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Impact of student centred learning environments on students' learning approach in higher education

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ABSTRACT

In this action research study we investigate the impact of a competence based and student centred learning environment on students' learning approaches. The impact in comparison to that of a traditional learning environment is taken into account. At four test moments bachelor of Computer Science students at the University of Antwerp filled in a questionnaire examining different aspects influencing a student's learning approach. Descriptive statistics and paired t-tests show a statistically significant impact of the competence based and student centred character of a learning environment on students' regulation strategies, their motivation, self-efficacy, student attitude and academic efficacy. No such impact was found on students' perceived fit in pedagogical approach between secondary and university education.

1. INTRODUCTION

1.1 Student centred learning environments and learning approach

In social constructivism learning is regarded as a social process in which students actively construct knowledge from experiences, preferably in cooperation and in learning situations as authentic and realistic as possible, in order to facilitate the transfer to vocational environments (Kinnucan-Welsch & Jenlik, 1998). Learning

is student centred and the students themselves are responsible for their learning process, which requires the acquisition of self-regulation skills. Students need to reflect on their learning for their further competence based development. The realisation of a competence-based education influences all aspects of the learning and teaching process. The role of the student changes from passively acquiring knowledge to actively constructing knowledge and developing broader competences with complex skills. Students are considered individuals rather than part of the student group. The teacher not only offers learning contents, he becomes a coach of learning processes and designer of powerful learning environments. The student and the learning process are focussed on, not the teacher and the educational process. Through self and peer assessment students get a task in the assessment process (Birenbaum, 1996).

The educational literature covers mainly the surface, the deep and the strategic approaches to learning (Entwistle, Meyer, & Tait, 1991; Entwistle & Ramsden, 1983; Struyven, Dochy, Janssens, & Gielen, 2006). Typical of the surface learning approach is memorizing in order to reproduce, little personal engagement, seeing study tasks as unwanted external impositions, routine, procedural problem-solving, limited conceptual understanding of the learning content and lower quality learning outcomes. Characteristic of the deep learning approach is the search for meaning in order to understand and active conceptual analysis, which results in a deep level of understanding and learning outcomes of high quality. The deep learning approach is the only way to fully understand learning contents (Trigwell & Prosser, 1991). In a strategic learning approach students have a performance-oriented motivation and intend to get the highest possible grades by use of organised study methods and effective time management. Depending on the assessment form these students apply surface memorising or deep understanding. Learning approaches are not characteristics of learners, but determined by a relationship between a learner and a context. A student can apply a deep learning approach in one context and a surface learning approach in another, depending on (the perception of) the characteristics of the context. Among the teaching/learning environment features that have an impact on the learning approach are the (expected) type of assessment (Entwistle & Entwistle, Contrasting forms of understanding for degree examinations: the student experience and its implications, 1991; Marton & Säljö, 1997; Kirschner, Meester, Middelbeek, & Hermans, 1993), the global quality of the learning environment (Entwistle & Ramsden, 1983; Sivan, Wong Leung, Woon, & Kember, 2000; Trigwell & Prosser, 1991) and discipline and institution specific influences (Eklund-Myrskog, 1998; Cashin & Downey, 1995).

1.2 Earlier studies on the impact of student centred learning environments on students' learning approach

Research shows that it is not easy to predict the impact of learning environments on the learning approach of students because of the many factors of the learning

environment that come into play. Various studies show an increase in the deep learning approach as a result of student centred and activating learning environments (Sivan, Wong Leung, Woon, & Kember, 2000; Wierstra, Kanselaar, van der Linden, Lodewijks, & Vermunt, 2003). Other studies show that certain course contexts exclude a deep learning approach (Case & Marshall, 2004) or when the teacher is the central figure a surface learning approach is encouraged (Trigwell, Prosser, & Waterhouse, 1999). Marton and Säljö (Marton & Säljö, 1997) argue that it is obviously easy to set up a teaching/learning environment inducing a surface learning approach, but when trying to induce a deep learning approach the difficulties turn out to be profound. Various studies confirm this finding: teaching/learning environments meant to stimulate students' deep learning approach often do not meet the expectations (Segers, Nijhuis, & Gijselaers, 2006; Maguire, Evans, & Dyas, 2001; Struyven, Dochy, Janssens, & Gielen, 2006; Stes, Coertjens, & Van Petegem, 2013). Problems such as higher workload, fragmented knowledge acquisition, less feedback and structure are associated with activating teaching methods and pave the way to a surface learning approach. These problems need to be solved in order to be able to come to a deep learning approach because experiencing a heavy workload and little freedom in learning is related to a surface learning approach while experiencing good lessons, clear objectives and more freedom in learning is connected with a deep learning approach (Entwistle & Ramsden, 1983; Trigwell & Prosser, 1991). According to Entwistle (Entwistle, 1991) the defining features are the students' perceptions of how the learning environment relates to their approaches to learning, not the academic environment as such.

