more than he actually did.’

We turn to another quote in the interview to get a better sense of what gave Thomas his “idea”. Below Thomas expands on it in relation to his decision to prioritize mathematics over physics and to continue applying himself to pass these mathematics courses:

Thomas: well, I thought I had an idea after all. I had attended the lectures and everything, and I knew that they didn’t think that mechanics was that terribly difficult. So, well, I still had the idea that I could take the physics. But I think the main reason that I didn’t, was that there seemed to be some interesting math courses that I wanted to take. (5.2.2)

At the beginning of our treatment of Thomas’ experience in the physics programme we argued that Thomas’ shift from physics to mathematics was more a result of misinterpreting institutional requirements (and thus a case of attrition) than an act of specialization. Above however, Thomas seems to be of the opinion that the latter is the case, that ‘the main reason was that he wanted to take interesting math courses’ (where his interest in mathematics is considered a material cause).

Holmegaard, Ulriksen and Madsen (2011) give convincing evidence that the process of choice—for instance the shift between one programme to another—is an on-going negotiation of intersecting spheres of interest, which work harmoniously at the subjectively present but might appear as if conflicting when viewed over time. In praxis, this means that we, as humans, remember and emphasize what interests us in an ad hoc manner in which we make meaning of the past based on our knowledge of the present. This ensures that we feel in control of our lives (cf. Bruner 1990). In accordance, we acknowledge that at the time of the interview with Thomas, his choice of studying mathematics is perceived by him as an act of specialization. But, as Thomas also indicates in the quote above, it was not always an act of specialization, since he initially intended to catch up with his aspirations regarding mathematics before he continued his studies towards becoming a theoretical physicist.

For Thomas, this way of constructing causality is fully functional and probably also very satisfying to him. But from the perspective of someone who wishes to gain insight into the interactions between students, institution and content, we will need to turn our focus back to the cause of Thomas’ “idea” or ‘plan’. Above we are led to know that this idea has its origin in Thomas’ interpretation of the lecturers’ perception of the content—‘they said mechanics was not difficult.’

Thus, a researcher who is interested in understanding causes of attrition in an interactions-perspective could use Thomas’ story as a cue for turning attention to the aspects of

introductory physics that downplays the importance of physics content—“I knew that they didn’t think that mechanics was that terribly difficult”—compared to, in this case, the mathematics content. It seems that such aspects confirm students like Thomas in emphasizing other aspects of their difficulties in such a course, than what has to do with the course itself. In the case of Thomas, we see that he turns to emphasizing that his main interest was in mathematics, and that the main reason for not passing his physics and mathematics courses was his inability to properly judge his own capacity as a physics and mathematics student. This capacity or ‘ability’ of his is essentially utilized by Thomas as a material cause for explaining the unfortunate events that, contrary to his original beliefs when he chose to study physics, allowed Thomas to experience that mathematics “was more abstract and interesting than I had thought it would be. That it was what I was searching for in some sense. [That] I liked it very much,” as he says at an early stage of the interview. Of course, we need not be anything but happy for Thomas, but we still need to be suspicious of aspects of physics teaching that downplays the importance of the physics contents; because as we see, when students are involuntarily confronted by systemic contradictions (as is a physics lecturer who tells his students that physics is easy) they tend to interpret the situation in terms of personal ability or endurance (see next subsection).

We find the same kind of basic pattern in the interview with Joanna who decided to attempt passing the mathematics examination by studying on her own. Joanna started studying physics because of an interest in astronomy. But she is struggling—on the motivational level but also on the very apparent level. She cannot pass her mathematics course, and she takes this as a sign that she, as a student, is incapable, and not as a sign that her learning needs to be facilitated through instruction. Instead of attempting to reinforce her motivation by moving on to the astronomy course, she lingers with the mathematics course and is of the impression that she needs to pass this course before anything else can happen:

