Effects of a School Reform on Longitudinal Stability of Students’ Preferences with Regard to Education.

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Abstract

Background. Students’ perspective on education is of crucial importance for its effectivity, but students’ opinions are seldom acknowledged by teachers and designers. Student participation in the educational design process could be a suitable tool to better take students’ preferences into account. However, for effective participatory design it is necessary to know whether students have stable preferences for the design of their education. Changeability of preferences would require a more continuing design process allowing continuous adaptations.

Aims. This longitudinal survey study aimed to determine the changeability over time of students’ preferences for different aspects of a learning environment. Additionally, causes of possible changes in preferences are investigated.

Sample. The participants were 1335 high school students of five schools for secondary education in the Netherlands, joining this study during a period of two years.

Method. Data about students’ preferences were collected at three moments, using the Inventory of Perceived Study Environment Extended. Learning-related student characteristics, like processing strategies and motivational orientations, were measured with the Inventory of Learning Styles. Additionally, data on learning performances were collected.

Results. The results showed stability on preferences for almost all studied characteristics of the learning environment. Particularly remarkable was a drop in desirability for student autonomy. This was larger for students with a certificate-oriented motivation and smaller for self-regulated students. Additionally, poorly-performing students had a larger decrease in preference for autonomy.

Conclusions. The stability on most aspects supports that participatory design might result in fairly stable instructional designs, although caution is needed with respect to student autonomy.
Effects of a School Reform on Longitudinal Stability of Students’ Preferences with Regard to Education.

Students are not just consumers of education. They have their own perspective on education and ideas about how education should be designed. These ideas are rooted in their mental models on teaching and learning which gradually develop in interaction with concrete teaching and learning experiences (Edwards-Leis, 2010). Given that students interpret instructional input from their own mental models and act in line with these models, it is of paramount importance for teachers and designers to consider these models. One way to get insight into students’ mental models is to listen to students’ preferences. Students often share their preferences about teaching and learning practices with peers; however, educational designers and teacher mostly do not listen to them (Cook-Sather, 2001, 2003; Könings, Van Zundert, Brand-Gruwel, & Van Merriënboer, 2007). Ignorance of students’ perspectives is common practice, as in schools the adults are in positions of power over students: They are considered as professionals in creating effective learning environments (Burke, 2007).

Student’s influence on the design process is mostly limited to the role of user, being observed by the designer while working in a newly designed learning environment (Druin, 2002). However, a much more direct relationship to designers is needed. “Students should help shape rather than simply be shaped by educational policies and practices” (Cook-Sather, 2003). There is a growing call for including students as participants in the educational design process (see e.g., Rudduck & McIntyre, 2007; Schultz, 2011), but much is as yet unknown about the prerequisites and effects of student participation.

Students’ preferences for education will determine their input while participating in the design process. They are expected to contribute to the design by sharing their opinions and preferences with the teachers and/or the designers. Little is known yet about how to implement participatory design (Berns, 2004; Kensing & Blomberg, 1998; Könings, Brand-
Stability of Preferences

Gruwel, & Van Merriënboer, in press) in the process of curriculum development. The current study aims to find out how changeable students’ preferences are. It is known from the literature that students’ learning strategies, conceptions and preferences change over time and that students’ learning gets more sophisticated (see e.g., Vermetten, Vermunt, & Lodewijks, 1999). However, it is currently unclear how to deal with this when students are involved in designing their education: How often do you have to adapt the educational design to account adequately to changing students’ preferences? For how long would a design be applicable - in the sense that it fits to students’ preferences - after it was designed? Stability of students’ preferences would imply that students can participate in structural, long-lasting educational design processes resulting in stable design outcomes. Changeable preferences would point to a need for a more continuing process of adapting instruction based on changing input from students. Moreover, students can have stable preferences for certain characteristics of their lessons, while changeable preferences for others. To implement participatory design well, it would be beneficial to know which characteristics of education students’ preferences are most likely to change.

The current study therefore focused on the changeability of students’ preferences over time on different characteristics of a learning environment. Changeability is defined in this study as a significant increase or decrease of a student’s preference for a characteristic of the learning environment over the period of one or two years. The first research aim is to investigate whether students’ preferences are stable, which enables participatory designing education for the longer run, or more changeable requiring a continuous re/design process. Therefore, student preferences for eight aspects of education (e.g., integration between different subject matters, interaction with peers during learning) are determined in a longitudinal study. Secondly, the study aims to gain insight in student variables that relate to possible changes in preferences. There are many studies investigating students’ preferences...
for education and characteristics of students that influence preferences at a single moment
(see e.g., Chang & Tsai, 2005; Furnham & Chamorro-Premuzic, 2005; Sadler-Smith &
Riding, 1999; Vermunt & Vermetten, 2004), but to our knowledge there is no research
available about characteristics that influence the degree to which students’ preferences change
over time. Therefore, a second aim of this study is to explore - for aspects that change over
time – which learning-related student characteristics predict later changes in preferences as
well as relations between the change in preferences and students’ performances.

Why Listen to Students’ Preferences?

Modern student-centred education is aimed to be driven by knowledge of the students,
for they are the users of educational designs (Markopoulos & Bekker, 2003). It is a positive
development that educational practice and research has begun to acknowledge the importance
of listening to students’ voices. However, it is hard to gather correct knowledge about
students’ learning from the perspective of an adult (i.e., teacher). Research has shown that
teachers are not able to assess their students’ preferences in learning more accurately than by
guessing (Holt, Denny, Capp, & de Vore, 2005). Therefore, making students’ learning
preferences explicit is an important step in the process of gathering information that is needed
for designing effective and adaptive education (Könings, Brand-Gruwel, & van Merriënboer,
2005; Smyth, 2001). Additionally, a mismatch between students’ preferences and the goals
that are pursued by teachers can result in motivational problems and disengagement of
students (Eccles, et al., 1993; Hijzen, Boekaerts, & Vedder, 2007).