2. AIM OF THE STUDY, DESIGN AND RESEARCH QUESTION

As discussed above, earlier studies show that it is not easy to predict the specific impact of learning environments on students' learning approach because of the many factors of the learning environment coming into play. The aim of this study is to investigate the effects of a student centred and competence based learning environment in three different university courses on students' learning approaches. To this end, we have chosen for each of these three experimental courses, a control course which applies a traditional learning environment and is attended by the same student group in the same semester. That way we selected for each experimental course a control course as similar as possible with regard to characteristics of study context: class size, level of expertise of the students, time and place. This yields an experimental design in which the experimental and control group are the same: in 3 successive semesters, participants attended both an experimental and a control course and filled out a questionnaire for each at the corresponding final exam.

As this study relies on the difference in students' perception between the experimental and control learning environments, in the first semester an additional

pretest-posttest design was used in the experimental and control course to allow for the analysis of these differences in perception. For this purpose, in the first experimental course, the experiment started only in the second half of the semester, after an initial six weeks of traditional teaching until the pretest at the midterm exam.
Our research questions are:

A. *To what extent do students perceive a difference between a traditional learning environment and a competence based and student centred learning environment?*
B. *For each of the following values of X,*
    1. *regulation strategies of learning: self-regulation, external regulation, lack of regulation*
    2. *student motivation: autonomous motivation, controlled motivation, amotivation*
    3. *self-efficacy: self-confidence, self-image, self-appraisal*
    4. *social aspects of learning: student attitude (student cohesiveness, involvement and cooperation) and teacher support*
    5. *perceived fit in pedagogical approach between secondary and university education*
    6. *enjoyment of studying*
    7. *academic efficacy,*

to what extent is there a difference in X in a learning environment that students perceive as competence based and student centred vs in a learning environment that students perceive as traditional?

3. RESEARCH CONTEXT

The University of Antwerp embraces a teaching concept of student centred and competence based teaching, aiming at challenging students to apply knowledge and skills in order to be able to solve problems in complex real-life situations. To change or strengthen lecturers' conceptions so that they are in line with this teaching concept and to raise professional standards with regard to classroom practice, lecturers can participate in a one-year instructional development program on a voluntary basis. This program, organised and designed by the university's Centre of Excellence in Higher Education (ECHO), triggered profound innovation in the three bachelor courses of the Bachelor in Computer Science in the Faculty of Sciences which are central in this study. Over the years their learning environments have been transformed from traditional to student centred and competence based, in particular in their extensive practical assignments. These learning environments are student centred in that they challenge students to take place in the driver's seat and to actualize their best potential in learning opportunities that activate their learning by doing. They are also competence based by requiring an integrated

development of knowledge, skills and attitudes in learning situations as realistic and authentic as possible.
In each of these courses, students work in group on a practical assignment for a period of 11 weeks, after an initial preparation of 6 weeks of lectures and practical lessons followed by a written midterm exam. The three central courses to this study are taking place in the first, second and third semester of the study program. In the first course, students are given a realistic and authentic problem to be solved step by step using problem solving techniques that professional computer scientists use. In the next two courses they are asked to first create their favourite project proposal related to the course material, then present it to an audience (peers and lecturers), to implement it upon acceptance - if rejected, to adjust it – and to finally present their work at a simulated conference. The assessment includes self and peer assessment.
The control courses apply a traditional learning environment with lectures and practical lessons during 13 weeks, followed by a study period and a written exam.
In order to find out whether students actually perceive a difference between a traditional and a student centred and competence based learning environment, we apply a traditional learning environment in the first experimental course until the midterm and diverge only after that pretest moment. *In what follows we use the following notation: Ei resp. Ci stand for the experimental course resp. control course in semester i.*

