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Students' conceptions of constructivist learning in different programme years and different learning environments

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Background. Constructivist views of learning have brought conceptions of learning to attention again. Conceptions are considered important determinants of effective learning. Students can differ in their conceptions depending on their educational experience.

Aims. The present study investigated students' conceptions of constructivist learning. Do students with greater experience in their academic programme differ in their conceptions of constructivist learning compared to students with less experience? In addition, to what extent are conceptions of constructivist learning different in a conventional, lecture-based curriculum compared to a constructivist, problem-based learning curriculum?

Samples. Three groups (i.e. first-year, second-year, and third-year students) in two different curricula (i.e. conventional, lecture-based and constructivist, problem-based) were tested.

Methods. A cross-sectional design was used. Students' conceptions of constructivist activities (i.e. knowledge construction, cooperative learning, self-regulation, use of authentic problems, self-perceived inability to learn, and motivation to learn) were measured by a questionnaire. Data were analyzed using a two-way multivariate analysis of variance (MANOVA).

Results. A significant difference in questionnaire's scores between year 1 and year 2 (but not between year 2 and 3) was found with respect to conceptions about knowledge construction, self-regulation, and the use of authentic problems, but not for cooperative learning and motivation to learn. For self-perceived inability, an interaction effect was found. Furthermore, results showed significant differences between both curriculum groups on all dependent measures.

Conclusions. Differences in conceptions can be perceived between students who enter a new learning programme (i.e. higher education) and students who already have one year of experience in higher education. Among students with more than one year

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of educational experience, differences disappear. Furthermore, this study shows that the learning environment can make a difference with respect to students' conceptions of constructivist learning activities.

Conceptions and their importance

Constructivist views of learning have brought conceptions of learning to attention again because personal knowledge constructions and learners' subjective beliefs play such a crucial role in these views (Wigfield, Eccles, & Pintrich, 1996). Students' conceptions of learning have become an increasingly significant construct in research on effective learning. The role of these conceptions as important determinants of effective learning (e.g. Boyle, Duffy, & Dunleavy, 2003), study strategies (e.g. Van Rossum & Schenk, 1984), approaches to learning (e.g. Crawford, Gordon, Nicholas, & Prosser, 1994), and academic achievement (e.g. McLean, 2001) has been frequently investigated.

Similarly, conceptions of knowledge (i.e. epistemologies) have also come to the fore (e.g. Schommer-Aikins, 2002), although Hofer and Pintrich (1997) have argued that it is better from a theoretical point of view that conceptions of learning and epistemologies, albeit indisputably related to each other, are kept separate. Despite this dichotomy in the theoretical field, educational researchers agree that both students' conceptions of knowledge as well as their conceptions of learning develop progressively through educational experiences.

Perry (1970) identified four stages in the development of students' conceptions of knowledge. He argued that the patterns of students' beliefs about knowledge develop throughout their academic programme from a dualistic view (i.e. knowledge is either right or wrong), to an understanding that one can approach a situation from different angles (i.e. multiplicity), to consciousness that objective information is interpreted and that these interpretations are the building-blocks of certain views from which numerous possible conclusions can be drawn (i.e. relativism), to, finally, the development of a personal opinion, acknowledging that all knowledge and ideas are relative. Similarly, Marton and colleagues, elaborating on the work of Säljö (1979), have categorised conceptions of learning in a qualitative way (Marton, Dall'Alba, & Beaty, 1993). Conceptions of learning that solely involve the increase of knowledge are considered as the starting-point from which all other conceptions of learning develop, whereas conceptions of learning that imply changing as a person are viewed as the most advanced (i.e. highest level in the development) conceptions of learning. The in-between stages in students' development of conceptions of learning involve (2) memorising, (3) applying, (4) understanding, and (5) seeing something in a different way. Essentially, these conceptions depict learning as developing from reproduction to transforming subject matter (Boulton-Lewis, Wilss, & Lewis, 2001). While these studies explicitly focused on constructing a theoretical overview of conceptions of knowledge and learning, other studies have focused on the application of these theoretical models and have investigated the kinds of conceptions of learning that are present within student groups. For example, Morgan and Beaty (1997) investigated university students' conceptions of learning over a six-year period and found the same conceptions of learning as proposed by Säljö (1979). Even the sixth conception, 'changing as a person', was held by some students. Furthermore, students' conceptions progressed from acquiring knowledge to developing understanding and seeing something in a different way. They argued that changes in conceptions of learning could be ascribed to students'