Taken together, there are convincing motives that student participation in the
educational design process earns a more prominent place in educational practice. Research on
necessary preconditions for student participation and ways to implement it in educational
practice is still very limited. An important prerequisite for successful student participation is
to know whether students have stable or changeable preferences for the different
characteristics of a learning environment. In the current study the longitudinal change of students’ preferences is investigated in secondary school students, just before and just after they enter a new learning environment.

Student preferences

Students’ ideas about how they would like to learn are described in literature in many ways. Sadler-Smith (1999) define instructional preferences as an “individual’s propensity to choose or express a liking for a particular instructional technique or combination of techniques” (p. 357). This definition, however, does not give an indication of underlying variables influencing these preferences. An important concept in this context is students’ meta-cognitive instructional knowledge: “knowledge of learners about the way in which instructional features may help or hinder them to learn or to realise (instructional or learning) tasks” (Elen & Lowyck, 1999, p.149). Additionally, instructional beliefs reflect students’ preferences as they are considered as “students’ ideas about optimal relationships between instructional features of a learning environment or specific instructional interventions on the one hand, and learning on the other” (Lowyck, Elen, & Clarebout, 2004). In other words, these beliefs about effectiveness of instructional approaches and how to handle them reflect their mental models of teaching and learning (Edwards-Leis, 2010).

Curry (1983) developed an ‘onion model’ to more clearly position the concept of students’ preference in our thinking about students’ learning. The outermost layer of the onion model refers to the student’s desires on the environment within s/he has to learn. The middle layer refers to the information processing style or learning styles, and the inner layer consists of the cognitive personality style which is a central personality characteristic. The inner layers can be considered as the basis for the more outside layers which are also more influenced by learning experiences and the learning context, and by consequence are more likely to change. So, both stability and variability in students’ preferences could be expected.
Indeed there is evidence in educational research for variability in students’ preferences. A study of Stjernquist and Crang-Svalenius (2007) has shown that students’ preferences can change during the medical curriculum. Students’ preferences for case-based learning and problem-based learning were evaluated in the 8th and 11th term of medical school. Students in the former group rated both methods highly, while in the latter group students’ preferences for problem-based learning were decreased in favour of case-based learning. Also, assessment preferences have been shown to be subject to variation. University bachelor students’ preferences for assessment with higher-order thinking tasks were lower after experiencing a new (formative) mode of assessment than before (Gijbels & Dochy, 2006). Even instructional beliefs about the instructional power of elements in a learning environment can change as a consequence of learning in a new and innovative environment (Elen & Clarebout, 2001; Sarfo & Elen, 2008). In a pre-test post-test design Elen and Clarebout (2001) found that through participation in an innovative (problem-based, collaborative and technologically rich) learning environment students’ beliefs changed. In this study the beliefs in the power of problem-based learning and technology diminished.

However, as well as studies showing changeability there is also contradictory evidence showing that students’ preferences are much more stable over time. Wiersta and colleagues (Wierstra et al., 1999) investigated perceptions and desires about education of Dutch students at their home university and South European students who were foreign students at a Dutch university. Large differences have been found between different countries on perceptions of education at the home institutions. However, all students had strikingly similar preferences for the learning environment, indicating that preferences are quite stable and not strongly determined by these experiences. Using a teach-back and focus group strategies to detect mental models about teaching and learning of secondary school students, Edwards-Leis
Stability of Preferences 8

(2010) also found stability in students’ mental models that greatly affected how they worked in problem-based learning environments.

Taken together, there are studies indicating that students adapt their preferences after concrete experiences, although other studies have mostly found stability. The literature described above does not, therefore, unanimously agree about stability or changeability. For the purpose of successful student participation in educational design, there is a need to know on which characteristics of a learning environment students’ preferences are that stable that effective contributions to the design process would be possible. The first aim of this study is to determine the stability over time of students’ preferences for different characteristics of a learning environment.

As well as the question as to whether student preferences changes, it is highly interesting to know why they change. Student preferences are influenced by their cognitive style (Sadler-Smith & Riding, 1999), personality traits as a student prefers similarity to their teachers’ traits (Furnham & Chamorro-Premuzic, 2005), and epistemological beliefs (Chang & Tsai, 2005). However, these studies investigated the relations between these variables and preferences at one single moment, not in a longitudinal perspective. The current study focuses on relations between students’ learning-related characteristics and changing preferences. More specifically, it is aimed to determine which student characteristics before entering a new learning environment predict changes in students’ preferences when entering it.

There is evidence from the literature for relations between students’ preferences and their learning-related characteristics, as there is an interaction between the student with his/her internal characteristics and the learning environment. Vermunt (1996, Vermunt & Vermetten, 2004) defined five clusters of internal learning-related variables: Information processing strategies, regulation strategies, motivational orientations, conceptions about learning, and affective processing strategies. For each of these clusters, earlier research has shown relations
with students’ preferences. Firstly, students’ habits for using different kinds of cognitive processing strategies (i.e., cognitive activities that students use to process learning contents) are related to desires about the learning environment: Students prefer an environment that supports their habitual way of learning (Entwistle & Tait, 1990). Secondly, the use of regulation strategies (i.e., the way in which students regulate and steer their learning process) influences the way of dealing with preferences. Students, who use self-regulatory strategies, actively manage their environment, adapt to it, and change the environment to better fit their desires and needs (Pintrich & Schauben, 1992). Thirdly, students’ motivational orientations (i.e., personal goals or motives students have for learning and going to school) seem relevant. Education which fails to meet students’ needs is likely to have negative consequences on students’ motivation and engagement (e.g., Eccles et al., 1993). Fourthly, students’ conceptions about learning and what constitutes learning relate to preferences about how to learn: Students with constructivist-oriented beliefs prefer environments in which knowledge construction has a prominent place (Tsai, 2000). Finally, affective processing strategies might also be related, as emotions and affective states influence students’ learning processes (Vermunt & Vermetten, 2004). However, these learning-related characteristics are shown to relate to what students prefer at one single moment. The current study investigated which of these students’ characteristics predict whether students’ preferences change over time.