4. METHOD

4.1 Participants

Participation is anonymous and on a voluntary basis. In the first semester (2013-2014) of their bachelor in Computer Science study at the University of Antwerp, all beginning students were invited to participate in this study during three successive semesters. In the first year, students are very heterogeneous with regard to learning background and prior knowledge which results in a considerable drop out and study delay. The drop out is mainly situated during and shortly after the first semester because students then get facilities to reorient: at the midterm exam n(E1pre) = 45 en n(C1pre) = 43 whereas two months later at the finals n(E1post) = 38 and n(C1post) = 39 and at the end of the second semester n(E2) = 32 and n(C2) = 29. The study delay comes into play in the third semester where students can only attend a course when satisfying the course prerequisites: n(E3) = 26 and n(C3) = 15.

4.2 Instruments

At the midterm exams shortly before the start of the student centred and competence based learning environment in E1 (experimental course in semester 1),

students were questioned anonymously about their learning approaches in the first halves of the courses E1 and C1 (control course in semester 1). Given the design of our study, it was important that not only C1 but also E1 applied a traditional learning environment until the midterm exams. The questionnaire used is a compilation of items and scales from the following instruments: LEMO (Donche, Van Petegem, Van de Mosselaer, & Vermunt, 2010) to measure regulation strategies, motivation and self-efficacy, Perceived fit (Torenbeek, Jansen, & Hofman, 2011) to measure the perceived fit in pedagogical approach between secondary and university education, Modified WIHIC (Afari, Aldridge, Fraser, & Khine, 2013) to measure student perceptions of and social attitudes in the different learning environments, TOMRA (Spinner & Fraser, 2005) to measure the enjoyment of studying, and the Student Efficacy Scale (MJSES) (Jinks & Morgan, 1999) to measure the academic efficacy. It has 82 items in 14 scales, each reflecting a specific learning approach aspect (Table 1).

Scale		Meaning
Regulation strategies	Self-regulation	The extent to which students actively steer their own learning process.
	External regulation	The extent to which students rely on teaching staff or the learning material to steer their learning process.
	Lack of regulation	The extent to which students experience a lack of clarity on how to steer their learning process.
Student motivation	Autonomous motivation	The extent to which students are intrinsically motivated to learn.
	Controlled motivation	The extent to which students are motivated to learn by a desire to please others.
	Amotivation	The extent to which students experience problems with motivation.
Self-efficacy		The extent to which students have confidence in their learning approach and believe in their own ability.
Perceived fit		The extent to which students perceive a fit in pedagogical approach between secondary and university education.
Social aspects of learning	Student cohesiveness	The extent to which students are supportive of one another.
	Teacher support	The extent to which the teacher helps, trusts, and shows interest in students.
	Student involvement	The extent to which students have attentive interest, participate in discussions, perform additional work.
	Student cooperation	The extent to which students cooperate rather than compete with one another on learning tasks.
Enjoyment of studying		The extent to which students enjoy their contact hours with and without teaching staff.
Academic efficacy		The extent to which students have confidence in their academic competence.

Table 1: *Scales used in this study and their meaning*

The items on regulation, social aspects, enjoyment and academic efficacy are

scored on a five-point Likert scale ranging from 1=almost never, over 2=rarely, 3=sometimes, 4=often to 5=almost always. The items on motivation, perceived fit and self-efficacy are scored on a five-point Likert scale ranging from 1=disagree, over 2=rather disagree, 3=neither agree nor disagree, 4=rather agree to 5=agree. Acceptable Cronbach's alpha values were found for the following scales: *Self-regulation* (Cronbach's α = 0.70), *Lack of regulation* (Cronbach's α = 0.73), *Autonomous motivation* (Cronbach's α = 0.86), *Controlled motivation* (Cronbach's α = 0.81), *Amotivation* (Cronbach's α = 0.81), *Self-efficacy* (Cronbach's α = 0.89), *Perceived fit* (Cronbach's α = 0.72), *Student cohesiveness* (Cronbach's α = 0.81), *Teacher support* (Cronbach's α = 0.87), *Student involvement* (Cronbach's α = 0.89), *Student cooperation* (Cronbach's α = 0.86), *Enjoyment of studying* (Cronbach's α = 0.90) and *Academic efficacy* (Cronbach's α = 0.91). Only the *External regulation* scale turned out to be unreliable (Cronbach's α = 0.59) and could therefore not be used for further analysis.

