The development of approaches to learning of student teachers with different 'study approach-profiles'

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Abstract

Research indicates that inciting a deep approach to learning in all students is far from obvious. To gain more insight in the development of students' approaches to learning, the idea of 'study approach profiles', conceptualised as 'similar patterns in approaches to learning adopted by subgroups of students', is explored. This study therefore aims at answering the following questions: (RQ1) Do students change their approaches to learning after experience with a learning environment? (RQ2) What study approach-profiles can be distinguished? (RQ3) Do students with a different study approach profile evolve differently on their study approaches when confronted with the same learning environment? (RQ4) Are student characteristics (age, gender, student status, year of participation in course) related to the development in these approaches to learning?

Two cohorts of students in a teacher-training course completed questionnaires measuring their approaches to learning, in a pre-test post-test design. Initial paired sample t-tests indicated that students did not change their approach to learning significantly during the course. Cluster-analysis revealed 5 clusters, a High Ambivalent Profile (HAP), a Deep Approach Profile (DAP), a Moderate Ambivalent Profile (MAP), a Surface Approach Profile (SAP) and a Fallen Angels Profile (FAP). Paired sample T-tests for these clusters indicated that approaches to learning of students with a different profile develop differently during the learning environment. A four way multivariate analysis of variance showed a main effect of the clusters on the differential scores for both a surface and a deep approach to learning. No main or interaction effects with student characteristics were found. Results of analyses show that, while the student-group as a whole did not change their approach significantly, different subgroups did and did so in different ways. These findings nuance to some degree the findings of previous research and plead for a more differentiated view on approaches to learning.

Key words: Approaches to learning, study orchestrations

1. Introduction

Today's higher education faces the challenge of not only having to teach students a bulk of domain-specific frameworks and disciplinary insights, but also having to foster skills that will enable them to become 'knowledge workers' and 'life long learners'. It is said that to reach these goals, education should make use of instructional methods and powerful learning environments that stimulate a more deep approach to learning in students (Biggs, 2003).

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The concept of a deep approach to learning is associated with students' intentions to understand and to engage in meaningful learning, focussing on the main themes and principles and using strategies that are appropriate for gaining understanding. Most theoretical models oppose this deep approach to learning to a surface approach to learning, referring to to students engaging in learning in an inappropriate or superficial way, based on motives or intentions that are extrinsic to the real purpose of the task. (Biggs, 2003; Entwistle, 1991; Trigwell & Prosser, 1991). There is also a general acceptance among researchers that the 'approaches to learning' students use in a specific learning situation, are the result of an interaction between the learning context and students' learner characteristics (Biggs, 2003; Entwistle & Ramsden, 1983).

Research has shown that stimulating a (desired) deep approach in all students is far from obvious (Marton & Säljo, 1997). For example, studies on the effects of new learning environments on student approaches to learning are not conclusive. Some studies concluded that new learning environments support the development of deep approaches to learning (Biggs, 1991; Albanese & Mitchell, 1993; Greening, 1998), whereas others found that educational innovation aimed at fostering deep approaches to learning unexpectedly resulted in students using a more surface approaches to learning (Struyven et al., 2006; Gijbels and Dochy,2006). As an explanation for these results, most studies point towards factors in the learning environment (e.g.Wilson & Fowler, 2005).

It is interesting to note, however, that most of these studies investigate changes in approaches to learning at a 'whole group level', possibly obscuring different developmental processes at a sub-group level. Far less research, however, has been devoted to an in-depth investigation of students' approaches to learning at an individual or sub-group level. This study therefore aims at exploring the development of students' approaches to learning within a learning environment, both at a whole-group level and a sub-group level, using the idea of study approach-profiles for the latter.