Additionally, students’ preferences are likely to be related to achievements, since students prefer methods that they feel are best-suited to their ability (Furnham et al., 2008). A perceived lack of ability is a reason for disliking subjects (Stables & Wikeley, 1997). There even appeared to be differences in preferences, depending on the learning context the student is thinking of. Elen and Lowyck (1999, 2000) found that “there is a tension between (a) what students regard to be important for learning itself, and (b) what students think to be important for learning in an instructional setting .... In the latter case, students hand over responsibility
to the instructional agent and look for ways to – as efficiently as possible – accomplish the
goals.” So, the goal to perform in education appears to influence students’ preferences for
learning. These studies, however, studied relations between achievements and preferences at a
single moment, not in a longitudinal perspective of changing preferences. Therefore, the final
aim of the current study is to investigate the relation between students’ achievements and
changes in their preferences.

To conclude, earlier research has demonstrated relations between students’ preferences
and their learning related characteristics, and learning performances. These relations,
however, are not studied in the context of changing preferences. In addition to the question
whether students’ preferences change, this study, therefore, investigates which learning-
related characteristics predict in student preferences (before the transition to a new learning
environment) and relations between learning performances and changes in preferences (after
the transition). For effective student participation in educational design this will provide
valuable information about stability or changeability of students’ preferences and the
background of eventual changes in preferences.

Research questions

During this longitudinal survey, students of five secondary schools in the Netherlands
have reported in questionnaires about their preferences about the educational design of their
lessons. At the first assessment time (T1), students were on the eve of participating in an
innovative learning environment and their preferences about it were measured on all eight
characteristics of the environment, mentioned above. Additionally, their learning-related
characteristics were measured to investigate which characteristics might predict later changes
in preferences. Students also reported on their preferences about their lessons after 1 year of
experience (T2) and again after 2 years (T3). Changes between measures at T1, T2, and T3
were investigated as well as relations between possible changes and learning-related
characteristics and performances. To define the subject of students’ preferences we have chosen to use the current theory about aims and characteristics of modern education as a frame of reference. It includes all components of powerful learning environments (see De Corte, Verschaffel, Entwistle, & Van Merriënboer, 2003, and Könings, Brand-Gruwel, & Van Merriënboer, 2005, for an overview), which have been shown to be beneficial for learning and that are, thus, assumed to be important topics to discuss during a participatory design process.

The proposed concepts involved in the current study are depicted in Figure 1: Students’ preferences are measured longitudinally on three moments. The changeability between the assessment times is the topic of interest. Learning-related student characteristics are investigated as predictors of change and, additionally, relations between changes in preferences and learning performances in the new learning environment are examined. In summary, the current study answers the following research questions: (1) Do students’ preferences change over time, after experiencing a new learning environment?; (2) Which learning-related characteristics of students predict changes in preferences later on?, and (3) Do possible changes in preferences relate to students’ learning performances?

As students enter a learning environment with a larger emphasis on student-centeredness than students were used to before, it is hypothesised that, in particular, students’ preferences for self-study and autonomy are likely to change because of the large transition in learning and teaching practice in this respect. We expect that students with high meta-cognitive skills – like self-regulation strategies, deep information processing, and constructive conceptions of learning – are most likely to have stable preferences, as they know best what helps and hinders their learning (Elen & Lowyck, 1999). Meta-cognition could be considered as an indicator of understanding and insight into own learning needs. Furthermore, it is hypothesized that bad achievements cause decreasing preferences for self-directed learning, as students are likely to prefer diminishing responsibility (Elen & Lowyck, 1999, 2000).
Method

Participants

At the first measurement (T1), the sample consisted of 842 ninth graders (mean age = 15.27 years, SD = .52) of five schools for secondary education in the Netherlands, attending either senior general education (i.e., a five year program, preparing for higher professional education) or pre-university education (i.e., a six year program, preparing for university education). They were on the eve of participating in an innovative learning environment in Dutch secondary education, called the Second Phase. One year later (T2), the sample consisted of 1,146 tenth graders, of whom 727 students had already participated at T1. At T2 all students had participated in the innovative environment for one year. At T3 the sample consisted of 704 eleventh graders of four schools: 433 of these students participated at all three measurement moments; 181 of them at T2 and T3; 16 at T1 and T3, and 74 at T3 only. At T3, the eleventh graders had studied for about two years in the learning environment. In total, 1,335 students participated in the study (50.6% girls, 49.4% boys).

The increase in the number of participants at T2 was partly due to one school, of which the management decided at T1 to participate in this study with only half of the students (i.e., classes). One year later (T2), however, all tenth graders of this school participated. Furthermore, about 200 of the newly included participants at T2 were repeaters from an earlier cohort (i.e., year). About 20 students at T2 had been absent during data collection at T1. The attrition at T2 is likely to be due to incidental absence of students and non-promotion from ninth to tenth grade. The decrease in the number of participants at T3 was partly due to non-promoted students who left the program. Because at each measurement the non-promoted students of an earlier cohort were added to the sample, there is prevented for unwanted shifts or biases in the sample. Additionally, part of the attrition was due to one school refraining from further data collection at T3.
Materials

The learning environment. The context of this study is a nationwide innovation in Dutch secondary education, called the Second Phase (Ministerie van OCW, 2005; Stuurgroep Profiel Tweede Fase Voortgezet Onderwijs, 1995; Veugelers, de Jong, & Schellings, 2004). The learning environment requires students to independently acquire skills and knowledge to better prepare them for higher professional education and university. Students learn in a self-directed way with possibilities for collaborative learning. There is more room for individual differences than in the traditional educational system and teachers have to take these differences into account. The teacher’s role is more like a coach and less like an instructor, who creates more possibilities for interaction between students and the teacher. The learning process is not only directed to knowledge acquisition, but also to the selection and processing of the vast amounts of information available today. Furthermore, learning contents are actualized and broadened. In addition, the coherence between knowledge and skills and the application of knowledge in subject-matter domains are emphasized.

