UNDERSTANDING STUDENT SUPPORT IN TRANSITION TO HIGHER EDUCATION: MATHEMATICALLY RELEVANT TRAJECTORIES IN ENGLAND AND NORWAY

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ABSTRACT

We examine the measurement of many pedagogical and learning components of students' transition into Higher Education, drawing on our projects of transition to mathematically challenging courses in UK Higher Education and an extension of this work in Norway. We highlight alienation and engagement experiences because we think they can provide a more comprehensive understanding of what students are learning. Our research is based on long-term surveys of students starting various programs at universities in the UK (N = 1778) and Norway (N = 721). The Rasch measurement framework is used for validation, which revealed issues in establishing measurement invariance. Subsequently, a cross-sectional study of the two datasets showed recurring trends in the alienation from mathematics process as well as some systemic mechanisms that may mitigate it.

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I. INTRODUCTION

It is well documented that very few students are well prepared and well disposed to continue their studies in mathematically-demanding courses in Higher Education (HE) institutions (for more details see Roberts, 2002; Smith, 2004). The aim of the TransMaths projects (www.transmaths.org), both in the UK and in Norway, was to understand how students can acquire a mathematical disposition and an identity that support their engagement with (mathematics in) Science, Technology, Engineering and Mathematics (STEM) courses in their pre-university and university education. In particular, we investigated how students' experiences of mathematics education practices interact with background social factors to shape students' self-identity, dispositions, learning outcomes and their decision-making in college and in transition into HE. In this paper we further explore the process of alienation through empirical quantitative evidence during students' transition. This relates to our earlier work, where we found evidence of a negative effect of transmissionist teaching on students' mathematics dispositions at the end of their pre-university courses, (Pampaka et al., 2012) which for some students meant deciding not to go into STEM subjects.

There are different reasons to support our rationale for investigating the English and Norwegian cases. Both are considered as highly-developed European countries, and 'rich' arguably due to their oil production and related industries.

However, there are interesting societal and educational level differences which make such a comparison relevant. It can be argued that

the UK is a relatively non-egalitarian class society, in which 'equity' is of mainly 'rhethorical' priority, but in practice schools prioritise attainment and league tables, which arguably militates against the 'priority' or equity. Norway, on the other hand, is regarded as one of the most egalitarian countries in Europe, where education is free, at all levels (including university education). Itis mandatory from grades 1–10, and everybody has the right to secondary education at grades 11–13. Elementary school (grades 1–10) follows the model of 'enhetsskolen' (one school for all). This means that there is an inclusive attitude, a wish to include everybody, and that everybody should get the same educational opportunities, and hence get the same opportunities to pursue HE and suitable careers. This can be seen in the light of strong social-democratic political traditions which have dominated Norwegian politics since the 19300 s, even in periods of conservative/coalition governments. Universities and university colleges are, with few exceptions, state—funded and students pay no tuition fees.

Norway is probably one of the richest countries in Europe (it was one of few countries which was able to steer free from the financial crisis in Europe in the 20000 s), and it still has a growing economy with high demand for labour force, in particular in engineering and other high-skill areas, including academic careers. Students going into HE can thus feel safe that they will get a job, nearly regardless which subjects they choose to study. This is particularly true for engineering, and teacher education, with a relatively similar situation in the UK job market. In the UK, whilst mathematics graduates find it easier to find employment (than other graduates), they typically seek, and find, employment in the financial sector: many mathematics graduates go into the financial sector, to make money as stock brokers, or work for the banks in the City (of London). From our survey it was also clear that UK students study mathematics for different reasons and purposes, and engineering was not the strongest incentive in the UK (Harris et al., 2015; Pepin, Lysø, &Sikko, 2012).