2. Theoretical background

2.1 Study orchestrations and study approach-profiles

Jan Meyer and his colleagues were harbingers of studying approaches to learning at a sub-group level, when they introduced the notion of 'study orchestration' (Meyer, 1991; Meyer, Parsons, & Dunne, 1990). They described this concept as contextualized patterns in learning, adopted by individual students or groups of students and sensitive to both students' perceptions of the learning environment and their learning conceptions (Meyer, 1991). Using case-oriented data techniques, like multidimensional unfolding analyses (Meyer et al., 1990) or cluster analyses (Heikkilä & Lonka, 2006; Long, 2003), several studies identified different orchestrations of students with similar study-approach patterns or profiles. A small but growing number of studies also expanded on this concept and revealed that qualitative differences in the consonance of these profiles, estimated on the basis of theoretical models, are related to differences in academic learning outcomes (Entwistle, Meyer, & Tait, 1991; Rodríguez & Cano, 2006). Generally, dissonant profiles are associated with lower-than-average academic performance (Lindblom-Ylänne & Lonka, 1999; Rodríguez & Cano, 2006), although this is not always the case (e.g. Boulton-Lewis, Marton, Lewis, & Wilss, 2004).

Through the years, some researchers have begun using the concept of study orchestrations, in a less stringent way (e.g. Cano, 2006; Long, 2003) than Meyer originally applied in his own work, using the notion to denominate contextual patterns of approaches to learning adopted by sub-groups of students or individuals, but without an explicit link to those students' conceptions of learning or their perceptions of the learning environment. Other researchers have also incorporated new variables into orchestrations. For example Vermunt and Verloop have explored dissonance in students' regulation of the studying process (Vermunt & Verloop, 2000).

2.2 The development of orchestrations and profiles

Researchers have also tried to explain the existence of (dissonant) study orchestrations. Lindblom-Ylänne and her colleagues, for example, related dissonance in students' approaches to learning profiles to students' attempts to adapt to their learning environment and to changes in learning practices according to the demands of their learning environment (Lindblom-Ylänne & Lonka, 1999; Lindblom-Ylänne & Lonka, 2000). In this way study orchestrations are seen as changeable and as a temporary state of 'in-between' more consonant orchestrations.

Therefore exploration of the evolution of orchestrations within and across learning environment seems valuable. So far, however, little research exists on this topic. One exception to this is a study by Boulton-Lewis and colleagues, who investigated the development of dissonant study orchestrations with a group of indigenous Australian students (Boulton-Lewis, Marton, Lewis, & Wilss, 2004). These researchers found, using a qualitative research methodology, that students with dissonant profiles were able to achieve success in an academic context, when they were highly motivated and invested a lot of time and effort in their study.

Therefore, the present study we will explore students' changes in their approaches to learning, both on a whole-group and sub-group (profile) level. However, as the current study also does not explicitly incorporate students' learning conceptions and their perception of the learning environment, when investigating patterns in approaches to learning the researchers of the current study opted to use the term 'study-approach profiles', instead of 'study orchestrations', to avoid confusion and to keep the original concept of study orchestrations as clear as possible, The following research questions guide the present study:

1. Do students change their approaches to learning?
2. What study approach-profiles can be distinguished?
3. Do students with a different study approach profiles evolve dissimilarly on their study approaches when confronted with the same learning-assessment environment?
4. Are student characteristics related to the evolution in these study approaches?

3. Method

A 2 year-study was set up within the 'Education and psychology'-course in the teacher training programme at the University of Antwerp. Data were gathered using a pre-test post-test design.

3.1 The Education and Psychology course

'Education and psychology' is a compulsory course in the teacher training programme at the University of Antwerp (3 ECTS, 7 weeks). In the 'Education and psychology' course a blend of active learning methods and a congruent assessment environments was created for the students: Open learning by means of open-learning packages, based on the model by John Race (1995), interactive lectures, two authentic group assignments (to prepare a lesson for your peers on a given topic related to the psychology of adolescents and to design 4 subsequent 'lessons' using student-activating learning material) and two individual assignments (an observation assignment and a self-reflection assignment). Students also actually taught the lessons they prepared in one of the group assignments. Teacher- and peer-feedback was given on these peer-to-peer teachings. Students were assessed by means of the 2 authentic group assignments and the individual assignments. No final examination was organised.

3.2 Participants

The sample used in this study consisted of 2 subsequent cohorts (cohort 2005-2006 and 2006-2007) of students in the teacher-training program. As the study investigates the development of approaches to learning, only students who participated on both pre- and post-test were included in the data analysis. Less than half of the students in the original sample (n_1= 100, n_2=107) completed all instruments or filled in a readable student ID number, on the basis of which the different instruments could be matched. 66% of the sample were fulltime students while 34% combined studying with a fulltime or part-time job. Female students were 'over-present' in this sample as only 22% of the students were male. About half of the students, 51%, were between 22 and 25 of age, while 24% was younger and 25% was 26 or older.