The objective characteristics of the implementation of the Second Phase on the schools participating in this study are beyond the scope of this research. However, we acknowledge that schools and teachers play an important role in translating the innovation to daily practice in the classroom and it is necessary to account for this in the current study. As the implementation could vary between schools of teachers, the analyses are corrected for possible school and/or class effects.

Inventory of Expected Study Environment Extended (IESEE) and Inventory of Perceived Study Environment Extended (IPSEE). The IESEE (Könings, Brand-Gruwel, van Merriënboer, & Broers, 2008) measures students’ expectations of a forthcoming learning environment and their preferences about that environment. It is a parallel version of the Inventory of Perceived Study Environment Extended (IPSEE), which aims to measure
students’ perceptions of a learning environment and preferences for its design. The IESEE/IPSEE measures eight main characteristics of powerful learning environments. Both IESEE and IPSEE consist of 67 items, partly based on the Inventory of Perceived Study Environment (IPSE; Wierstra, Kanselaar, van der Linden, & Lodewijks, 1999). The items are covering the following eight scales:

The scale **fascinating contents** contains items about the extent to which the learning contents are interesting, challenging, and personally relevant for students. The scale **productive learning** indicates little emphasis on the sole reproduction of learning contents. The scale **integration** concerns integration of new knowledge with prior knowledge, the integration of different knowledge domains, and the integration of knowledge and skills. The scale **student autonomy** measures attention paid to student’s self-directing concerning the content of learning, the way of learning, and time planning. The scale **interaction** incorporates collaboration with peers and interaction with the teacher. The scale **differentiation** inquires about opportunities for students to choose and make different tasks, solve problems in different ways, and use different learning materials. The scale **clarity of goals** includes items about the clarity of instructional goals and task demands. The scale **personalization** measures the availability of support of teachers.

A sample item of each scale is included in Table 1. All items contain a description of one of the characteristics of a learning environment and two statements; one related to its expectation/presence and one related to its desirability. For example:

The teacher makes a connection between theory and examples from practice.

A) This happens

B) I would like this to happen
Statements are rated on a 6-point rating scale, ranging from totally disagree (1) to totally agree (6). For answering the research questions we are especially interested in the scores on statement B, showing what the student prefers for the environment.

Internal consistencies of the preference items of the scales of the IESEE are presented in Table 2 (Column 2). The coefficients ranged from .65 for the scales clarity of goals and personalization to .78 for the scale student autonomy. In total, 4 of 8 Cronbach’s alpha coefficients were above .60 and 4 were above .70. To examine whether the eight scales are sufficiently independent to warrant separate consideration, pairwise correlations between the scales were computed. Of the 28 correlations, all were below .50 implying that less than 25% of the variation on that scale can be explained by variation on the other scale. In addition, the tolerance was computed as a check for possible collinearity between scales. The tolerance measure, which has a range from 0 to 1, indicates serious collinearity if the values are below .10. It was computed separately for each scale: The lowest value was .65. There is no statistical objection to considering the 8 IESEE-scales on desires separately.

Internal consistencies of the IPSEE scales are computed separately at T2 and T3 (Columns 3 and 4; Table 2). The coefficients ranged from .68 for the scale personalization (at T3) to .84 for the scale student autonomy (at T2). In total, 1 of 16 Cronbach’s alpha coefficients were above .60; 11 were above .70, and 4 were above .80. As for the IESEE-scales, correlations between the scales were computed. At T2, 25 of 28 correlations were below .50, 2 were between .50 and .60, and 1 was .65. The lowest tolerance value found at T2 was .44. Of the remaining values, 3 were above .50 and another 4 were above .60. For T3, 24 correlations between the scales were below .50, 4 were between .50 and .60, and 1 was above .65. The lowest tolerance value was .49; 2 values were above .50 and another 5 above .60. Thus, there are no statistical objections to considering the 8 scales on desires separately.
Inventory of Learning Styles for Secondary Education (ILS-SE). The ILS was originally developed to measure higher education students’ learning styles (Vermunt, 1992) and was adapted for secondary education by Vermunt, Bouhuijs, and Picarelli (2003). It measures learning-related characteristics of students, based on their usual way of learning. The ILS-SE consists of 100 items, divided in five clusters: Processing strategies (cognitive activities students use to process learning contents), regulation strategies (the way students regulate their own learning process), motivational orientations (personal goals or motives students have for learning and going to school), conceptions of learning (mental models about learning), and affective processing strategies (emotional aspects of learning). Each of the clusters contains several scales (see Table 3).

For each item, students rate the degree to which a statement corresponds to their own learning on a 5-point scale. Information about internal consistencies of the scales at T1 is included in Table 3. Cronbach’s alpha ranged for almost all scales from .60 to .87. However, two scales had an alpha below .60: For both the scales concerning intrinsic motivation and certificate-oriented motivation the alpha was .58. In the original report on the psychometric characteristics of the ILS-SE Cronbach’s alphas of respectively .60 and .77 were reported, indicating a satisfactory level of internal consistency (Picarelli, Slaats, Bouhuijs, & Vermunt, 2006). Despite the limitation of the low alphas on these two scales in our study, we are still using them in the analyses, as we prefer to use the inventory in its original version. However, the results on these scales are interpreted with caution.