4.3 Data analysis

First we apply descriptive statistics and paired t-tests using the pretest and posttest data gathered for the experimental course E1 and the control course C1 to verify whether, and to what extent, students perceive differences between a traditional learning environment and a competence based and student centred learning environment. To this end, we perform three paired t-tests: for E1 and C1 at the pretest, for E1 en C1 at the posttest and for E1 at pretest and posttest.
Next we use descriptive statistics and paired t-tests to examine to what extent regulation strategies, motivation, self-efficacy, perceived fit, teacher support and student attitudes (cohesiveness, involvement, cooperation) differ in a learning environment that students perceive as competence based and student centred vs in a learning environment that students perceive as traditional.
Effect sizes are reported along with p-values in order to distinguish between practically significant results and results being statistically significant (Keselman, et al., 1998).
In each of the paired t-tests we only use the data of participants who participated in both the experimental course and the corresponding control course.

5. FINDINGS

5.1 Students' perception

Tables 2 to 5 present for each scale the mean and standard deviation as well as the results of the corresponding paired t-test. The number of respondents (column N) differs from scale to scale due to missing data.
The stars indicate the statistically significant effects. *, ** and *** denote resp small (p-value < 0.05), medium (p-value < 0,01) and large (p-value < 0.001)

effects. In case of statistic significance, both the corresponding p-value and Cohen's d are in bold. The notations (S), (M) en (L) indicate the practically significant effects. (S), (M) and (L) denote resp small ($0.2 \leq |d| < 0.5$), medium ($0.5 \leq |d| < 0.8$) and large ($|d| \geq 0.8$) effect sizes.

Scale		**E1**		**C1**		**paired t-tests**		**N**
		M	**SD**	**M**	**SD**	**p-value**	**Cohen's d**	
Self-regulation	Pre	2.79	0.76	2.61	0.61	0.16	0.23 (S)	39
	Post	3.11	0.78	2.91	0.93	0.28	0.20 (S)	29
Lack of regulation	Pre	2.63	0.65	2.58	0.71	0.65	0.08	38
	Post	2.28	0.67	2.71	0.69	**0.01 ****	**-0.56 (M)**	29
Controlled motivation	Pre	2.78	0.91	2.88	0.92	0.55	-0.10	39
	Post	2.95	0.86	2.99	0.84	0.78	-0.05	30
Autonomous motivation	Pre	2.87	0.56	2.86	0.76	0.95	0.01	38
	Post	3.07	0.62	2.84	0.85	0.16	0.26 (S)	30
Amotivation	Pre	1.72	0.60	1.64	0.55	0.51	0.11	39
	Post	1.66	0.62	1.87	0.79	0.12	-0.30 (S)	30
Self-efficacy	Pre	3.15	0.67	2.90	0.73	**0.04 ***	**0.34 (S)**	39
	Post	3.54	0.65	2.70	1.02	**0.00 *****	**0.97 (L)**	30
Perceived fit	Pre	2.48	0.69	2.63	0.95	0.36	-0.15	37
	Post	2.36	0.67	2.60	0.89	0.20	-0.24 (S)	30
Student cohesiveness	Pre	3.06	0.84	2.86	0.76	0.19	0.22 (S)	38
	Post	3.72	0.62	2.93	0.63	**0.00 *****	**1.05 (L)**	29
Teacher support	Pre	3.76	0.59	3.72	0.60	0.77	0.05	31
	Post	4.01	0.47	3.65	0.49	**0.00 *****	**0.70 (M)**	26
Student involvement	Pre	3.02	0.73	3.06	0.62	0.82	- 0.04	35
	Post	3.67	0.38	2.96	0.57	**0.00 *****	**1.08 (L)**	29
Student cooperation	Pre	3.06	0.79	2.64	0.84	**0.01 ****	**0.48 (S)**	32
	Post	4.04	0.46	2.59	0.77	**0.00 *****	**1.57 (L)**	26
Enjoyment of studying	Pre	2.84	0.56	2.77	0.71	0.60	0.09	36
	Post	3.23	0.50	2.91	0.52	**0.01 ****	**0.48 (S)**	30
Academic efficacy	Pre	2.85	0.53	2.46	0.61	**0.00 *****	**0.62 (M)**	34
	Post	3.14	0.65	2.30	0.76	**0.00 *****	**1.06 (L)**	27