3.3 Research Instrument and data gathering

Students' approaches to learning were measured by the revised study-process-questionnaire (R-SPQ-2F) (Biggs, Kember & Leung, 2001). The R-SPQ-2F is a refined version of Biggs' (1987) original Study Process Questionnaire (SPQ), using a two factor-model. Other studies, including cross-cultural research, confirmed that a two factor solution with deep and surfaces approaches, rather than the initial three factor solution, accounted for most of the variance (Snelgrove & Slater, 2003; Watkins & Regmi, 1996; Zhang, 2000). The revised two factor SPQ is scored on a 5 point Likert scale and measures students' approaches to learning using two scales, namely a 'surface learning approaches' scale and a 'deep learning approaches' scale.

The R-SPQ-2F was administered during the first and final lecture respectively to measure their initial and actual approaches to learning. Data on student characteristics, like gender, age and whether students combined studying with a job were also collected.

3.4 Data Analyses

First, the reliability of the scales for surface and deep approach was computed. The reliability for the deep learning scale, measured by Cronbach's alpha, resulted between .79 to .80. For the surface learning scale of the R-SPQ-2F the reliability ranged between .68 and .77 (see table 1). The reliability for both scales on both pre- and post-test was deemed sufficient.

Scale	Condition	Cronbach's alpha
Deep approach	Pre-test	.806
	Post-test	.790
Surface approach	Pre-test	.689
	Post-test	.770

Table 1: Reliabilities of R-SPQ-2F scales

To asses whether the learning-assessment environment evoked a change in student's approaches towards a more deep or surface approach, paired sample T-tests were computed. To identify different study-approach profiles, a series of K-means cluster analyses were used. Cluster analysis forms groups of respondents into clusters, with similar patterns of variation using a set of variables (Hair, Anderson, Tatham, & Black, 1998). Statistics were used to determine the most suitable number of clusters. Means on the pre-tests were computed for all clusters to interpret and label clusters. Paired sample T-tests were used to evaluate whether students with a different study approach-profiles evolved similarly or dissimilarly on deep or surface approaches to learning. Finally, a four-way MANOVA was conducted to determine the effects of the study approach-profiles and student characteristics on the differential scores for deep and surface approach.

4. Results

For our first research question, paired-samples T-tests were conducted to evaluate whether students changed their approach to learning during the course 'Education and psychology' (see table 2). The results indicated that the mean on the deep learning scale did not augment significantly from pre-test (M= 2.92, SD= .64) to post-test (M=2.85, SD=.60), $t(203)= 1,620$, $p=.107$ Thus, no proof can be found that the constructivist learning environments as described evoked a learning oriented towards a more deep approach. The same analysis was run to evaluate whether students changed their approach to learning towards a more surface approach when confronted with a constructivist

learning environment. The mean on the scale for a surface approach to learning did not increase significantly from pre-test (M=2.26, SD=.53) to post-test (M=2.31, SD=.56), *t*(203)=-1,26, *p*=.208.

Scale	Condition	M	SD	M Post-Pre	SD Post-Pre	T	p (2-tailed)
Deep approach	Pre-test	2.92	.63	-.06	.555	1,62	.107
	Post-test	2.85	.60				
Surface approach	Pre-test	2.26	.53	.05	.560	-1,26	.208
	Post-test	2.31	.56				

Table 2: Paired Sample T-test for differences between pre- and post-test R-SPQ-2F (DF=203)

To resolve our second research question, as to what study approach-profiles or orchestrations could be distinguished, a series of K-means cluster-analyses were used to determine student-approach profiles. Solutions ranging from 3 up to 6 clusters were explored. Statistical means (One way-ANOVAs, post hoc test, partial η^2) and theoretical grounds were drawn on to decide on an appropriate amount of clusters. A model with 5 clusters was deemed most suitable. The number of respondents belonging to each of the clusters ranges from 30 to 57 (Table 3)

		N
5 cluster model	1	30
	2	36
	3	57
	4	44
	5	37

Table 3: Number of cases in each cluster

The mean scores for each cluster on both the surface and the deep approach scales for the pre-test were used to label and interpret the 5 clusters (Table 4):

The first cluster was labelled *'High Ambivalent Profile'* (HAP), because the means on both deep approach scale (M= 3,582) and surface approach scale (M=2,480) were relatively high. This profile bears resemblance to a 'both high orchestration' Lonka & Lindblom-Ylänne (1995) identified.