By computing correlations and tolerance values, we tested the independence of the 16 ILS–SE-scales. It showed that 116 of the correlations were below .50, three were between .50 and .60, and only one was slightly above .60. The lowest tolerance value was .40, with 12 values above .60. Thus, there was no statistical objection to considering the 16 ILS–SE scales separately.
Student Performances. Marks that students obtained on their school reports were used as a measure for learning performances. At T2, data from school administrations were available for this study and an average score was computed of marks on two different reports, three and seven months after the beginning of the school year in September (respectively, reports delivered around Christmas and Easter).

Procedure

At T1, the participants were in the ninth grade and just before entering the new learning environment when they filled out the IESEE and the ILS-SE. After one and two year of experience in this environment (respectively, T2 and T3), students filled out the IPSEE. Preceding the completion of a questionnaire, students received a short oral instruction about the goal and content of the questionnaire and about the way items had to be scored. This instruction was repeated on the first page of each questionnaire. The IESEE/IPSEE took between 30 and 40 min. to complete; The ILS-SE took between 20 and 30 min. The participants filled out the questionnaires during regular school hours.

Data Analysis

Data are analyzed with a longitudinal mixed model: Repeated measures are considered to be nested in participants (due to repeated measurements) and participants are considered to be nested in classes (i.e., year groups). Because the number of schools is too small to permit inference to the population of schools, school was included as a fixed factor in the model to correct for correlations in the data due to nesting within schools. School and/or class were only included in the model if their effects were significant at a level of $p < .10$.

Apart from accounting for the multilevel structure of the data, the longitudinal mixed model analysis has the advantage over traditional repeated measure analyses that participants with missing data on one or two measurements can still be used for estimation purposes.
Under the assumption that cases are missing at random (which is plausible in our case) mixed model analysis allows for a more efficient use of the available data.

A specific problem for analyzing data is correction for class effects. Class composition changed over the time periods so that the same pupil could belong to three differently composed classes. This problem was circumvented by trying out (a maximum of) three different class corrections for each separate model. Class was first tried out as a random factor by using the classes as composed at T1, at T2, and at T3. In principle, this procedure might end up with more significant class effects to be reported. In the Results section, the reported standard errors are corrected for school effects (if relevant). If a significant class effect changed a parameter estimate from significant to non-significant, or vice versa, this will be explicitly discussed in the text. Only results significant at a level of $p < .01$ are reported.

To answer the first research question on how preferences change over time, $F$-values were computed for testing longitudinal effects over time (with post-hoc pairwise comparisons, Bonferroni correction). Mixed model analyses were conducted for analyzing the relationship between changes in preferences and learning-related student characteristics at T1 (research question 2), but only when changes in preferences were apparent. For investigating the relationship between changes in preferences and students’ performances (research question 3) Pearson correlations were computed. Again, analyses were limited to those scales that showed considerable changes between times of measurement.

Results

Longitudinal Change of Student Preferences

Table 4 presents the means and standard deviations of preference scores (T1, T2, and T3). The results of mixed model longitudinal analyses on preference scores are presented in Table 5 and indicate whether scores are stable over time (research question 1). $F$-tests showed non-significant longitudinal effects on three scales: Interaction, personalization, and clarity of
goals. On the latter scale, preference scores showed no significant longitudinal effect when corrected for school only. However, when corrected for class composition at T3 and school, they did show a significant, but small, effect ($F = 7.09$; T2 – T1 = -.10 ($SE = .03$; $d = .19$); T3 – T2 = .01 ($SE = .02$; $d = < .01$); T3 – T1 = -.08 ($SE = .03$; $d = .08$)).

Analyses showed significant longitudinal effects on five scales: fascinating contents, productive learning, integration, and differentiation (see also Figure 2). These changes in preferences between the three times of measurement were small. Effect sizes in terms of Cohen’s $d$ of 0.2 to 0.3 are considered small effects, around 0.5 as medium effects and larger than 0.8 as large effects (Cohen, 1988). Inspecting Table 5 demonstrates that the effect sizes of differences between either T1 and T2, or T2 and T3, or T1 and T3 were all below .25, indicating only small changes. Additionally, however, a change of medium effect size was found in preference for student autonomy. In particular, students considered student autonomy as much more desirable before entering the new learning environment (at T1) than after one year of experiencing it (at T2). There were no large changes in the scores from T2 to T3 on this scale and, by consequence, the significant decrease between T1 and T3 was due to the decline in desirability between T1 and T2.

In summary, results showed that students’ preferences for the design of the learning environment showed stable elements and also some longitudinal changes which were mostly small. However, the desirability of student autonomy decreased considerably from T1 to T2 and, therefore, will be subject of further analyses in respect to research question 2 and 3.

**Relationships Between Changes in Preference for Student Autonomy and Learning-Related Student Characteristics**

The mixed model analyses on the relation between changes in preference and learning-related student characteristics (research question 2) indicate which students’ characteristics at T1 predict a later decrease in preference for student autonomy. The results showed that the
more self-regulation of own learning processes was reported by students before entering the new learning environment, the smaller was the subsequent decrease in preference for autonomy \((B = -.09; SE B = .04; \beta = -.09; t(640) = -2.32; p = .02)\). Additionally, it yielded that the more certificate-oriented students’ motivation for learning was, the larger the later decrease in preference for student autonomy \((B = .11; SE B = .05; \beta = .10; t(640) = 2.57; p = .01)\). The latter result, however, should be interpreted with some caution because of a low Cronbach’s alpha on certificate-orientedness and a low regression weight.

So, a large decline in preference for student autonomy between T1 and T2 took place especially for students reporting low self-regulation beforehand and for students who studied mainly for passing tests and gaining high grades. No significant influence was found for either effects of school or class composition.