educational experiences (Morgan & Beaty, 1997). In sum, conceptions of learning and knowledge are liable to change and need to be considered as process variables.

Research questions

The present study investigated students' conceptions of *constructivist* learning in different programme years and different learning environments. Do students buy into constructivist learning to a greater extent with greater experience in their academic programme? In addition, it was examined to what extent students' conceptions of constructivist learning are different in a conventional, lecture-based curriculum compared to a constructivist (i.e. problem-based learning) curriculum. Instruction that students receive, or more broadly, the learning environment in which students are enrolled, can affect students' conceptions (Tynjälä, 1997; Vermunt & van Rijswijk, 1988).

Constructivism

Constructivism can be defined by four characteristics. A first characteristic is knowledge construction: Students build their own knowledge structures by discovering and transforming information, checking new information against old, and by revising rules when they no longer apply. Students' prior knowledge plays a key role in the development of new conceptual understandings, or in other words, in their knowledge construction process (Taylor, Fraser, & Fisher, 1997). A second aspect of constructivist learning is cooperative learning. According to a constructivist view of learning, knowledge construction can be fostered through interaction of the learner with others (e.g. fellow students and teachers; Tenenbaum, Naidu, Jegede, & Austin, 2001). Although constructivists differ with regard to the extent that cooperation contributes to knowledge acquisition, they share the idea that social negotiation and interaction is an important factor in this process (Greeno, Collins, & Resnick, 1996). The role of metacognition in learning has been stressed as a third important factor (Heikkilä & Lonka, 2006). New information is preferably acquired through self-regulated learning, which implies goal setting, self-observation, self-assessment, and self-reinforcement. Research has shown that students benefit from a learning environment that allows them to exercise control over their learning experiences and that requires them to be responsible for their own learning performances (Tenenbaum *et al.*, 2001). Fourth, most constructivists agree that meaningful learning is encouraged by authentic learning tasks. Encountering situations and solving problems that are similar to the kinds of situations and problems learners will face in their future profession provide students with practice in thinking in realistic, life-like situations (Needels & Knapp, 1994).

Hypotheses

Three student groups (i.e. first-year, second-year, and third-year students) in two different curricula (i.e. conventional, lecture-based and constructivist, problem-based) were tested. It is hypothesized that students' conceptions of constructivist learning are different in different programme years, in line with previous research (e.g. Boulton-Lewis *et al.*, 2001; Morgan & Beaty, 1997). This is expected because in the course of their academic programme, students are supposed to experience the beneficial effects of constructivist activities such as knowledge construction, cooperative learning, self-regulation, and working on authentic problems on their learning processes. Furthermore, it is hypothesized that students enrolled in a constructivist learning

environment should agree on constructivist learning assumptions to a greater extent, since such a learning environment is based on these constructs.

Method

Participants

Participants were 212 first-year (146 female, 66 male; mean age=20.02, *SD*=2.95) 155 second-year (112 female, 43 male; mean age=20.01, *SD*=1.83), and 57 third-year (46 female, 11 male; mean age=22.01, *SD*=4.05) students enrolled in a problem-based learning (PBL) psychology curriculum at Erasmus University Rotterdam in The Netherlands.

In addition, 378 first-year (308 female, 71 male; mean age=19.05, *SD*=2.73), 187 second-year (161 female, 26 male; mean age=20.82, *SD*=3.81), and 36 third-year (29 female, 7 male; mean age=21.33, *SD*=0.99) students of Utrecht University in The Netherlands took part. They were enrolled in a conventional, psychology curriculum.