We hypothesize, thus, that the social and cultural differences between the UK and Norway will give rise to differences of perceived feeling of (support or) alienation towards mathematics learning at school and university. A free and inclusive educational system, together with a social democratic and open society, relates to a less competitive and grade focused system at school and university. This is likely to lead to a more respectful environment regarding students' independent learning, and hence to less perceived alienation in the Norwegian system, as compared to a more competitive and class divided UK system

In this paper we focus on students who went through the respective educational processes in Norway and the UK, overcoming barriers, and managed to secure a place in HE. We aim to further investigate the role of pedagogical experiences and support on students' transition into HE, as sources of alienation from mathematics and STEM related topics (or even studying at university), as manifested through associations with disposition measures which we consider as subjective experiences of alienation. This will provide valuable insights into mechanisms for keeping students in STEM subjects, and generally in HE, and hence for students' educational and socio-economic life opportunities (Ball, Davies, David, &Raey, 2002; Boaler&Greeno, 2000). The paper starts with a short overview of the concept of 'alienation' and our conceptualisation of it within the context of this study. We continue with our methodological and analytical framework, and subsequently present results regarding our measure validation, as well as substantive findings with the use of these measures. We conclude with a discussion of our findings and their implications.

II. THE CONCEPT OF ALIENATION

The term 'alienation' is rooted in Marx' work and the notion of 'estranged labour' (Marx, 1844), which essentially builds on relevant concepts from Hegel. In its generic form it refers to "the process whereby people

become foreign to the world they are living in". 1 The term was brought more closely into education through the work of Lave and McDermott (2002) who replaced 'learning' for 'labour'. This interpretation and further implications in (mathematics) education have been extensively discussed by Williams (2015, 2012).

More recently, and taking another perspective, alienation has been linked to student approaches to learning (e.g. for a summary of key concepts in this perspective see Biggs, 2003), with a clear focus on cognitive aspects of student learning experience. However, these studies have been criticised for their limited focus, and scholars have suggested (e.g. Malcolm &Zukas, 2001) that insufficient care has been taken of the learner's social and cultural context. Critics have argued that this represents the student as "an anonymous, decontextualized, degendered being whose principal distinguishing characteristics are 'personality', 'learning style' or 'approach to learning" (ibid, p.38). Trying to address the limitations of the approaches to learning perspective, Mann (2001) suggested an alternative approach: a focus on experiences of alienation and engagement, which appeared to provide 'a broader and more contextualised view on the student learning experience'. Here the notion of alienation refers to a disconnection in the context of a desired or expected relationship; and this is a useful perspective in terms of analysing, and identifying potential relationships of students' learning experiences, and subsequently of examining instances of connection/engagement, or disconnection/alienation. This view is in agreement with Marx's definition of alienation (and recent work in maths education as mentioned earlier).

The literature is clear that the sources of student alienation are varied, including curricular, institutional, and sociocultural factors (e.g. Brown, Higgins, & Paulsen, 2003). Alienated students feel 'disconnected' from curricula and unable to establish meaningful connections. They simply do not see any opportunities for doing so, which often results in apathy in the learning processes. Recent studies describe alienation in terms of student estrangement or dis-engagement from the learning process (e.g. Case, 2008). This perspective has been influenced by the work of Mann (2001) who focussed on student learning in HE, offering some theoretical perspectives which help to understand an 'alienating experience' by considering alienation as the result of:

– the post-modern focus on utilitarianism, functionality and competence;
– the ways in which academic discourse constructs student identity;
– the experience of being an 'outsider' in the academic world;
– a context which requires compliancy rather than creativity;
– disempowering assessment practices;
– assessment practices which impose power and compliance by means of examinations, learning journals, learning contracts, etc.

Case (2008) provided a simpler framework of alienation resulting from three categories: entering HE; fitting into HE community; staying in the HE. This suitably aligns with our empirical position in this paper, since we follow students during their transition and focus on alienating or engaging experiences of learning.