Relationships Between Changes in Preference for Student Autonomy and Performances

For answering research question 3, the relation between the decrease in preference for student autonomy (between T1 and T2) and performances is investigated. School report data at T1 and T2 were used, including grade marks on the reports of three and seven months after students entered the new learning environment. Note that data collection about preferences took place about nine to ten months after beginning of the school year.

Results of Pearson correlations showed trends: the lower the 10th grade marks after three months, the stronger the decrease in preference for student autonomy \((r = .07, p < .10)\).

Explorative analyses on a possible influence of the level of education students were attending yielded different correlations for students of senior general education and of pre-university education. Data of students of senior general education showed no significant relations between performances and change in preference for student autonomy. For pre-university students, all performance measures correlated with change in preference: the lower
student’s performances in the 10th grade, the stronger the decrease in preference for autonomy (report after three months: \( r = .14, p < .01 \); report after seven months: \( r = .11, p < .05 \)).

The results on the three research questions are summarized in Figure 3: There was a medium sized effect (i.e., decrease) in desires for student autonomy between T1 and T2. This decrease related to higher scores on certificate-oriented motivation and lower scores on self-regulation. Additionally, poor performances related to a larger decrease in preference for autonomy.

Conclusions and Discussion

The current study investigated students’ preferences with respect to the design of their learning environment. More specifically, it aimed to examine whether preferences are stable or changeable over time. Modern education tries to adapt to student needs, but the way of arranging it largely depends on the changeability of students’ preferences. Therefore, this study focused on comparing the preferences before students entered in a new, innovative learning environment with their preferences after one and two years of experiences in that environment.

The first research question focused on the longitudinal change of preferences. Eight characteristics of the learning environment are investigated. Results show no changes on two of them (interaction and personalization) and only small changes on five other characteristics (fascinating contents, productive learning, integration, differentiation, and clarity of goals). With respect to student autonomy a large drop in desirability was apparent after students enter the new environment, confirming our hypothesis on this research question. At T2 – after one year of experience in the new learning environment – the preferences for student autonomy (i.e., self-direction concerning learning contents, way of learning and time planning) were much lower than one year before. The findings on fairly stable preferences are in line with the results of studies of Wierstra and colleagues (1999, 2003) showing similarities in preferences,
despite of large differences in the perceived learning environments. However, our results on preferences for student autonomy points also to changeability.

Therefore, the second and third research question offers deeper insight in possible correlates of this change for student autonomy. With respect to learning-related student characteristics, it showed that the more students learned in a self-regulated way before entering the new environment, the smaller was the decrease in desirability of autonomy. In contrast, a certificate-oriented learning orientation related to a larger decrease in preferences for autonomy (with some caution because of a low Cronbach’s alpha). These findings are in line with the hypothesis that meta-cognitive skills could have a stabilizing effect on preferences and lack of them may relate to changeability. Decreasing preferences for autonomy are also found for students performing badly in the new learning environment. This confirms our hypothesis, but, remarkably, explorative analyses showed that this is true especially for students at pre-university education and does not hold for students of senior general education.

The fact that poor performances could be a ground for changing preferences indicates that students perceive school primarily as a study environment for accomplishing their performance goals (see, Elen & Lowyck, 1999). Students are likely to desire an environment with distributed responsibilities between teachers and students, in which students are encouraged to work independently, but with ample support (Elen et al., 2007). This combined responsibility creates a safe environment, but if the balance between teachers’ and students’ roles is disturbed by too extremely-implemented student-centeredness, students may feel losing control over their learning and performances, resulting in the decrease in preference for autonomy we found in this study.

Another possible explanation for the decrease on student autonomy may be that students adapt their preferences based on disappointing experiences with working
autonomously. Probably it was difficult for them. Research of Jolles and colleagues has shown that adolescents are not yet able to direct their learning processes themselves since the frontal parts of the brain are not mature enough to enable complex processes required for planning and control functions (Jolles et al., 2006). The brain is still in development and students have difficulties with learning tasks that are too unstructured and require difficult choices concerning selecting relevant study materials. Our findings may reflect that students themselves experience that they are not well able to study autonomously. Further research is needed to investigate the truth of the assumption that students are aware of their difficulty with studying autonomously, when reducing their preferences for autonomy.

Finally, an explanation for students getting lower preference for autonomy could be that the innovation (Second Phase) is not implemented as it was expected. As it is often the case with large educational innovation, getting started with this implementation was difficult. Both students and teachers experienced high work load and there was too little support for optimally implementing new didactics (Dijsselbloem et al., 2008). Especially the implementation with respect to stimulating student autonomy and differentiation were not convincingly perceived by teachers (Könings, Brand-Gruwel, & van Merriënboer, 2007). Although this might have influenced students’ preferences for student autonomy, it is not self-evident. If students are not given enough room for autonomy during learning they could still prefer it, or even prefer it more strongly because they lack it. However, high workload could also have influenced preferences for autonomy, since it might then be more efficient for students to hand over the control over learning to the teacher. This links to the explanation mentioned earlier, that students prefer a safe learning environment under difficult circumstances.

An implication of the results of this study is that students seem able to participate successfully in an educational design process. Students have, predominantly, fairly stable
ideas about what they consider as desirable in an educational design. Therefore, including them as participants in the design process is likely to result in stable design outcomes for the longer run. However, educational designers and teachers should be aware that with respect to student autonomy students do not have stable preferences. Extra attention should be given to the design of autonomous learning elements in a learning environment. Possibilities should be provided to redesign the environment while implementing it, as students could then immediately reflect on their experiences and translate them to the educational design.

Moreover, some students adapt their preferences on student autonomy, dependent on their performances. It seems important to account for this during the educational design process. An alternative to accounting for changeability of preferences on autonomy could also be to train students to be able to plan and monitor their study behaviour and improve their meta-cognitive skills and study behaviour. Such a training could influence stability of the students’ preferences on autonomy and by that fulfil a prerequisite for an innovation to be successful.