Students were attended to this study by means of messages posted on the electronic learning environments at both universities. Participation was voluntarily and participants received compensation in terms of research credits or a gift certificate.

Learning environments

The PBL curriculum involved in this study was structured as follows. Students work in small groups (maximum 11 students, randomly put together) on authentic problems under the guidance of a tutor (Barrows, 1996). These problems consist of a description of observable phenomena or events that are to be explained in terms of their underlying theoretical explanation. First, students discuss these problems and possible explanations or solutions are proposed. Since their prior knowledge of the problem-at-hand is limited, questions will come up and dilemmas will arise that are used as learning issues for subsequent, individual learning. Subsequently, students spend time studying literature relevant to the issues generated. After this period of self-study, students share their findings, elaborate on knowledge acquired, and have an opportunity to correct misconceptions (Hmelo-Silver, 2004; Norman & Schmidt, 1992). Tutorial sessions last three hours each and are held twice a week. Each year of the PBL curriculum in this study consists of eight courses of five weeks each. At the end of each course, a test is administered.

The conventional, lecture-based curriculum consists of two semesters of 22 weeks each. Each semester is divided in two periods of 10 weeks, followed by an examination week. Students attend lectures of two hours each, twice a week. For some courses (e.g. statistics), students need to attend additional two-hour practical sessions as well.

Measurement of students' conceptions

Students' conceptions of constructivist activities were measured by means of a 55-item questionnaire (Loyens, Rikers, & Schmidt, 2007a). The statements needed to be rated on a 7-point Likert-scale ranging from -3 (entirely disagree) to $+3$ (entirely agree). Although constructivism is embodied in numerous ways (e.g. Windschitl, 2002), most views share important ideas. Most constructivist theories share four core assumptions that should be considered while creating learning environments for students. These assumptions can be labelled as (1) knowledge construction, (2) cooperative learning,

(3) self-regulation, and (4) the use of ill-structured, authentic problems (e.g. Marshall, 1992; Woolfolk, 2004). Students' conceptions of these four constructs were measured by the aforementioned questionnaire. In addition, self-perceived inability to learn and motivation to learn were taken into account. Self-perceived inability to learn refers to feelings of doubt concerning one's own learning capacities. It has been observed that open, constructive learning environments require a great deal of responsibility from learners in terms of being socially apt, self-regulated knowledge constructors. Some learners may experience this as a positive challenge and as part of their learning process, but others may relapse into uncertainty, confusion, and even anxiety (Duke, Forbes, Hunter, & Prosser, 1998). Motivation to learn is a widely acknowledged factor influencing students' learning (e.g. Pintrich & Schunk, 1996; Schunk, 1991).

The questionnaire is influenced by research on self-regulated learning and motivation (Pintrich & de Groot, 1990), mental models (Vermunt, 1992), conceptions of learning (Marton *et al.*, 1993), conceptions of knowledge (Schraw, Bendixen, & Dunkle, 2002), and constructivist literature (e.g. Marshall, 1992; Steffe & Gale, 1995; Tenenbaum *et al.*, 2001) with respect to its theoretical background. However, the questionnaire developed focuses explicitly on *conceptions* of the utility of *constructivist* learning activities and is therefore different from existing instruments (Loyens *et al.*, 2007a). Examples of items are shown in Table 1.

Table 1. Item examples of students' conceptions of constructivist learning activities

Concept	Item examples (translated from Dutch)
Knowledge construction ($n = 10$)	'Previous learned facts are the building blocks of new knowledge'
Cooperative learning ($n = 9$)	'Discussing subject matter with fellow-students leads to a better understanding'
Self-regulation ($n = 9$)	'Preparing a test is difficult when the teacher has not pointed out exactly what has to be studied' (reversed scoring)
Authentic problems ($n = 7$)	'Emphasis on practical abilities during the curriculum gives you a head start in your future job'
Self-perceived inability to learn ($n = 12$)	'I doubt if I can complete this study successfully'
Motivation to learn ($n = 8$)	'I easily find the motivation to study'