- I: ...then you decided ‘now I’m gonna go for the exam’?
 Joanna: yeah, because I really liked algebra, I just
 I: you did?
 Joanna: Yeah! I really liked it! And I wanted to pass. But apparently I didn’t. So maybe it was too difficult for me
 I: well... if you only studied the two first months...
 Joanna: But I had the book. So I expected to pass on the book
 I: But why...? Why didn’t you do anything? Or sorry, but I mean why? You had a chance to take some astronomy courses I bet, after autumn, or after Christmas
 Joanna: But I have to pass the math first as well. Or anyway, so... (5.2.3)

Although Joanna had not opted for the more advanced mathematics strand as Thomas did, Joanna was also of the impression that she should be able to learn mathematics alone. Unlike Thomas she did not realize that she might have chosen an unwise alternative strategy. Instead she uses the experience to explain how she realized that she did not have sufficient ability. The interviewer even suggests that given her lack of effort (“you only studied the two first months”) other aspects than ‘ability’ could be a cause for failing. But Joanna maintains that since she had the book, she expected to pass. Penetrating the logic of this statement we see that Joanna and a book, is what it should take, for Joanna to pass an examination. If she does not, there is only the book or Joanna to blame.

The interviewer then goes on to suggest that gaining a broader perspective on the programme by taking an astronomy course would also be a viable attempt for regaining the motivation she needed to study in the programme. Joanna denies this: “I have to pass the math first”. To Joanna passing mathematics is a structural requirement she has to abide to, and nothing but the book mediates her learning of mathematics. Hence, as a reason for failing, there is nothing or no-one left, but Joanna herself.

True, it is a requirement in the programme that the students pass the mathematics course before they move forward and take new courses, but although the sentiment might seem reasonable from an administrative point of view, failure at an examination, whatever examination, does not have to be cause for leaving. Students do however interpret these experiences differently, and those students who are able to perceive of failure as an invitation to attempt different forms of participation fare better than students who focus on the aspects of these experiences that constitute a formally designated exclusion (Hasse 2007). Joanna’s sole interpretation of her failure is that it constitutes a formal designation of lack of ability and she decides that she will have to leave without ever taking any of the courses she originally enrolled in the programme to take.

Compared, Thomas’ and Joanna’s stories are markedly different. Thomas moved on in a way that to him resembles specialization, while Joanna left the institution entirely. Thomas was not put off by failing his examinations, but moved on to other courses that he thought were interesting, expecting to return to the failed courses later. Joanna took the rules and regulations at face value and was stopped by her immediate inability to pass the mathematics course. By comparing the two stories, it would be possible to gain further insight into how structural boundaries specific to the institution are perceived and dealt with by different students.

We return to Anita who found out that ‘she was not meant to study physics’ (transcript line 5.1.3). She also failed an examination. But in retrospect, she figures that at that point she was in a state of denial:

Anita: I didn’t want to accept the fact that I was going to fail. So I tried not to think about that, which meant that I didn’t actually handle it as I perhaps should have. (5.2.4)

We get the sense that Anita, just as Joanna, could see no viable alternative to passing the examination. Had she been able to see one, she might have been better equipped to “accept” that she was going to fail, and thus try different ways of approaching her impediment. As it was, she was unable to, did not and concluded that she would have to leave the programme.

In this section, we have seen how students use the notion of ‘ability’ with respect to the content of the discipline and to formal requirements. By approaching their stories as Discourse models that can be analysed to penetrate the implied and taken for granted truths, one is allowed a glimpse through the wall of introspection, into how their interactions with the institution might also add to the cause for their experience in the physics programme. Generally we see that the students feel like they had decided on an unsuccessful approach to their studies, because they overestimated their own abilities. It is important to add that the extra interpretational layer reveals how efficient causes, with respect to students’ (misplaced) interactions with the institution, are also important factors that add to explaining this estimation at a level that can be addressed at the institutional level.