In our more mathematically-focused work we have also previously constructed, and validated for the UK, measures related to students' experiences during their transition to HE. From this empirical perspective alienation is viewed as a process rather than an attribute associated with a student. In this way we deal with what others (e.g. Williams, 2015) classify as subjective experiences of alienation from mathematics and try to objectify these within pedagogical and institutional processes that are assumed to be influencing the former. As our approach is more instrumental, while we acknowledge the distinction (i.e. between subjective and objective experiences), we stay away from this for our operationalisation. Instead, in this paper we attempt to quantify the process of alienation through students responses in surveys and subsequent statistical modelling

of proxies of subjective experiences of alienation (e.g. negative dispositions towards mathematics) accounting for other (perceptions of) experiences during the process of transition to university and related to the pedagogy before and during university that might enhance or alleviate dispositions. This becomes possible with the previously developed and validated instruments (for the UK) that capture students' pedagogical experiences (e.g. experiencing transmissionist teaching), and more generic perceptions of the transitional gap and positivity towards the transitional experience in HE (Pampaka, Williams, Hutcheson, 2012). Building on this work, and its extension to Norway, we thus ask the following research questions:

(1) How can we measure students' perceptions of alienating processes during their transition to HE, related to pedagogical and learning aspects? How can we evaluate the comparability of these measures across two different educational systems? (i.e. can we establish construct validity and ensure measurement invariance?)

(2) How are these measures linked to students' experiences of alienation, such as students' dispositions?

III. THE RESEARCH DESIGN AND SAMPLES

We draw on data from two studies within our TransMaths agenda: the first study, which also sets the methodological framework for the other, was an ESRC funded project2 entitled "Mathematics learning, identity and educational practice: the transition into Higher Education" and took place from 2008 to 2010 in the United Kingdom (UK). The second study, from 2010 to 2012,3 aimed to replicate the established methodology and instruments, developed for the UK population, in the

Table 1
Description of the two samples.

Sample/by Gender	DP1/NDP1	DP2	DP3
UK Sample*	N = 1778 (%)	N = 875 (%)	N = 824 (%)
Female	726 (41)	411 (47)	383 (46.5)
Male	1052 (59)	464 (53)	441 (53.5)
Norwegian Sample**	N = 721 (%)	**NDP2:** N = 563 (%)	
Female	361 (50)	278 (49.5)	
Male	359 (50)	284 (50.5)	

Norwegian educational system. Both studies were methodologically hybrid, mixed methods studies involving a longitudinal student survey (the most relevant part for this paper) and case study work. The UK TransMaths project included three data points (DPs hereafter): at or just before the beginning of students university course (DP1 @ summer/autumn of 2008), later in the first year (DP2 @ February to May 2009), and early in their second year (DP3 @ October 2009 to January 2010). The Norwegian study included only two DPs: early in the first (NDP1 @ September 2010) and second (NDP2 @ Autumn 2011) year of university studies (altogether about 15 months into HE). Surveys were complemented with multiple case studies of HE programmes and students who enrolled on them, following them as they progressed through their transition from the end of their pre-university education,4 or start of university, until about 15 months into their HE studies.

IV. METHODOLOGICAL/ANALYTICAL APPROACH

In this paper, as in our previous work (Pampaka, Hutcheson, & Williams, 2014; Pampaka, Kleanthous, Hutcheson, & Wake, 2011; Pampaka, Williams, Hutcheson, 2012; Pampaka et al., 2013; Pampaka et al., 2012), we have followed the common methodological/analytical framework shown in Fig. 1, in order to guide our way towards responding to the research questions. In particular, the various instruments forming our questionnaires were developed first in English, based on the theoretical background, the research literature and information collected during the projects' pilot stages. A distinctive feature of the work presented here at this stage involved the adaptation of these instruments (after they have been validated for UK) for the Norwegian context. This involved "back-and-forth" translation into Norwegian by a team consisting of both native English and Norwegian speakers fluent in both languages, and subsequent validation of the questionaires with students in a pilot study. Validation of the relevant constructs was performed with the Rasch model, and the resulting measures were then used in further statistical analysis and modeling. These steps are detailed next.

4.1. The questionnaires & instrument development

Questionnaires, for both countries, included a mixture of structured quantifiable items

measuring students' dispositions, perceptions of teaching and transitional experiences, open-ended questions, giving rise to more qualitative data, and background variables such as gender, age, previous maths qualifications (at school), as well as 'programme'-related variables (i.e. course and institution). The constructs/measures of interestfor this paper are outlined next with their operationalization herein in regards to the process of alienation.