Confirmatory factor analysis has demonstrated that the questionnaire was able to measure students' conceptions in a reliable and valid fashion (Comparative Fit Index; CFI of 0.94, Tucker-Lewis Index; TLI of 0.92 and a Root Mean Square of Approximation; RMSEA of 0.05). Students were able to identify the six dimensions comprising the questionnaire. Testing for measurement invariance showed that factor loadings were equivalent across different groups of students and that the questionnaire's underlying factor structure gave evidence of cross-validation. The reliability of the six latent constructs was assessed using coefficient H (Hancock & Mueller, 2001) and ranged from .60 to .86 (Loyens *et al.*, 2007a).

Procedure

A cross-sectional design was used to test the three student groups of both (i.e. lecture-based and problem-based learning) curricula. The questionnaire was administered to

all students at the beginning of the academic year. The questionnaire's instruction stated that there were no right or wrong answers to the items, all answers were correct as long as they reflected students' personal opinions. No information was given about the constructs underlying the questionnaire. Filling in the questionnaire took approximately ten to fifteen minutes. The questionnaire could be filled out at home or at campus.

Statistical analysis

Responses to negatively stated items ($n = 23$) were reversed so that for all items the highest response score was indicative for a positive rating of each of the six constructs. Descriptive statistics were calculated for the four constructivist learning assumptions together with self-perceived inability to learn and motivation to learn in the two curricula and three programme years.

Data were analyzed using a two-way multivariate analysis of variance (MANOVA) with programme years (first, second, and third year) and learning environment (conventional, lecture-based and constructivist problem-based) as between-subject factors and six conception-measures as dependent variables. Post-hoc multiple comparisons were performed for the year-of-programme-variable.

Results

Descriptive statistics

Table 2 reports the means and standard deviations of the four constructivist learning assumptions together with self-perceived inability to learn and motivation to learn in the two curricula and the three programme years. In our sample, scores were highest (i.e. students agreed the most) for conceptions of knowledge construction and the lowest for conceptions of self-perceived inability to learn. This implies that students acknowledge the importance of previous learned knowledge and actively constructing new knowledge for their learning processes the most. On the other hand, students do not have strong doubts concerning their own capabilities to learn. Furthermore, all self-regulated learning scores for both student groups were negative, indicating that students disagree with the importance of self-regulated learning activities for their learning processes.

Testing the assumptions for MANOVA

Preliminary analysis of the data involved inspection of the assumptions of independent observations, normality, and homogeneity of the covariances. The assumption of independent observations was met because students filled in the questionnaire independently of each other. All dependent measures met the normality criterion. Box's test of equality of covariance matrices was significant (Box's $M = 194.66$, $p < .001$), implying that the assumption of equal covariances was not met. However, further analysis showed that the smallest (co)variances were found in the smallest subsamples (i.e. third-year students). According to Tabachnick and Fidell (1996), the F-statistic is conservative in that case, meaning that the actual α is lower than the usual 5%.

Table 2. Means and standard deviations of the six dependent variables in the two curricula and three programme years

	Conventional, lecture based curriculum						Constructivist, problem-based learning curriculum					
	1		2		3		1		2		3	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Knowledge construction	1.31	0.45	1.64	0.52	1.45	0.50	1.51	0.50	1.72	0.57	1.68	0.51
Cooperative learning	0.53	0.83	0.36	0.78	0.41	0.86	0.90	0.69	0.82	0.71	0.73	0.73
Self-regulated learning	−0.66	0.72	−0.49	0.71	−0.39	0.69	−0.49	0.78	−0.30	0.84	−0.21	0.72
Authentic problems	0.03	0.78	0.27	0.86	0.35	0.67	0.66	0.77	0.82	0.80	0.71	0.72
Self-perceived inability to learn	−0.34	0.89	−0.79	0.96	−1.20	0.62	−0.56	0.85	−0.55	1.01	−0.67	0.78
Motivation to learn	0.56	0.96	0.56	1.09	0.72	0.90	0.51	1.00	0.34	1.03	0.43	1.11