Implementing participatory design has to be the focus of future research, investigating possible procedures to organise participatory design meetings as well as testing the effectiveness of participatory design in terms of learning outcomes. An interview study with students and teachers about their possible preferences for a possible implementation of participatory design meetings yielded several practical guidelines (Könings, van Zundert, Brand-Gruwel, & van Merriënboer, 2007). These could be a starting point for further research.

A theoretical implication of our study is that it seems very difficult to determine the stability of preferences. Our study offers support to earlier studies showing stability in students’ preferences. However, there is also much evidence for changes in preferences. In order to better understand why preferences sometimes appear to change while others remain
stable, further research is needed on defining variables that might explain changes in students’ preferences.

A limitation of the current study is that preferences are measured at a fairly global level. More precise measures would be applicable when studying students’ preferences for a smaller element of the instruction, for example the lessons on a specific topic. For getting better understanding about causes for changes in preferences it might, additionally, beneficial to reduce the time between the measurements. Measuring preferences once a year, was suitable for our study on long-lasting stability of preferences for enabling effective student participation in educational design. For getting a deeper understanding of the underlying processes, however, more fine-grained studies are needed. Furthermore, it would be valuable to examine in detail the possible relations between learning-related student characteristics and performances in the context of changing preferences for education, as former research has indicated the existence of such relations (Busato, Prins, Elshout, & Hamaker, 2000). In the current study, data on learning-related characteristics were from a different time measurement than data on performances, which hindered a proper analysis of (possible) interrelatedness and its effects on changes in student preferences. Investigating possible interaction effects between performances and learning-related student characteristics was beyond the scope of our study, but would be an interesting goal of future research. With structural equation modelling direct and indirect effects of the variables could be examined in future research.

To conclude, this study showed that students have fairly stable ideas on how ideal education would look like for them. This is a good starting point for collaborating more intensively with students when designing education. However, students’ preferences with regard to student autonomy are far less stable and change depending on learning-related characteristics and study performances. Extra attention should be paid to this aspect of a learning environment, when designing it in a participatory way.
Acknowledgments

The authors gratefully thank Chris Harrison, Keele University (UK) for checking and correcting use of the English language.
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### Table 1

**Sample Items for All Scales of the IPSEE**

<table>
<thead>
<tr>
<th>IPSEE Scale</th>
<th>Sample item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fascinating contents</td>
<td>The assignments students have to make clearly relate to topics in everyday life.</td>
</tr>
<tr>
<td>Productive learning</td>
<td>The teacher expects the students to get the meaning of the concepts into their mind one by one</td>
</tr>
<tr>
<td>Integration</td>
<td>The teacher expects students to connect the various aspects of the subject matter on their own.</td>
</tr>
<tr>
<td>Student autonomy</td>
<td>I am given the opportunity to pursue my particular interest in the course.</td>
</tr>
<tr>
<td>Interaction</td>
<td>During classes, the subject matter is discussed with the students.</td>
</tr>
<tr>
<td>Differentiation</td>
<td>All students solve their assignments in the same way.</td>
</tr>
<tr>
<td>Clarity of goals</td>
<td>Students are informed what to expect of the examination.</td>
</tr>
<tr>
<td>Personalization</td>
<td>Students can always rely on the teacher for help.</td>
</tr>
</tbody>
</table>
Table 2

Internal Consistencies of the Scales of the IESEE at T1, and the IPSEE at T2 and T3, All With Respect to Preference Scores

<table>
<thead>
<tr>
<th>Cronbach’s alpha coefficient</th>
<th>Number of items</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fascinating contents</td>
<td>9</td>
<td>.69</td>
<td>.77</td>
<td>.80</td>
</tr>
<tr>
<td>Productive learning</td>
<td>5</td>
<td>.76</td>
<td>.81</td>
<td>.76</td>
</tr>
<tr>
<td>Integration</td>
<td>11</td>
<td>.73</td>
<td>.78</td>
<td>.78</td>
</tr>
<tr>
<td>Student autonomy</td>
<td>15</td>
<td>.78</td>
<td>.84</td>
<td>.81</td>
</tr>
<tr>
<td>Interaction</td>
<td>11</td>
<td>.68</td>
<td>.73</td>
<td>.71</td>
</tr>
<tr>
<td>Differentiation</td>
<td>6</td>
<td>.72</td>
<td>.73</td>
<td>.73</td>
</tr>
<tr>
<td>Clarity of goals</td>
<td>4</td>
<td>.65</td>
<td>.72</td>
<td>.72</td>
</tr>
<tr>
<td>Personalization</td>
<td>6</td>
<td>.65</td>
<td>.70</td>
<td>.68</td>
</tr>
</tbody>
</table>