Table 2: *Paired t-tests E1pre-C1pre (N = 39) and E1post-C1post (N = 31)*

To answer research question A, we consider paired t-tests for the following 3 combinations:

- E1pre-C1pre (Table 2) to verify if there is a difference in students' perception between the learning environments of the courses E1 and C1 at the midterm before which both courses applied a traditional learning environment.
- E1post-C1post (Table 2) to verify if there is a difference in students' perception between the student centred and competence based learning environment in the experimental course E1 and the traditional learning environment of the control course C1, at the final exams.

- E1post-E1pre (Table 3) to verify if there is a difference in students' perception between the student centred and competence based learning environment in the second half of the experimental course E1 and the traditional learning environment of the first half of E1.

At the midterm the paired t-tests for E1pre-C1pre yield statistically significant differences and small to medium practically significant effects in 3 out of 13 scales. At the final exams (E1post-C1post), after the experimental learning environment experience in E1, students' data denote 8 - mainly large - statistically significant differences in favour of the experimental setting, with in addition mainly large practically significant effects. Moreover, the 3 scales with significant effects at the pretest show increased effects, statistically and/or practically, at the posttest.

Scale	**E1post**		**E1pre**		**paired t-test**		**N**
	M	**SD**	**M**	**SD**	**p-value**	**Cohen's d**	
Self-regulation	3.08	0.80	2.84	0.78	0.15	0.25 (S)	35
Lack of regulation	2.46	0.63	2.62	0.63	0.28	-0.19	34
Controlled motivation	2.83	0.88	2.74	0.97	0.70	0.06	35
Autonomous motivation	3.08	0.62	2.90	0.61	0.14	0.25 (S)	35
Amotivation	1.67	0.59	1.69	0.61	0.89	-0.02	35
Self-efficacy	3.41	0.61	3.24	0.65	0.25	0.20 (S)	35
Perceived fit	2.31	0.75	2.49	0.70	0.29	-0.19	34
Student cohesiveness	3.70	0.60	3.02	0.79	**0.00 *****	**0.69 (M)**	34
Teacher support	3.95	0.49	3.77	0.51	0.17	0.26 (S)	29
Student involvement	3.60	0.36	3.09	0.68	**0.00 *****	**0.68 (M)**	32
Student cooperation	3.95	0.50	3.11	0.74	**0.00 *****	**0.91 (L)**	30
Enjoyment of studying	3.18	0.50	2.80	0.53	**0.00 *****	**0.53 (M)**	33
Academic efficacy	3.01	0.62	2.90	0.61	0.50	0.12	30

Table 3*: Paired t-test E1post-E1pre (N = 35)*

Considering E1 in itself, with measurements at the midterm (E1pre) and at the finals (E1post), in between which an experimental learning environment was applied, paired t-tests yield 4 large statistically significant effects with medium to large practically significant improvements, again in favour of the student centred and competence based learning environment. In the next section, we discuss these results in more detail.

5.2 Impact of student centred and competence based learning environments

To answer research question B, we consider the paired t-tests for the combinations E1post-E1pre (Table 3), E1post-C1post (Table 2), E2-C2 (Table 4) and E3-C3 (Table 5) and summarize the results in Table 6.