The second cluster was named *'Deep Approach Profile'* (DAP), because the mean on the deep approach scale was high (M= 3,671) while the mean on the surface approach scale (M=1,611) was rather low. This cluster most closely resembles the 'deep approach to learning' as presented in student approaches to learning theory (e.g. Biggs, 2003).

The third cluster was labelled 'Moderate Ambivalent Profile' because the means on both the deep approach scale (M= 2,886) and surface approach scale (M=2.044) were moderate.

The fourth cluster was named *'Surface Approach Profile'* (SAP) as the score on the deep approach scale was moderate (M=2,645) and the score on the surface approach scale was

high (M=2,955). This cluster most closely bears resemblance to the 'surface approach to learning' as featured in theoretical frameworks (e.g. Biggs, 2003).

The fifth cluster was labelled *'Fallen Angels Profile'* (FAP) as the means on both the deep approach scale (M=2,013) and the surface approach scale (M= 2,211) were low to moderate. The more lyrical name for this cluster originates from Christian mythology, where fallen angels -Angels who are banished from heaven- don't exhibit any gender characteristics. This cluster seems might be similar to some degree to the 'both-low orchestration' Lonka & Lindblom-Ylänne (1995) discerned.

To answer our third research question, Paired sample T-tests were computed to evaluate whether the change in approach to learning differed for different clusters (Table 4). For clarification, graphics about the evolution of the clusters on both the deep and surface approach to learning were drew up; (figure 1 and 2).

Results of the paired sample T-test show that, for deep approach scale, the mean score significantly decreases for the High Ambivalent Profile, $t(29)= 4{,}621$, $p= .000$, and the Deep Approach Profile, $t(35)= 3.680$, $p=.001$. For the Fallen Angels Profile a significant increase in the means, $t(36)= -3{,}807$, $p=.001$, score was observed. The mean scores for both the Moderate Ambivalent Profile $t(56)= -0{,}951$, $p=.346$ and the Surface Approach Profile, $t(43)= 0{,}627$, $p=.534$ did not change significantly.

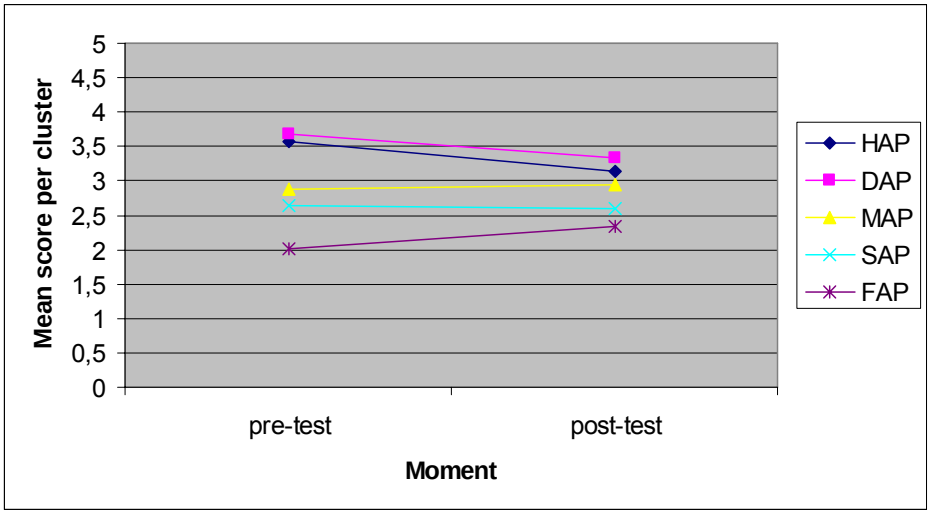

Figure 1: Evolution in deep approach to learning per cluster

Regarding the evolution for the surface approach on learning, a significant increase in mean score was determined for both the Deep Approach Profile, $t(35)= -4{,}398$, $p=.000$, the Moderate Ambivalent Profile, $t(56)= -2{,}900$, $p=.005$, and the Fallen Angels Profile, $t(36)=-3{,}980$, $p=.000$. A significant decrease was found for the High Ambivalent Profile, $t(29)= 3{,}225$, $p=.003$, and the Surface Approach Profile, $t(43)= 3{,}555$, $p=.001$.