4.1.1. Mathematics disposition (DP1,DP2, DP3, NPD1, NPD2)

These are considered as proxies of students' subjective experience of alienation as they denote students' dispositions towards further use/study of mathematics. An example item that defines this measure is: "If I find out that any future study involves more mathematics than I thought, this would make me feel:" with response options from very happy to very unhappy. These measures have been validated and extensively used in our previous work and the details are provided elsewhere (Pampaka et al., 2011; Pampaka& Williams, 2010; Pampaka et al., 2013).

Fig. 1. Framework for building, validating and using alternative measures of teaching and learning outcomes.

4.1.2. Perceived pedagogical experiences at pre-uni (DP1, NPD1) and university (DP2, NPD2) maths

The development of these two instruments capturing students' perceptions of the teaching practices they experienced before and during their university (maths relevant) studies, was based on the theoretical framework of our previous work, which detailed a measure of teacher self-reported pre-university pedagogy and its association with students' learning outcomes (Pampaka et al., 2012). For this we employed Swan's previously developed instrument (Swan, 2006), which in turn built on the research findings of Askew and his team (Askew, Brown, Rhodes, Johnson, &Wiliam, 1997) and Ernest (1991): From the work of Askew and colleagues Swan derived the 'ideal' categories of teachers' orientation towards each component (i.e. transmission, discovery and connectionist). In Pampaka et al. (2012) this is described in detail: using and adopting Swan's items we constructed a unidimensional measure of transmissionism (or 'teacher-centricism') in teaching mathematics. For the purposes of the TransMaths projects, we reduced the original 28-item teacher survey to an 11-item instrument of students' perceived transmissionist pedagogical experience, which we hypothetise here plays a role in the alienating process. The items, as presented to British students at DP1 are shown in Appendix A1. This instrument will be used as an indicative example of how measures were constructed, and thus the main focus of the detailed validation process presented later in the paper.

V. RESULTS

In this section we focus on the measurement results for the 'reduced' pedagogy instrument (Pampaka et al., 2012) into the two measures of students' perceived pedagogical experience before and during their first year at university in UK and Norway. We then summarise the measurement outcomes of the other relevant measures, and we move on to use these measures to map students transitional experiences and find explanations of potential alienation and its resolution.

5.1. Validation results: students' perceived pedagogical experiences in two systems

The responses of students to the 11 items of the shortened instrument about their perceptions of the pedagogical experiences they encountered in their maths classes before and during university (Appendix A1) were analysed with the Rasch RSM as this is the most appropriate model for the case of items that share the same response options. For easier interpretation of the measures and in order for higher scores to indicate transmissionist teaching (for consistency with our previous results) the coding of items 2–8 was reversed. Analysis was performed initially with both DPs together but these results did not support time invariance of the measures (i.e. the two instruments could not be

considered equivalent), so independent analysis was considered more valid. We limit the detailed presentation of results here to the instrument relevant to the pre-university mathematics experience.

We first explore the Rasch item fit statistics, which provide evidence for construct validity and in case of inconsistent data (with the model) they might suggest the existence of new dimensions in the data, or may flag items to which responses are overly predictable (overfits), an indication that they somehow depend on other items and might be candidates for deletion (Bowles, 2003; Wright, 1994). At this point we acknowledge the debate around cut-off points for acceptable ranges for fit statistics (Linacre, 2002; Smith, Schumacker, & Busch, 1998), and considering existing recommendations we take 1.3 as a value for infit and outfit mean squares that suggests cause of concern. Items with fit statistics higher than 1.3 will be considered as 'misfits' and will be further investigated (qualitatively as well). Items with value below 1 will not be explored in detail since they are not considered as a threatto the measure's validity. Finally, we endorse the recommendation of Bohlig et al. (1998) who state that 'less than pleasing fit statistics say "think again", not "throw it out"' (p. 607), and hence we seek explanations and interpretations for the high fit values.