Material cause: ability—to pull through

Sometimes ‘ability’, in terms of ability to understand or learn, turned out to be insufficient to explain early departure. This was especially the case when the interviewer asked the participants to compare and contrast different experiences that came up during the interview. In some of these instances, the interviewed would extend the notion of lack of ability to also include lack of ability to ‘pull through’: an inherent lack of ability to commit, be motivated or desire. In this section, we will explore this aspect of ‘ability’, but also explore how ‘ability to learn’ relates to the ‘ability to pull through’.

We begin by demonstrating that the ‘ability to pull through’ also has a causal-efficient dimension, much the same way ‘ability to learn’ has.

During the start of the interview Marie explains that she decided to leave the physics programme when she realized that she would not be able to compete with the other students in her year. To finish would thus be pointless, she explained, since she would have difficulties getting the job she wanted. As the interview continued, and Marie’s experiences as a student in other programmes were explored, Marie realizes that her initial thoughts on leaving were probably premature:

Marie: if I had wanted to do it, I would probably have gone for it anyways, right? I mean, I wasn’t the best person in my class in English class. I wasn’t, I’m not the best person in my health and sports-science class, for sure. But... **(5.3.1)**

Marie’s initial way of constructing an explanation was very much in line with the other students we interviewed. It was about ability to understand and learn. But what Marie realizes above, is that had she asserted herself differently, she might have been able to learn physics. But during the interview, she explains that she was not sufficiently interested to ‘want’ to make the effort necessary. Here, ‘inherent ability’ is turned into ‘inherent ability to will a result’ or to ‘desire it’—but given the inherent quality of her desire, she still applies cause to her argument in the form of material cause. This is also the case when David Allen (1999) links desire to academic performance and persistence by conceptualizing the notion as an innate ability, a precollege variable along with academic ability, which to Allen translates into an issue of knowing “why am I really going to college?” (p. 467).

With the following three quotes from the interview with Clas, we exemplify how this relationship can be interpreted in different ways. The first quote starts where Clas explains that his decision to take a break away from the programme was due to his perception of the pace in the programme. Instead of allowing this perception to be the basis for a critique of the programme, Clas insists that his experience was purely subjective, and thus cannot be used to characterize the physics programme:

Clas: [...] I think the speed was too high, too much
 I: But what kept you from getting angry and saying ‘what are you doing? It doesn’t make sense!’ for instance?
 Clas: No I th.... well... yeah because some students did manage the speed, so I guess it wasn’t me that just ehm... You know people, people can do. Some have it very easy to learn, and some have it harder. I don’t think I have it hard to learn, but I... well I don’t know.
 I: But you are not among the best or the fastest learners?
 Clas: no **(5.3.2)**

Just previous to the beginning of this quote (transcript line 5.3.2), Clas was explaining how he had a feeling that he needed more time to really understand, that he needed to slow

down a bit. The interviewer then asks about the particulars of the situation, asks why he did not complain about not having enough time; i.e., why Clas did not attempt at finding explanations external to himself. Clas replies that people are different, saying that understanding is about ability to learn, and that some people learn more readily than others. In effect, Clas refuses the viability of the notion that the pace was generally too high. It was merely too high for him.

We know from the literature (cf. Ramsden 2003) that subject matter abundance and the experience of a fast pace, like Clas describes it, are factors that encourage students to use surface learning approaches. The learning environment thus presents itself as a viable alternative cause, an efficient cause, for Clas' experiences: the high pace characteristic of the learning environment did not allow Clas room nor opportunity to engage the way he values. But Clas will not accept this alternative cause:

I: [...] Why should they [the students who cope with the pace] set the standard?

Clas: Well... ehm, yeah you are absolutely right, and I don't... But at the same time you have to get, there has to be meaning with the course. If it's said you are gonna learn this, you can't say 'No, because I can't'. Then there is no point in...