*Note.* T = Time of assessment (1, 2 or 3).
Table 3

*Descriptions and Internal Consistencies of the Scales of the ILS-SE at T1*
<table>
<thead>
<tr>
<th>Cluster</th>
<th>Scale</th>
<th>Description of scale</th>
<th>Number of items</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processing strategies</td>
<td>Deep processing</td>
<td>Relating and structuring knowledge elements and critical processing of information</td>
<td>12</td>
<td>.84</td>
</tr>
<tr>
<td></td>
<td>Stepwise processing</td>
<td>Memorising, rehearsing, studying information in detail</td>
<td>8</td>
<td>.81</td>
</tr>
<tr>
<td>Regulation strategies</td>
<td>Self-regulation</td>
<td>Regulation of the own learning process through activities like planning, monitoring, reflecting and own initiatives with respect to learning contents</td>
<td>8</td>
<td>.71</td>
</tr>
<tr>
<td></td>
<td>External regulation</td>
<td>Learning processes to be regulated by external sources (i.e., books/teacher)</td>
<td>6</td>
<td>.68</td>
</tr>
<tr>
<td></td>
<td>Lack of regulation</td>
<td>Difficulties with regulating learning and processing contents effectively</td>
<td>4</td>
<td>.66</td>
</tr>
<tr>
<td>Learning orientations</td>
<td>Intrinsic motivation</td>
<td>Learning because of interest in learning contents and the desire to develop oneself</td>
<td>4</td>
<td>.58</td>
</tr>
<tr>
<td></td>
<td>Certificate-oriented</td>
<td>Learning for passing tests, gaining high grades, and obtaining certificates</td>
<td>5</td>
<td>.58</td>
</tr>
<tr>
<td></td>
<td>Vocation-oriented</td>
<td>Learning for future study and professions</td>
<td>4</td>
<td>.73</td>
</tr>
<tr>
<td></td>
<td>Ambivalent</td>
<td>Doubtful, uncertain attitude toward own capacities and chosen courses</td>
<td>5</td>
<td>.75</td>
</tr>
<tr>
<td>Conceptions of learning</td>
<td>Construction and use of knowledge</td>
<td>Learning as constructing one’s own knowledge and using it by means of concretising and applying</td>
<td>8</td>
<td>.82</td>
</tr>
<tr>
<td>Affective processing strategies</td>
<td>Problems with motivation and concentration</td>
<td>Problems with staying concentrated and motivated during learning, easily being distracted and showing postponing behaviour</td>
<td>8</td>
<td>.87</td>
</tr>
<tr>
<td></td>
<td>Cooperative learning</td>
<td>Preferring learning in cooperation with fellow students</td>
<td>3</td>
<td>.70</td>
</tr>
<tr>
<td>Fear of failure</td>
<td>Experiencing stress during learning, especially in testing situations, and having a negative self-image</td>
<td>8</td>
<td>.87</td>
<td></td>
</tr>
<tr>
<td>Keeping a good state of mind</td>
<td>Having a positive idea about own capacities, being self-confident and performing activities to stay motivated and concentrated</td>
<td>8</td>
<td>.72</td>
<td></td>
</tr>
</tbody>
</table>
Table 4

Measures and Standard Deviations of Preference Scores

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
<td>$M$</td>
</tr>
<tr>
<td>Fascinating contents</td>
<td>4.76</td>
<td>.65</td>
<td>4.87</td>
</tr>
<tr>
<td>Productive learning</td>
<td>4.10</td>
<td>.94</td>
<td>3.85</td>
</tr>
<tr>
<td>Integration</td>
<td>4.58</td>
<td>.55</td>
<td>4.60</td>
</tr>
<tr>
<td>Student autonomy</td>
<td>4.88</td>
<td>.51</td>
<td>4.56</td>
</tr>
<tr>
<td>Interaction</td>
<td>4.59</td>
<td>.58</td>
<td>4.56</td>
</tr>
<tr>
<td>Differentiation</td>
<td>3.39</td>
<td>.94</td>
<td>3.22</td>
</tr>
<tr>
<td>Clarity of goals</td>
<td>5.37</td>
<td>.53</td>
<td>5.32</td>
</tr>
<tr>
<td>Personalization</td>
<td>4.97</td>
<td>.61</td>
<td>4.99</td>
</tr>
</tbody>
</table>

Note. T = Time of assessment (1, 2 or 3).
Table 5

Results of Mixed Model Analyses on Longitudinal Data of Preferences at T1, T2, and T3

<table>
<thead>
<tr>
<th>Preference</th>
<th>T2 – T1</th>
<th>T3 – T2</th>
<th>T3 – T1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$F (df)$</td>
<td>$\Delta$</td>
<td>$SE$</td>
</tr>
<tr>
<td>Fascinating contents</td>
<td>26.94* (2, 357.85)</td>
<td>.12*</td>
<td>.02</td>
</tr>
<tr>
<td>Productive learning</td>
<td>27.12* (2, 391.90)</td>
<td>-.24*</td>
<td>.03</td>
</tr>
<tr>
<td>Integration</td>
<td>12.64* (2, 388.82)</td>
<td>.02</td>
<td>.02</td>
</tr>
<tr>
<td>Student autonomy</td>
<td>115.65* (2, 490.25)</td>
<td>-.31*</td>
<td>.02</td>
</tr>
<tr>
<td>Interaction</td>
<td>3.46 (2, 327.57)</td>
<td>-.01</td>
<td>.02</td>
</tr>
<tr>
<td>Differentiation</td>
<td>13.18* (2, 477.97)</td>
<td>-.16*</td>
<td>.03</td>
</tr>
<tr>
<td>Clarity of goals</td>
<td>3.14 (2, 608.02)</td>
<td>-.05</td>
<td>.02</td>
</tr>
<tr>
<td>Personalization</td>
<td>.44 (2, 374.00)</td>
<td>.02</td>
<td>.02</td>
</tr>
</tbody>
</table>

Note. T = Time of assessment (1, 2 or 3). Standard errors are based on estimation of fixed effects without correction for Class effects, but with correction for School effects (if $p_{school} < .10$). Additional correction for Class effects did not change the significance of the result, unless stated in text. * $p < .01$
Figure Captions

*Figure 1.* Visualization of variables involved in the study.

*Figure 2.* Mean Scores and Standard Deviations of Preferences over Time.

*Figure 3.* Visualization of the results of the study.
Figure 1
Figure 2
Figure 3

LEARNING ENVIRONMENT

Student autonomy

Students’ preferences at T1

Change T1 – T2

Students’ preferences at T2

Learning-related student characteristics:
Self-regulation_{T1} (+)
Certificate-oriented_{T1} (-)

Students’ performances at T2 (-)