The fit statistics and item measures for the pre-university experience for both UK and Norway were first pooled together for a preliminary analysis. This indicated one highly misfiting item, namely Item 10: "The teacher was encouraging us to work more quickly". We interpreted this departure from ideal fit as a possible misinterpretation of the item by the students or simply denoting a practice that can be mutually present in various levels of transmitionist classrooms. This item also seems to be problematic for the perceived university pedagogy measure (DP2) and is one that causes huge problems with time invariance. The item, also presented large DIF size when UK and Norway measures were compared. Based on all presented evidence it was thus decided to exclude this item from subsequent analysis. We then recalibrated the remaining 10 items with the pooled data and fit statistics were within acceptable ranges.6 DIF analysis however was still problematic as shown with Fig. 2: in fact this indicates that more than half of the items present significant DIF. In brief we could say that practices where the UK point is on the happen less frequently compared to Norwegian pre-university math courses. The largest distance observed with Item 7 ("We were working collaboratively in pairs") which appears to happen significantly more frequently in the UK: our experience with the Norwegian system is also in agreement with this observation as students are more used to working in groups of three or four rather than pairs. Given this DIF and the potential problems it might cause on directly comparing these groups we decided to proceed with separate calibration for each national group.

The 'cleaned' recalibrated results, for the pre-university measures are shown in Table 2 for both samples. As shown, the fit is now acceptable for all the items and thus we can claim that they work welltogether to define the measure called 'students' perception of a transmissionist pedagogy in pre-university maths experience'. The dimensionality of these two scales is further explored with the results of the principal component analysis of the residuals (Table 3). According to this 'test of dimensionality' the Rasch model explains 35.4% of the variance for both samples

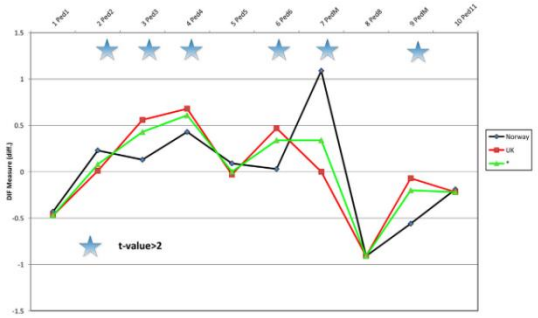

Fig. 2. DIF analysis for 'perception of a transmissionist pedagogy in pre-university maths experience' scale.

Table 2
Item statistics for the revised scale students' perception of a transmissionist pedagogy in pre-university maths experience': UK and Norway.

	UK								Norway							
Item Entry No	Raw Score	Observed Count	Measure	SE	Infit		Outfit		Raw Score	Observed Count	Measure	SE	Infit		Outfit	
					MNSQ	ZSTD	MNSQ	ZSTD					MNSQ	ZSTD	MNSQ	ZSTD
item1	4590	1507	−0.50	0.04	0.91	−2.5	0.96	−1.0	2316	701	−0.44	0.06	1.06	1.2	1.19	3
item2	4129	1489	0.01	0.03	0.94	−1.7	0.95	−1.5	2104	703	0.24	0.05	1.07	1.4	1.07	1.3
item3	3672	1495	0.57	0.03	0.83	−5.6	0.83	−5.3	2114	696	0.14	0.05	0.77	−4.9	0.78	−4.5
item4	3532	1480	0.69	0.03	0.98	−0.6	1.00	0.00	1958	680	0.46	0.05	0.85	−3.1	0.89	−2.1
item5	4184	1494	−0.03	0.03	0.99	−0.3	0.97	−0.8	2154	704	0.11	0.05	1.16	2.9	1.12	2.1
item6	3754	1495	0.47	0.03	0.86	−4.6	0.84	−4.9	2177	703	0.04	0.05	0.94	−1.1	0.9	−1.9
item7	4154	1494	0.00	0.03	1.08	2.4	1.11	3.1	1772	705	1.14	0.05	1.19	3.8	1.19	3.6
item8	4829	1487	−0.92	0.04	1.09	2.3	1.01	0.3	2439	698	−0.94	0.07	0.98	−0.3	0.91	−1.4
item9	4199	1490	−0.06	0.03	1.10	2.8	1.09	2.5	2372	706	−0.57	0.06	1.04	0.7	1.06	1.0
item11	4298	1476	−0.24	0.04	1.25	6.8	1.3	7.6	2162	676	−0.19	0.06	0.93	−1.2	0.94	−1.0
	Mean:		0.00	0.04	1.0	−0.1	1.01	0.00	Mean:		0.00	0.06	1.0	−0.1	1.0	0.00
	SD:		0.47	0.00	0.12	3.6	0.13	3.6	SD:		0.55	0.00	0.12	2.5	0.13	2.5
PERSON: REAL SEP.: 1.57 REL.: 0.71									PERSON: REAL SEP.: 1.43 REL.: 0.67							
ITEM: REAL SEP.: 12.84 REL.: 0.99									ITEM: REAL SEP.: 9.54 REL.: 0.99							