I: Exactly, and that's what I mean. What goes into the consideration of deciding the pace? I mean, I don't think they just look at the best and say 'OK, they are hanging on, so we can continue.' There must be something that decides what, something that makes you think that it is reasonable to have that pace

Clas: OK. I think maybe if I had kept to the studies, maybe then I had understood what they did 6 months ago, after working with it. Working with things besides and so on

(5.3.3)

Like Joanna in transcript line 5.2.3, Clas constructs an argument based on the necessity for accepting his notion of what is entailed in the structural constitution of the discipline. One aspect of the way the discipline is constituted is apparently the pace. But when he is asked to attempt at explaining what considerations might have gone into deciding that pace, he changes the subject. The reason for this change might very well be that Clas does not accept the question's premise, that pace is somehow decided upon. For Clas' Discourse model to be consistent, it is necessary that pace is an inherent aspect of the discipline, the structural: unquestionable and inadaptable. The interviewer in turn suggests that the discipline and the way it is taught is a construction based on student-institution negotiations, and that the discipline thus might have been adapted to certain kinds of students, who are either faster learners or willing to adopt surface learning strategies. Instead Clas changes the focus of the conversation and states that his lack of ability to cope in this particular environment was due to his lack of commitment. Following this line of argumentation, the interviewer tries to track the source of this waning commitment:

I: You said that the pace was too fast for you, and that sounds like you decided that you couldn't keep up with that speed, so you had to slow down a bit?

Clas: Yeah, exactly. I think it was during the summer, when I started working, I decided to take a year off and... let things fall in a bit... but then, ehm...

I: Okay, how did you expect things to fall in? Did you...

Clas: No, maybe I just... no maybe not like that... that I will wake up and understand what I have been doing. Not in that way, just that ehm... I don't know really... ... maybe I just thought that I needed new, ehm... Just rest a bit to get more strength to come back and continue...

(5.3.4)

As we see, Clas interprets his lack of commitment as a lack of strength; something that was lacking from within himself. He starts out by attempting to explain that he just needed a year to let what he had learned fall into place. The interviewer hints at the peculiarity of the notion that you learn physics by distancing yourself from it. Clas does not attempt at explaining this, but instead he elaborates his sentiment by saying that it is about “strength”. He needed to rest to regain some quality of his, without which he could not function well in the physics programme. It is also worth noting how he describes the programme as quite relentless and immutable, and that he considers the programme ‘black-boxed’ much the same way it is in the two research strands of assimilation and institutional services.

One student describes how the ability to perform and the ability to pull through can be seen as related: in case you do not possess the needed abilities, you must exert yourself better or more. If you do not have what it takes to muster this exertion, you leave. This sentiment is apparent in the interview with Karl, who is the seventh student that was interviewed:

Karl: [...] it should be possible for most people [to study physics]

I: In terms of archetypes, do you think that there is something that, I mean, a quality that you have to possess to be able to do well in physics?

Karl: No I don't think so. I think you have to have the qualities that all people have to have to succeed. I mean, I don't think you have to be brilliantly smart. I think you can compensate by working very hard for example. [...] So I think you have to choose to be good in physics, you have to believe that you can do well in physics. And if you believe you can do well in physics and want to do it, then you can. **(5.3.5)**

Clearly Karl describes the situation in terms of the material cause: in terms of qualities that people either have, do not have or choose to have. His sentiment, although turned on its head, is related to Sheila Tobias' explanation of mathematics anxiety: “Confidence in mathematics, especially among females, is not a necessary outcome of exposure to the subject or even of achievement in it. Instead what appears to link students of very diverse mathematical ‘ability’ is a collection of what might be called ideological beliefs or prejudices about the subject” (Tobias 1985, p. 62).