Scale	E2		C2		paired t-test		N
	M	SD	M	SD	p-value	Cohen's d	
Self-regulation	2.99	0.88	2.89	1.04	0.56	0.13	22
Lack of regulation	2.69	0.65	2.56	0.54	0.33	0.21 (S)	22
Controlled motivation	2.92	0.96	3.17	0.83	**0.01 ****	**-0.62 (M)**	22
Autonomous motivation	2.76	0.58	2.64	0.96	0.42	0.18	22
Amotivation	2.02	0.83	2.21	0.79	0.28	-0.24 (S)	22
Self-efficacy	2.92	0.99	2.75	1.15	0.37	0.20 (S)	22
Perceived fit	2.41	0.87	2.83	0.99	0.09 .	-0.38 (S)	22
Student cohesiveness	3.29	0.56	2.84	0.90	**0.01 ****	**0.61 (M)**	22
Teacher support	3.97	0.60	3.61	0.81	**0.02 ***	**0.56 (M)**	21
Student involvement	3.50	0.61	2.94	0.90	**0.03 ***	**0.51 (M)**	22
Student cooperation	3.81	0.58	2.84	1.13	**0.00 *****	**0.82 (L)**	19
Enjoyment of studying	2.74	0.56	2.50	0.72	0.18	0.30 (S)	22
Academic efficacy	2.54	0.76	2.42	0.97	0.39	0.19	22

Table 4: *Paired t-test E2-C2 (N = 22)*

Scale	E3		C3		paired t-test		N
	M	SD	M	SD	p-value	Cohen's d	
Self-regulation	3.27	0.72	2.77	0.80	**0.02 ***	**0.69 (M)**	15
Lack of regulation	2.10	0.47	2.77	0.52	**0.00 *****	**-1.42 (L)**	15
Controlled motivation	2.68	0.81	2.79	0.86	0.41	-0.24 (S)	13
Autonomous motivation	3.26	0.78	2.54	0.97	**0.01 ****	**0.86 (L)**	14
Amotivation	1.58	0.51	2.27	0.94	**0.01 ****	**-0.73 (M)**	15
Self-efficacy	3.75	0.98	3.18	0.99	**0.05 ***	**0.58 (M)**	14
Perceived fit	2.29	0.64	2.29	0.73	1.00	0.00	14
Student cohesiveness	3.52	0.76	2.69	0.86	**0.00 *****	**0.96 (L)**	13
Teacher support	4.42	0.52	2.93	1.06	**0.00 *****	**1.47 (L)**	13
Student involvement	3.41	0.83	2.60	0.82	**0.00 *****	**1.26 (L)**	14
Student cooperation	3.87	0.77	2.59	1.06	**0.00 *****	**1.33 (L)**	14
Enjoyment of studying	3.27	0.69	2.06	1.03	**0.00 *****	**1.33 (L)**	14
Academic efficacy	3.15	0.75	2.40	0.84	**0.01 ****	**0.88 (L)**	14

Table 5: *Paired t-test E3-C3 (N = 15)*

Table 6 gives an overview of the impact of the 3 student centred and competence based learning environments of this study. We notice a considerable number of statistically and practically significant improvements. Most striking are the effects regarding social aspects of learning, with mainly large statistically significant as well as medium to large practically significant effects for the scales *Student cohesiveness, Student involvement* and *Student cooperation*. Next comes *Enjoyment of studying* and *Teacher support* with statistically significant improvements in 3 cases and practically significant improvements in all cases. For *Self-efficacy* we find statistically significant improvements in 2 cases and

practically significant improvements in all of them. *Academic efficacy* increases with medium to large statistic significance and large practical significance in 2 cases. *Lack of regulation* decreases both statistically and practically significantly with medium to large effects in 2 cases, and shows a small practically significant increase in one case. For *Self-regulation*, *Autonomous motivation* and *Amotivation,* we note statistically significant improvements in 1 case and practically significant improvements in 3 cases. *Controlled motivation* decreases statistically significantly in 1 case and practically significantly in 2 cases. Finally, for the scale *Perceived fit*, there are only 2 cases with a small practically significant decrease.

Scale	E1post-E1pre	E1post-C1post	E2-C2	E3-C3
Self-regulation	0.25 (S)	0.20 (S)		**0.69 (M) ***
Lack of regulation		**-0.56 (M)****	0.21 (S)	**-1.42 (L)*****
Controlled motivation			**-0.62 (M)****	-0.24 (S)
Autonomous motivation	0.25 (S)	0.26 (S)		**0.86 (L)****
Amotivation		-0.30 (S)	-0.24 (S)	**-0.73 (M)****
Self-efficacy	0.20 (S)	**0.97 (L)*****	0.20 (S)	**0.58 (M)***
Perceived fit		-0.24 (S)	-0.38 (S)	
Student cohesiveness	**0.69 (M)*****	**1.05 (L)*****	**0.61 (M)****	**0.96 (L)*****
Teacher support	0.26 (S)	**0.70 (M)*****	**0.56 (M)***	**1.47 (L)*****
Student involvement	**0.68 (M)*****	**1.08 (L)*****	**0.51 (M)***	**1.26 (L)*****
Student cooperation	**0.91 (L)*****	**1.57 (L)*****	**0.82 (L)*****	**1.33 (L)*****
Enjoyment of studying	**0.53 (M)*****	**0.48 (S)****	0.30 (S)	**1.33 (L)*****
Academic efficacy		**1.06 (L)*****		**0.88 (L)****