(UK and Norway). As suggested by relevant guidelines7 (Linacre, 2014) important lines to check regard the contrasts—in our case the eigenvalue for the first constrast is marginal according to guidelines (i.e. if the first contrast is much larger than the size of an eigenvalue expected by chance, usually less than 2), and it is advised to inspect the 'contrasting content of the items which produce this large off dimensional component in the data: in our case these were items 5–7 (and 8 for UK) which were those reversed and indicating more student-centered practices. So even though the results may be suggestive of a secondary dimension this is not considered sufficiently strong as to threaten the validity of this overall measure.

Once validity is established at item and category level, the resulting common measurement scales (in logits as shown with the arrow in the middle) are presented in the form of item-person maps, as shown in Fig. 3 for both UK and Norway. At the right side of each plot, the distribution of the students on this measure is shown with a histogram. The higher the place of

Table 3
Principal components analysis of the residuals.

	UK			Norway		
	Empirical		Modeled	Empirical		Modeled
Total raw variance in observations	15.5	100%	100%	15.5	100%	100%
Raw variance explained by measures	5.5	**35.4%**	35.4%	5.5	**35.4%**	35.7%
Raw variance explained by persons	2.2	14.2%	14.2%	2.4	15.2%	15.3%
Raw Variance explained by items	3.3	**21.2%**	21.2%	3.1	**20.2%**	20.4%
Raw unexplained variance (total)	10	64.6%	100% 64.6%	10	64.6%	100% 64.3%
Unexplained variance in 1st contrast	**2**	**13.1%**	20.3%	**2**	**13%**	20.2%
Unexplained variance in 2nd contrast	1.4	8.8%	13.6%	1.5	9.9%	15.4%
Unexplained variance in 3rd contrast	1.3	8.6%	13.2%	1.2	8%	12.5%
Unexplained variance in 4th contrast	1.3	8.1%	12.5%	1.2	7.9%	12.3%
Unexplained variance in 5th contrast	1	6.6%	10.2%	0.9	5.8%	9%

the "practice", the more transmissionist (or teacher-centered) the student perceived their pre-university math courses. The item distribution is also shown on the left hand side of the scales: items at the bottom of the scale (e.g. "we don't invent our own methods') are items easier to report higher frequency of occurrence, thus 'easier' for the measurement of 'transmissionist' teaching practice.

5.2. Overview of other relevant validated measures

The same methodology was employed for the other measures as summarised in Table 4; for the UK validation details are presented elsewhere (Pampaka et al., 2014; Pampaka, Williams, Hutcheson, 2012). In sum two more measures were validated for the Norwegian sample, based on analysis of the items regarding the transitional gap (Appendix A2). The first, defined as 'perception of transitional gap', was derived from analysis of the 13 statement stems denoting changes between pre-university and university experiences, replicating the results presented in (Pampaka, Williams, Hutcheson, 2012) for UK with the help of the dichotomous model (as the ratings were recoded so as 0 indicates no change, and 1 change in either direction).