Results of the MANOVA

Results of the MANOVA showed significant differences on all dependent measures between the two learning environments [Hotelling's $T^2=0.13$, $F(6, 1014) = 21.21$, $p < .01$] as well as among the different years of both programmes [Wilks's $\Lambda = .87$, $F(12, 2028) = 12.02$, $p < .01$][1]. Furthermore, a significant interaction effect was observed between different programme years and both curricula [Wilks's $\Lambda = .97$, $F(12, 2028) = 2.93$, $p < .01$].

Differences between the constructivist and conventional curriculum

Univariate results showed significant differences between the two curriculum groups on all dependent measures. The problem-based learning group agreed more on knowledge construction, cooperative learning, self-regulated learning, and the use of authentic problems and agreed less on statements about motivation to learn, which is in line with a previous study (Loyens, Rikers, & Schmidt, 2006).

The interaction effect appeared only significant for self-perceived inability to learn [$F(2,1019) = 10.75$, $p < .01$, $\eta^2 = .02$][2]. While students in a conventional curriculum agreed significantly less on statements concerning self-perceived inability to learn in the course of their academic programme, conceptions of students enrolled in a constructivist curriculum with respect to this factor do not differ significantly over the years.

Differences in the course of the programme

To examine differences in students' conceptions in the course of their programme, collapsed over both curricula, post-hoc multiple comparisons were conducted, using the Bonferroni method. No significant differences were found between the three programme years on cooperative learning (*MD* year 1 - year 2 = .09, $p = .26$; *MD* year 1 - year 3 = .05, $p > .99$; *MD* year 2 - year 3 = −.04, $p > .99$) and motivation to learn (*MD* year 1 - year 2 = .09, $p = .58$; *MD* year 1 - year 3 = 0, $p > .99$; *MD* year 2 - year 3 = −.09, $p > .99$). Significant differences were found between the first-year and the second-year students and between the first-year and the third-year students with respect to conceptions about knowledge construction (*MD* year 1 - year 2 = −.30, $p < .001$; *MD* year 1 - year 3 = −.21, $p < .001$), self-regulation (*MD* year 1 - year 2 = −.20, $p < .001$; *MD* year 1 - year 3 = −.32, $p < .001$), and the use of authentic problems (*MD* year 1 - year 2 = −.26, $p < .001$; *MD* year 1 - year 3 = −.31, $p < .001$). Students in year 1 scored significantly higher compared to students in year 2. However, second-year students did not differ in terms of conceptions of constructivist learning with third-year students (knowledge construction; *MD* year 2 - year 3 = .09, $p = .40$; self-regulation; *MD* year 2 - year 3 = −.12, $p = .49$; authentic problems; *MD* year 2 - year 3 = −.05, $p > .99$). For self-perceived inability to learn, first- and second-year students differed significantly (*MD*=.27, $p < .001$) as well as first- and third-year students (*MD*=.46, $p < .001$). In contrast, scores on self-perceived inability did not differ significantly between second- and third-year students (*MD*=.19, $p = .20$). However, as mentioned above, there was an interaction effect for this variable.

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[1] *Note that for a between-subject factor with more than two groups Wilks's Λ is used (Stevens, 1996).*

[2] *Following (Stevens 1996, p. 177; based on Cohen, 1977, pp. 284–288), partial $\eta^2 = 0.01$ was interpreted as small, partial $\eta^2 = 0.06$ as medium, and partial $\eta^2 = 0.14$ as large.*

Discussion

The present study investigated students' conceptions of constructivist learning activities. More specifically, it examined (1) whether students' conceptions differ with more experience in university education and (2) whether constructivist conceptions are different in a conventional, lecture-based curriculum compared to a constructivist, problem-based curriculum.