Table 6: *An overview of the statistically and practically significant differences*

6. CONCLUSIONS AND DISCUSSION

6.1 Conclusion

In this action research study we investigate the impact of a competence based and student centred learning environment on students' learning approaches. Students of the Bachelor in Computer Science at the University of Antwerp participated by completing four times a questionnaire (82 items in 14 scales) for three successive experimental and control courses. We applied descriptive statistics and paired t-tests to verify the difference in students' perception of a traditional and a student centred learning environment and to examine to what extent regulation strategies, motivation, self-efficacy, perceived fit in pedagogical approach between secondary and university education, and student attitudes differ in a learning environment that students perceive as competence based and student centred vs in a learning environment that students perceive as traditional. We find statistically significant differences in students' perception of traditional vs student centred and competence based learning environments.

Moreover, this study illustrates the positive effects that may result from competence based and student centred learning environments. Our results show that these environments yield statistically and practically significant improvements for all scales of our study but one (*perceived fit*). We find significant increases for the scales *Self-regulation, Autonomous motivation, Self-efficacy, Student cohesiveness, Teacher support, Student involvement, Student cooperation, Enjoyment of studying* and *Academic efficacy*. In addition, we note significant decreases for the scales *Controlled motivation, Amotivation* and *Lack of regulation.* The only two exceptions are the *Perceived fit in pedagogical approach between secondary and university education* scale with small practically, but no statistically significant results, and a small practically significant increase in the *Lack of regulation* scale.

6.2 Comparison with the results of earlier studies

Our findings are in line with various studies that show an increase in the deep learning approach as a result of student centred and activating learning environments (Sivan, Wong Leung, Woon, & Kember, 2000; Wierstra, Kanselaar, van der Linden, Lodewijks, & Vermunt, 2003). On the other hand, when considering the different results in Table 6 for the different experimental learning environments, this study is also in line with research that shows that it is difficult to predict a learning environment's impact (Stes, Coertjens, & Van Petegem, 2013; Segers, Nijhuis, & Gijselaers, 2006; Maguire, Evans, & Dyas, 2001; Struyven, Dochy, Janssens, & Gielen, 2006).

6.3 Pathways for future research

In this study, we concentrated on the impact of learning environments on students' learning approach. However, also the characteristics and experiences of the individual student are major aspects that define the learning approach. A question for future research is whether competence based and student centred learning environments are valuable instruments to act not only on the learning approach, but also on deeper levels such as personality and learning style. Education 4.0 (Scharmer & Kaufer, 2013) wants to provide learners with the opportunity to achieve their highest future potential. Further investigation will have to find out which educational environments can help students to bring their personality and/or learning style in line with their highest potential.

6.4 Implications for the design of student centred and competence based learning environments

This study shows that it is worthwhile to invest in making learning environments more competence based and student centred, in order to boost students' self-

efficacy and academic efficacy, to improve their motivation and regulation strategies of learning and to increase the enjoyment of learning. It indicates (statistically significantly with mainly large effect sizes) that we can distinguish four social aspects of learning, characterizing the student perception of our experimental learning environments. These are: (a) student cohesiveness, the extent to which students are supportive of one another; (b) student involvement, the extent to which students have attentive interest, participate in discussions, perform additional work; (c) student cooperation, the extent to which students cooperate rather than compete with one another on learning tasks; and (d) teacher support, the extent to which the teacher helps, trusts, and shows interest in students. We conclude that these social qualities of learning may be helpful aspects when trying to induce a deep learning approach. Moreover, as earlier studies show that learning environments meant to stimulate students' deep learning approach often do not meet the expectations, an action research study such as presented in this paper turns out to be a valuable tool to measure the impact of the learning environment at hand.

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