Results indicated a very good fit to the model, but very poor person separation (similar to the UK): The resulting students' distribution on this measure is shown on the left histogram in Fig. 4 and actually contextualises the low separation: in fact as most students have reported differences between the two systems (pre-Uni and Uni) there is some skewness in their measures towards the positive side and low discrimination between these scores. The histogram on the right presents the distribution of students' 'positivity towards transition' which resulted from the 'feelings' column of the items in Appendix A2 (for his analysis we preserved an ordered level of 'positive feeling' to the change by coding Negative = 1, Neutral = 2 and Positive = 3, and consequently applied the RSM). As can be observed the picture here is much better and indicates good psychometric properties; similarly the measure of "quality of learning support for mathematics", based on analysis of the items in Appendix A3 (after excluding item 6 which was not contributing towards the underlying construct) also shows appropriate measurement properties as shown in Table 4.

As a concluding point for the measures validation, we note our decision to treat the results from the two groups separately: this is mainly because of the complexity in the interpretations of DIF results, with most of the items falling outside the confidence intervals

for measure invariance. For further analysis in this paper we treat the samples as separate, thus we do not violate any analytical assumptions of comparability

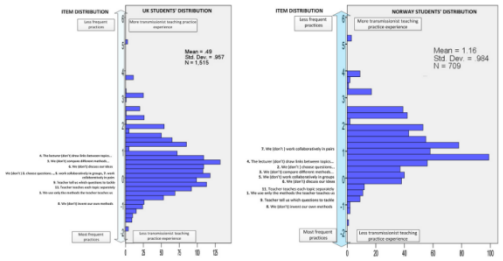

Fig. 3. The item-person map with the hierarchy of students' perception of a transmissionist pedagogy in pre-university maths experience (UK and Norway).

Table 4
Psychometric overview of other validated measures.

Measures / Dimensionality Information	Model	Item N		Infit MNSQ	Infit Zstd	Outfit MNSQ	Outfit Zstd	Item Separation	Item Reliability	Person Separation	Person Reliability
Pedagogy@Uni (UK)	RSM	10	Mean	1	0.1	1	0.1	9.51	0.99	1.46	0.68
Note: Analysis was run with Facets, therefore dimensionality tests are not available			SD	0.2	3.7	0.2	3.7				
			Max	1.4	6	1.4	7				
			Min	0.8	−4	0.9	−5				
Pedagogy@Uni (Norway)	RSM	10	Mean	0.99	−0.3	1.01	−0.1	9.38	0.99	1.51	0.70
Eigenvalue of 1st contrast:2.5			SD	0.21	3.4	0.22	3.5				
Raw variance explained by measures: 39%			Max	1.46	6.9	1.47	6.7				
			Min	0.77	−4.5	0.78	−3.9				
Transitional Gap (UK)	Dich	12	Mean	1	0	1	0	7.66	0.98	0.55	0.23
Note: Analysis was run with Facets			SD	0	0.8	0	0.7				
			Max	1.1	1	1.1	1				
			Min	1	−1	0.9	−1				
Transitional Gap (Norway)	Dich	12	Mean	0.95	−0.2	1.68	0.4	8.31	0.99	0.38	0.13
Eigenvalue of 1st contrast: 2			SD	0.10	1.0	2.53	3.2				
Raw variance explained by measures: 59.2%			Max	1.12	1.1	9.90	9.9				
			Min	0.84	−2.8	0.18	−2.9				
Positivity towards transition (UK)	Dich	12	Mean	1	−0.0	1	−0.1	13.66	099	1.87	0.78
Note: Analysis was run with Facets			SD	0.1	2.9	0.1	1.8				
			Max	1.4	6	1.3	3				
			Min	0.8	−4	0.8	−3				
Positivity towards transition (Norway)	RSM	12	Mean	1.00	−0.2	0.99	−0.3	8.34	0.99	1.56	0.71
Eigenvalue of 1st contrast: 1.9			SD	0.23	3.9	0.25	3.6				
Raw variance explained by measures: 33.5%			Max	1.57	8.6	1.65	8.8				
			Min	0.71	−5.7	0.69	−5.3				
Perception of Support (UK)	RSM	9	Mean	1.02	−0.3	1.01	−0.4	8.66	0.99	1.4	0.66
Eigenvalue of 1st contrast: 1.9			SD	0.19	5.1	0.19	4.9				
Raw variance explained by measures: 42.8%			Max	1.21	5.2	1.20	4.9				
			Min	0.69	−8.9	0.68	−9.0				
Perception of Support (N)	RSM	9	Mean	1.03	0.2	1.03	0.1	18.94	1	1.22	0.60
Eigenvalue of 1st contrast: 2.6			SD	0.21	3.3	0.21	3.3				
Raw variance explained by measures: 58.1%			Max	1.36	5.0	1.34	4.8				
			Min	0.77	−4.4	0.75	−4.8				