Differences in students' conceptions of constructivist learning activities

In general, students' conceptions of constructivist learning activities differ among students in different stages of their academic programme, but differences can only be found between first- and second-year students. This was the case for conceptions of knowledge construction, self-regulation, and the use of authentic tasks. Second-year students agreed significantly more on the utility of these constructs, compared to first-year students. With greater experience in their programme, students become more convinced of the impact of constructivist activities on their learning processes, which is in line with previous research that states that educational experiences have an influence on conceptions (e.g. Entwistle & Peterson, 2004; Hofer & Pintrich, 1997; Morgan & Beaty, 1997). This could be because they have experienced the beneficial and motivating effects of relating new subject matter with previous learned knowledge, self-regulated activities such as goal setting, self-assessment, and self-reinforcement, and the encounters with authentic learning tasks. Why no significant differences were found concerning students' conceptions of cooperative learning and motivation to learn is puzzling, since one would expect that students also encounter positive effects of social interaction and motivation to learn.

For self-perceived inability to learn, an interaction effect was found: Students in a conventional curriculum agreed less on self-perceived inability throughout the years, while this factor remained at the same level for the constructivist learning population. This finding reflects the fact that open, constructivist learning environments require more responsibility from learners which can lead to a certain level of uncertainty and self-perceived incapability, which is in line with previous research (Duke *et al.*, 1998). Comparison of both students groups indicated that students in constructivist learning environments have more feelings of doubt (although those feelings are not very strong) concerning one's own learning capacities. While with greater academic experience, students' beliefs of self-perceived inability seem to diminish within students enrolled in a conventional curriculum, students in a constructivist-learning environment maintain these beliefs. Previous research has demonstrated that these conceptions can make students work harder in terms of study hours to overcome their self-perceived inability (Block, 1996; Loyens, Rikers, & Schmidt, 2007b). However, conceptions of self-perceived inability are on the other hand related to undesirable regulation strategies (Loyens, Rikers, & Schmidt, 2008). Mean scores of conceptions of self-perceived inability to learn demonstrate that students tend to disagree with this construct, which will be explained in the next section.

Differences between the constructivist and conventional curriculum

Results indicated that students enrolled in a constructivist-learning environment agree more on several constructivist learning assumptions (i.e. knowledge construction, cooperative learning, and the use of authentic tasks) compared to a conventional

curriculum group. Being enrolled in a constructivist learning environment and experiencing effects of such an environment clearly reflects on students' conceptions. In fact, it has been demonstrated that first-year students who chose a constructivist learning environment already start with some different (i.e. in favour of constructivist learning assumptions) conceptions of constructivist learning at the beginning of the academic year, compared to students who chose to be enrolled in a conventional curriculum (Loyens *et al.*, 2006). The present study shows that when second- and third-year students are also taken into account, differences evolved on even more constructivist learning assumptions.

However, students in the problem-based learning group agreed less on the influence of motivation to learn on their learning process. This finding is somewhat surprising, since making students intrinsically motivated to learn is especially prominent in constructivist learning environments. However, it is in line with previous research among starting, first-year students in a problem-based learning and lecture-based curriculum, with PBL students reporting less agreement on the importance of motivation (Loyens *et al.*, 2006). There is little research that bears directly on this issue in constructivist learning environments. Most research has instead investigated student satisfaction or confidence (Hmelo-Silver, 2004). Several explanations have been put forward for why learning formats such as problem-based learning can possibly fail to motivate students. Although these learning formats can lead to effective solutions, it is usually unsystematic. This implies that when the problem-solving process fails, learners tend to ascribe this to their ability, rather than to their technique, which is detrimental to their motivation (Zimmerman & Campillo, 2003).