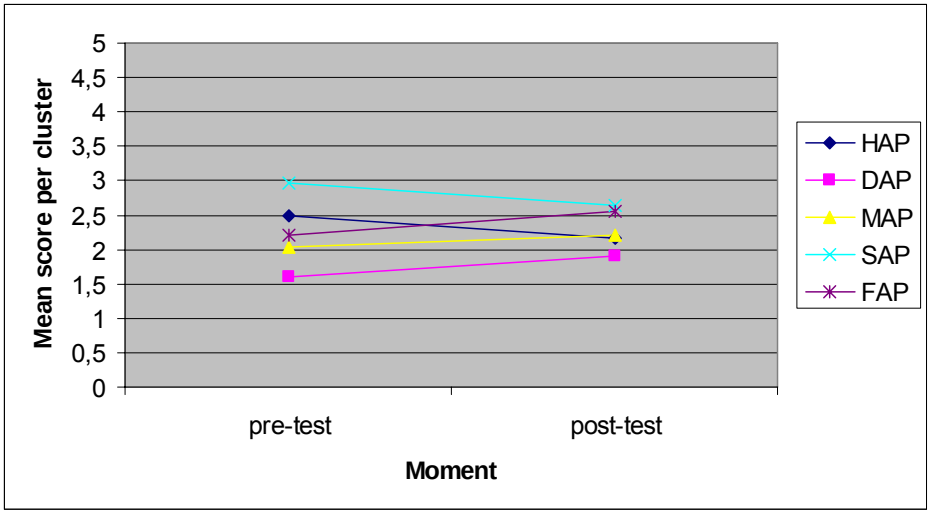

Figure 2: Evolution in surface approach to learning per cluster

Finally, the graphics seem to indicate that the different profiles seem to converge to one another at the post-test as compared to the pre-test.

Cluster	Condition	M	SD	M Post-Pre	SD Post-Pre	T	DF	p (2-tailed)
1 HAP	DA Pre-test	3,5819	,25340	,43852	,51975	4,621	29	,000
	DA Post-test	3,1433	,46786					
	SA Pre-test	2,4796	,26547	,31074	,52771	3,225	29	,003
	SA Post-test	2,1689	,56033					
2 DAP	DA Pre-test	3,6713	,33316	,34475	,56208	3,680	35	,001
	DA Post-test	3,3265	,56493					
	SA Pre-test	1,6108	,28930	-,29167	,39786	-4,398	35	,000
	SA Post-test	1,9025	,42082					
3 MAP	DA Pre-test	2,8858	,20930	-,05458	,43339	-,951	56	,346
	DA Post-test	2,9404	,45192					
	SA Pre-test	2,0436	,24510	-,16637	,43319	-2,900	56	,005
	SA Post-test	2,2099	,46890					
4 SAP	DA Pre-test	2,6452	,32791	,04747	,50245	,627	43	,534
	DA Post-test	2,5977	,48966					
	SA Pre-test	2,9548	,27076	,30480	,56872	3,555	43	,001
	SA Post-test	2,6500	,51782					
5 FAP	DA Pre-test	2,0129	,28320	-,31592	,50475	-3,807	36	,001
	DA Post-test	2,3288	,53122					
	SA Pre-test	2,2108	,34704	-,34797	,53178	-3,980	36	,000
	SA Post-test	2,5588	,51795					

Table 4: Descriptives and Paired Sample T-test for differences between pre- and post-test per cluster

To resolve our final research question, a four-way MANOVA was conducted to determine the effects of the study approach-profiles and student characteristics -gender, age, cohort and fulltime student or not- on the differential scores for deep and surface approach. A significant main effect was found for study-approach profiles (Wilks's Λ= .699, *F(8, 300)*=7.352*, p*=.000, partial η^2=.164, see table 5). The analysis revealed no other significant main or interaction effects. This means that the different clusters are the single significant factor influencing differential scores on both a deep and surface approach to learning. The clusters explain 16% of the variance in differential scores.