VI. DISCUSSION AND CONCLUSIONS

In this paper alienation has been conceptualised and operationalised with the construction of selected measures that denote either (subjective) alienating experiences or other aspects of the alienating process that can help explain how the 'system' functions. As examples of such procedural indicators are students' perceptions of the transitional gap and their associated feelings regarding the transition. We also consider mathematics dispositions as a proxy of subjective alienating experience, especially with the noted drop of these dispositions. More interestingly though, measuring students' perceptions of teaching and learning aspects of their transitional experience, such as pre- and at-unitransmissionist practices, allows us to shed some light onto potential sources of alienation for these students.

One of the primary tasks of this paper has been to introduce these measures, which we believe add substantially to the existing literature on relevant existing scales (e.g. Ghaith, 2003; Thorpe, 2003) and the comparability of measures across different contexts. In regards to the latter, as expected, our psychometric approach revealed some issues regarding measurement invariance when converting instruments from one academic context to another (Millsap, 2011; Pepin, 2000). Our resolution in this paper was to proceed with 'safe' separate analysis and focus on commonalities and differences in the resulting associations.

Having these measures at hand, we then examine various relationships to help us identify factors that increase disengagement, or to phrase it more positively, that ease the transition and thus reduce the chances for alienation. So, essentially we deal here with the two categories of factors related to alienation as defined by Case (2008): experiences of entry; and fitting into HE. It is worth summarising here the most important commonalities and differences of these relationships in the two educational contexts.

With regards to differences, it appears that there is evidence for a negative association between the quality of support at uni and pre-university transmissionist pedagogy for UK, whereas for Norway perceived support at uni is negatively associated with the perceived transmissionist pedagogy at university. Positivity towards transition is positively related to the perception of the transitional gap: the biggest the gap, the more positive the students are! This is new and we did not find evidence of it in the UK context. This is consistent, however, with more qualitative evidence. In particular, in the open statements of the questionnaires, and during interviews, Norwegian students told us that the biggest difference they experienced between upper secondary school and university was that at university they have to take more responsibility for their own learning (see also Pepin, Lysø, &Sikko, 2012). The majority of students found this to be an interesting and necessary move, and they had mainly positive feelings about it, whilst at the same time they saw it as a challenge. This can also be interpreted in the sense that the students were happy to move away from the more

transmissionist system they encountered at school. Another difference we found in the associations, was the negative correlation between maths disposition at DP1 and positivity towards transition, only found in the UK, i.e. the less disposed they were to continue studying maths, the happier they were with the transition. This was also supported by our earlier findings, where maths students appeared to be the "unhappiest group" in transition (followed by the engineering students) (Pampaka, Williams, Hutcheson, 2012). Hence, mathematics students in the UK experienced a bigger transitional gap, and felt more alienated at university than other students, whereas Norwegian mathematics students felt less alienated at university, because they appreciated the responsibility that came with the freedom of being a university student compared to high school student learning.

Finally, the model of developing students dispositions for Norway and UK presented in Table 7 suggests that, even though there is an almost significant negative effect of students perception of the transitional gap in their developing (dropping) Maths dispositions, atthe same time there is a significant and stronger positive effect of their perception of quality of support they receive at university. This highlights the significance of supporting mechanisms to be in place at university to facilitate students' transitions and thus minimise the probability of alienation and potential dropout.

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