Karl's idea is that everyone can do it, if they choose to believe they can. In the previous subsection, we saw that students have difficulties estimating their own ability and in this subsection we have seen that it is hard for students to ‘will’ a belief that they can, once they have experienced that they cannot. When asked, Karl is of the impression that “at this university they were pretty good at bringing everyone along.” But then again, Karl tells that he did not leave the physics programme because he experienced difficulties. He explains that he “wanted to work with people.” Also, the sentiment implied by Karl's Discourse above is that if you do not “choose to be good in physics” you will not be able to be good at physics. If we wanted to further our understanding of this sentiment, we would have to ask what prevents students from making such a choice. Because in all fairness, we cannot reasonably expect that students who start at university have decided from the outset that they do not want to be ‘good.’ Marie for one was a student who had not, and Anita (transcript line 5.1.3) hints at also having come to believe that she could not become ‘good’ after she was exposed to the programme.

A place to start looking to find what make students believe that they are inherently deficient is to look where the students look first: the introduction to their first physics textbook. Here, it says:

Listening to lectures is not enough. All processes of learning are somehow connected to active participation, and the learning of physics is no exception. To underline this viewpoint we have, at the beginning of the course, always written on the blackboard, as a kind of motto: *At Home, by Your Desk*. Nearly all the chapters in the book are followed by a set of problems. Very few of these problems are simple “plug-in” exercises. Most problems will demand some independent thinking. If you cannot solve all the problems at first try, do not despair. We have good advice which has worked for many students: study the text, and in particular the examples, one, two, ... many times over. In the end you will succeed. (Knudsen and Hjorth 2000, p. VII, emphasis in bold and italics in the original)

Obviously, the authors got the concept of “active participation” wrong (cf. Laws 1997)—they seem to equate active participation with individual reflection. They emphasize “independent thinking” and stress that independent work is something that is done in solitude, at home—not at the university.

If this way of thinking about teaching and learning permeates the environment in which our interview-participants had once studied, then we come to understand their reasoning a great deal better. Clas wanted to stay at home, away from the institution, in order to let the physics fall into place. Thomas and Joanna both thought that they were supposed to be able to learn by studying the book alone. Clearly this was a strategy that did not work well for these students. Marie left because she apparently thought that she needed to compete against the others, on her own, and thus positioned herself in opposition to the aspect of the university-experience that is about social interrelations. Susan was left alone, and did not fare well at all. Both Anita and Clas thought that everyone needs to confront physics, to see if they are “meant to study it” (transcript line 5.1.2 and 5.1.3).

They all insist that the main cause of their departure has to do with themselves, their abilities, internally, individually. Only material causes are suggested and accepted.

Now of course, had we taken the students at their word, we would have come to understand that they had chosen the wrong programme, that they did not have sufficient abilities, and that they were not sufficiently motivated—precisely as the ‘institutional services strand’. But alternative causal explanations than those that are explicit in students’ narratives exists. By exerting ourselves in interpreting interviews focusing especially on efficient causal linkages between students’ experiences of their participation in their field of study and attrition they become evident. These linkages, in turn, translate into institutional circumstances that make academic integration difficult for the students. Now framed as circumstances that also resides at the institutional level, student difficulties are accessible to institutional planners, teachers etc.

The case of mistaken agency: it was the institutionally and culturally embedded discourse that did it

In this paper, student discourse on attrition in university physics is critically analysed as it unfolds in seven interviews about causes for early departure.

We start with a critical overview of attrition and retention literature and find that it is necessary to take on a perspective of attrition and retention conceptualized as an issue of ‘interactions’: an issue of possible mismatches in the interplay between student and institution. We use a discourse analysis framework that emphasizes the constructed, taken-for-granted aspects of discourse in order to penetrate this interplay, and add to this

Aristotle's four causes as a layer that illustrates our interpretation. We find that students make use of an 'introspective Discourse' to explain all aspects of their departure. They insist that their reasons for leaving only pertain to themselves: their lack of ability, lack of strengths, lack of persistence, or how they are or were meant to be. These reasons all refer to one type of cause: the material cause.