	Value	**F**	**Df**	**Error df**	**Sign**	**Partial eta squared**
Intercept	,983	1,267	2,000	150,000	,285	,017
5 clusters	,699	7,352	8,000	300,000	,000	,164
combining work with studying	,991	,718	2,000	150,000	,489	,009
Gender	,986	1,046	2,000	150,000	,354	,014
Age (in categories)	,998	,051	6,000	300,000	,999	,001
year	,985	1,176	2,000	150,000	,311	,015
Combining work with studying* 5 clusters	,959	,795	8,000	300,000	,607	,021
Gender* 5 clusters	,926	1,472	8,000	300,000	,167	,038
5 cluster * age	,894	,724	24,000	300,000	,827	,055
5 clusters*year	,982	,346	8,000	300,000	,947	,009

Table 5: Multivariate analysis of variance (MANOVA)

Post hoc comparisons between the different study approach-profiles, using Dunnett's C tests revealed differential scores varying significantly on deep approach for the High Ambivalent Profile compared to the Moderate Ambivalent Profile, The Surface Approach Profile and the Fallen Angels Profile. (See table 6) The Deep Approach Profile developed their deep approach significantly more than the Moderate Ambivalent Profile and the Fallen Angels Profile. For the evolution in surface approach there were significant differences in mean differential scores between the High Ambivalent Profile on the one hand and the Deep Approach Profile, the Moderate Ambivalent Profile and the Fallen Angels Profile. The Surface Approach Profile also evolved differentially for the surface approach to learning compared to the Deep Approach Profile, the Moderate Ambivalent Profile and the Fallen Angels Profile. This further evidences the fact that different study-approach profiles evolve differently on both a surface and deep approach to learning.

Deep approach		Deep Approach		Surface approach	
		Mean difference	Stand. Error	Mean difference	Stand. Error
HAP	*DAP*	-,1152	,13958	-,5813*	,12264
	MAP	-,5568*	,11647	-,3944*	,11782
	SAP	-,4416*	,12759	,0402	,13464
	FAP	-,8127*	,13024	-,6066*	,13612
DAP	*HAP*	,1152	,13958	,5813*	,12264
	MAP	-,4417*	,11575	,1869	,08957
	SAP	-,3264	,12693	,6215*	,11076
	FAP	-,6975*	,12960	-,0253	,11255
MAP	*HAP*	,5568*	,11647	,3944*	,11782
	DAP	,4417*	,11575	-,1869	,08957
	SAP	,1153	,10097	,4346*	,10540
	FAP	-,2558	,10430	-,2122	,10728
SAP	*HAP*	,4416*	,12759	-,0402	,13464
	DAP	,3264	,12693	-,6215*	,11076
	MAP	-,1153	,10097	-,4346*	,10540
	FAP	-,3711*	,11659	-,6468*	,12551
FAP	*HAP*	,8127*	,13024	,6066*	,13612
	DAP	,6975*	,12960	,0253	,11255
	MAP	,2558	,10430	,2122	,10728
	SAP	,3711*	,11659	,6468*	,12551

Table 6: Multivariate analysis of variance (MANOVA) Post-hoc test Multiple comparison. Result marked with an * are significant at the >0.025 level

5. Conclusions and discussion

5.1 Conclusions

Current research originated from the idea that motivating students to use a deep approach to learning is crucial, if contemporary higher education wants to meet the challenges it faces. Research showed however that stimulating students to apply this approach is far from obvious. As most studies explore changes in students' approaches to learning at a whole-group level, our study hypothesized that additional insights could be gained by analysing the evolutions of students' approaches to learning at a sub-group level, using the notion of study approach profiles. The present study wanted to explore this phenomenon in a teacher-training program at a Belgian University, using a pre-test post-test design.

Results of paired sample T-tests indicate that, when looking at the whole-group level, the claim made by Marton and Säljo (1997) saying *'a deep approach is difficult to incite'*, still stands.