Students in constructivist learning environments also agree more on statements of self-regulation compared to students in the conventional curriculum under study. However, it should be noted that both students groups produce negative scores (i.e. disagree) with this construct, but students in the constructivist curriculum disagree less. Although being able to regulate your own learning is viewed as the key to successful learning in school and beyond (Boekaerts, 1999) and although self-regulation has positive effects on students' learning processes (e.g. Cantwell & Moore, 1996; Heikkilä & Lonka, 2006; Minnaert & Janssen, 1999; VanZile-Tamsen & Livingston, 1999), students tend to disagree. One can argue that goal setting, self-observation, self-assessment, and self-reinforcement, although important for learning, impose a substantial burden on students and calls for a great responsibility of learners. Devolving the responsibility for their learning process (in terms of which subject matter needs to be studied, time management etc.) on to the teacher and relying on faculty goals (instead of setting one's own learning goals) can make students more confident (Lloyd-Jones & Hak, 2004). Nevertheless, a significant difference in conceptions of self-regulated learning was found between first- and second-year students with second-year students scoring higher on this construct, as mentioned earlier.

Finally, comparison of the students enrolled in the problem-based learning and lecture-based curriculum showed that students in the problem-based learning group significantly agreed more on the construct of self-perceived inability to learn. However, both groups obtained negative scores (i.e. disagree) for this construct implying that, in general, students believe they are capable of attending higher education successfully. As mentioned before, open, constructivist learning environments are more demanding for learners in terms of being socially apt, self-regulated knowledge constructors. The results of this study indicate that students in constructivist learning environments have more feelings of doubt concerning their own learning capacities compared to students in a lecture-based curriculum, but all in all, they disagree with this construct.

The present study demonstrates that differences with respect to students' conceptions of constructivist learning activities can be detected between students of different learning environments. While earlier studies (e.g. Tynjälä, 1997) demonstrated the effect by manipulating the learning environment (i.e. by implementing certain learning tasks that were labelled as constructivist), we were able to demonstrate it in an actual learning environment.

In summary, the majority of students' conceptions of constructivist learning activities differ for students in different stages of their academic programme. However, significant differences could only be found between first- and second-year students of higher education. It has been argued that entering higher education leads to conflict and eventually to different conceptions, since students encounter a different learning environment (Entwistle & Peterson, 2004). Unlike conceptions of learning and knowledge, however, conceptions of constructivist learning activities do not form a hierarchical system. Differences in conceptions of constructivism such as the ones we found between first- and second-year students imply greater agreement with certain assumptions or, in other words, becoming more convinced of the impact of these assumptions on their learning process. Possibly, that is the reason why no significant differences were found for students in later college years.

Implications

The present study indicated students in different learning environments have different conceptions of constructivist learning. This implies that comparative educational research should take students' conceptions into account, since they can influence other aspects of learning (e.g. study approaches). In fact, two-way relationships have been proposed between conceptions and study approaches. Conceptions can differ through experiences of teaching and studying, which influences subsequent learning activities (Entwistle & Peterson, 2004).

Secondly, the results of this study show that differences in conceptions due to a new learning programme (i.e. higher education) were only found between first- and second-year students. For students in later years, no significant differences were found. A longitudinal design should be employed to investigate whether the first year of higher education is indeed a 'critical period'. This could have important implications for training programmes developed to alter students' conceptions.

Limitations and directions for further research

There is, however, a constraint to our findings. This study used a cross-sectional design while a longitudinal design could have mapped changes in conceptions more precisely. Also, students in this study were all psychology students. Research including students from other programmes can enhance generalisation of the findings of this study. In the present study, students of a conventional lecture-based and a constructivist problem-based learning curriculum were compared. However, students chose themselves to be enrolled in a particular learning environment. Conducting a controlled experiment in which students are randomly assigned to either a conventional or constructivist-learning environment should reveal the influence of this choice of learning environment. Furthermore, a controlled experiment could also rule out the possibility that a conventional curriculum also contains constructivist elements, although to a lesser extent than a problem-based learning environment. A final point of attention is that fourth-year psychology students, who are traditionally doing internships in this phase of

the academic programme, were not included in this study. During internships, students need to apply the knowledge they have learned into practice, which may reflect on their conceptions. For example, it can be argued that it is only during internships that students can fully acknowledge the value of for instance cooperative learning, since they have to work together with colleagues in a professional setting. Therefore, a direction for further research is to scrutinize this particular group of students.

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