Compared to Seymour and Hewitt's study of attrition and retention in science, mathematics and technology college education in the US, this is a peculiar result. To craft the argument that all students have similar experiences but different reactions, they compare interviews with switchers and non-switchers and find, for example, that 90 and 74 % respectively complain about "poor teaching by SME faculty" (1997, p. 33). As stated above, we find that students do not complain about teaching or anything teaching related, and we cannot help but wonder why. It might be a matter of different cultures (e.g. US commodification of education versus Scandinavian massification of education). Had it not been for the fact that Seymour and Hewitt's results echo through space and time, it might have been just a matter of different times. In 1976 Briggs reported that disinterested Australian students "blame the way [physics] is taught" (p. 487), and so did researchers from USA in 2005 (Perkins et al. 2005). In a paper from 1999 though, Andrew Elby, also a North American physics education researcher, notes (with a reference to Seymour and Hewitt's study) that students who learn by rote and consequently experience difficulties on physics examinations, do not attribute these difficulties to an inadequate learning strategy. "Instead [they] take home the lesson that the test was unfairly difficult or that they're just not good at physics" (p. S56).

In sociology, however, the phenomenon of self-referential reasoning has long been recognized as a symptom of individualization. Ulrich Beck (1992, p. 136) argues that in the individualized world the only viable reaction to any systemic contradictions is the biographical solution: "an *ego-centered world view* ... which turns the relation of ego and world on its head, so to speak ... The institutional conditions that determine individuals are no longer just events and conditions that happen to them, but *also consequences of the decisions they themselves have made*, which they must view and treat as such" (emphasis in original). Likewise, but from different perspectives, Nikolas Rose (1999) talks about the individual as incorrigibly self-governing, and Pierre Bourdieu about symbolic violence as the social mechanism that ensures cultural reproduction whilst rendering the individual unable to specify precisely the cultural processes through which (s)he was reproduced (cf. Jenkins 2002, p. 130ff).

As educational researchers, we are interested in getting at aspects of the students' educational experiences as they pertain to the institution and the institutional setting and especially as they pertain to issues of what Tinto (1993) terms 'academic integration.' In interviews, one therefore tends to emphasise a focus on issues that relate to the efficient cause. We found that students on the other hand focus on the material cause. When these different perspectives confronts, it appears as if the interviewed student builds a 'wall of introspection' that is impenetrable to the interviewer who searches for efficient causes. But considering introspective reasoning a reply based on a premise that is different to that of a question that assumes all learning experiences ultimately externally rooted in action and interaction, we find that by being sensitive to issues of internal consistency in the way students model their discourse introspectively and link reasons for leaving with causes for leaving, the researcher is allowed occasional peeks through this wall of introspection. Such peeks reveal some of the institutional deficiencies that may lead students to opt out.

It must be emphasized that the argument we make, is not that the large attrition rate characteristic of physics programmes (and mathematics, technology and many other science programmes) are necessarily bad because they are large. Instead, we argue that even if

students who opt out of physics confirm that they do not meet the ‘idea of the good physics student,’ this idea might still not be a good idea at all. Seymour and Hewitt (1997) provide evidence that the difference between students who stay and students who leave is their ability to cope. Since it would be a mistake to assume that a student’s agency in coping equates to learning, we owe it to both the students who stay and those who leave to work hard to ensure that institutionally and culturally embedded ideas about how students ought to act and be are justly biased and aligned reasonably with the scientific practice that their education is supposed to prepare them for. It bears repeating that it simply does not suffice to base such notions solely on what kinds of students do and do not choose to continue a career in our disciplines (Tobias 1990).

Ultimately, we see no reason not to extend the same sentiment to all university education, why we strongly recommend for researchers and teachers involved with any evaluation practice that includes student testimonies, to take into consideration that young people of late modernity societies might make use of introspective reasoning by drawing on aspects of cause that pertain to the material cause only. Therefore, if one wishes to gain insight into issues external to the individual student that might be addressed at the institutional level, interpretation needs to be performed accordingly. This paper presented and discussed an example of such an interpretational analysis.

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