Cluster-analysis however revealed 5 sub-groups of students with different study-approach profiles. Paired sample T-tests were use to investigate the evolution on deep and surface approaches to learning for these clusters and reveal a more nuanced image. Some profiles do significantly change their approach towards a more deep approach to learning, most notably those profiles who scored rather low on this approach at the pre-test (Fallen Angels Profile). For other profiles, like the High Ambivalent Profile and the Deep Approach Profile, the score on the deep approach decreased significantly. For the surface approach to learning a similar picture emerges. Profiles with a low score on the pre-test, Fallen Angels Profile, Moderate Ambivalent Profile and Deep Approach Profile, increased their scores on the surface approach scale, while profiles with a high surface approach score at the pre-test, namely the Deep Approach Profile and the High Ambivalent Profile, significantly decreased their score. On the whole, the various clusters seem to converge on both approaches throughout the learning environment.

These results might indicate, like for example Lindblöm-Ylänne (1999) suggests, that subgroups of students change their approach to learning in different ways to adapt to the demands of the learning environment. These findings call for caution when interpreting the results of some recent studies, who report difficulties in stimulating desired approaches in students. Moreover they support the value of the differentiated and contextualized view on approaches to learning as advocated by Meyer and his colleagues and the 'study orchestration-tradition' (Meyer et al., 1990).

Our research also showed that the study approach-profile on the pre-test is the single factor influencing differential scores in both surface and deep approaches to learning, explaining about 16% of the variance in differential scores. Neither gender, age, cohort or student-status had a significant effect.

5.2 Discussion

There are some specific methodological limitations to the present study.

Our first limitation concerns the use of cluster-analyses for identifying study-approach profiles. One of the known problems with this technique is the stability and interpretation of the clusters. Choosing the appropriate amount of clusters, for example, is to a certain extent an informed decision by the researcher, based not only on statistics but also by theoretical preferences. Also the meaning of the clusters is to a certain degree open for interpretation. In our research, for example, most profiles seemed to bear resemblance to other orchestrations found in earlier research, but one can never be certain on this. This hinders the comparison between results of different studies and thwarts the generalisation of models and orchestrations across studies. To some extent, the use of latent class analyses and models solves these limitations (McCutcheon & Hagenaars, 1999).

Secondly, in our study approaches to learning were measured using the R-SPQ-2F a self-report questionnaire. These instruments are not context-specific and are said to measure students' general disposition toward a specific approach to learning (Entwistle & Mc Cune, 2004). The question can be raised if this instrument is most suitable and capable of capturing study approach-profiles, a question also raised by Lindblom-Ylänne (2003). She states that the instruments used must be

sensitive enough to pick up the conceptual contrasts that form the basis for orchestrations. As our study was exploratory in nature, we decided not to invest in the development a context-specific instrument, although this might be necessary for future, more in-depth studies.

Our final limitation regards the sole use of quantitative data. These data were deemed adequate for this initial exploratory study, but are not sufficient for gaining a thorough understanding of the actual processes taking place within different study approach-profiles. This aim necessitates the use of a mixed-method design (Tashakkori & Teddlie, 2003) combining quantitative and qualitative data. Lindblom-Ylänne and Lonka (1999) for instance used cluster analysis based on questionnaire responses to identify different profiles, but made use of interviews to get an in-depth understanding of how individual students interacted with their learning environment.

5.3 Suggestions for further research

Finally, some suggestions for further research. As stated earlier, research exploring the evolution of study orchestrations of study-approach profiles is scarce. The present study used these concepts to investigate the development of approaches to learning within a single learning environment. Future research should focus on the development of these orchestrations across different learning environments and different stages in students' academic careers. Moreover, although this research used the study-approach framework, it did not investigate the consonance or dissonance of the emerging profiles. Therefore it could not be investigated whether dissonant orchestrations evolved towards consonant profiles and whether other dissonant profiles might have emerged. Finally, this study did not explicitly explore the relationship between the evolution in approaches to learning for the different profiles and perceptions on the learning environment or study results. While earlier research uncovered a relationship between study orchestrations and academic results (e.g. Lindblom-Ylänne & Lonka, 1999; Rodríguez & Cano, 2006), to our knowledge this relationship has hardly been explored, taking the development of these orchestrations into account.

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