

Student engagement and performance: A weekly diary study on the role of openness

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Published online: 16 September 2014
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Abstract In the present study, we used a quantitative diary design to investigate within-person fluctuations in student engagement and performance. Specifically, we analyzed the impact of weekly personal and study resources on weekly student engagement, active learning behaviors, and performance. In addition, we investigated whether students high (vs. low) in trait Openness reacted differently to their weekly resources. The sample was composed of 45 first-year psychology students who filled in a questionnaire over 3 weeks; twice per week ($N = 45 \times 6 = 270$ occasions)—during the days they had tutorial group meetings. The tutors evaluated each student's active learning behaviors during these meetings. Results of hierarchical linear modeling analyses showed that study engagement fully mediated the relationship between personal resources and observed learning activities; study resources were indirectly positively related to learning activities through study engagement. In addition, observed learning activities were positively related to the

course grade. As hypothesized, trait Openness strengthened the positive relationship between personal/study resources and study engagement. Our findings highlight the importance of fostering students' engagement. We conclude with a discussion of the theoretical implications for education and suggestions for future research.

Keywords Diary study · Openness to experience · Personal resources · Student engagement · Study resources

Introduction

Regardless of the definition, research has shown that student engagement is related to improved performance (e.g., Fredericks et al. 2004; Lee and Shute 2010; Schaufeli et al. 2002). Engaged students are intrinsically motivated to invest in learning, attend classes, and participate in study activities. They are curious, ask questions, and enjoy learning challenges. Vigorous and dedicated students are energetically immersed in their studies, which makes them successful as well (Salanova et al. 2010).

Engagement in learning activities is a particularly relevant variable because it is responsive to contextual features, and amenable to environmental change (Finn and Rock 1997; Fredericks et al. 2004). Thus, unlike gender or socio-economic status, engagement may be malleable. Educators may be able to influence engagement to increase students' chances of completing their education successfully. However, remarkably, the vast majority of studies on student engagement have examined relatively stable differences between students in terms of their enduring engagement and performance. Such between-person studies cannot explain why even highly engaged students may have an off-day and sometimes show below

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average or poor performance in the classroom or on course exams.

In the present study, we investigate short-term fluctuations in engagement and active learning behaviors of students who follow a problem-based learning model. We followed students over the course of 3 weeks, during which they participated in tutorial group meetings twice per week. In problem-based learning, students “use “triggers” from the problem case or scenario to define their own learning objectives. Subsequently they do independent, self directed study before returning to the group to discuss and refine their acquired knowledge”. (Wood 2003; p. 328). We use a quantitative diary design to investigate within-person fluctuations in student engagement and learning activities, and we relate this to study performance. Whereas students reported on their weekly resources and levels of engagement, tutors observed students’ active learning behaviors during the group meetings. An important advantage of diary research is that it relies less on retrospective recall than regular surveys, since the questions relate to individuals’ perceptions, feelings, and behaviors on a certain day (Ohly et al. 2010).

The central aim of the present study is to examine the impact of weekly personal and study resources on student engagement and performance. We will also investigate whether students high (vs. low) in trait Openness react differently to their weekly resources. Of the traditional dimensions of personality, Conscientiousness usually has the strongest main effects on performance (Hurtz and Donovan 2000; Poropat 2009). However, we will argue that those who are open to experience are most likely to be triggered by weekly personal and study resources. Open individuals are behaviorally flexible and intellectually curious, and these qualities make them particularly sensitive to and appreciative of weekly resources.

Theoretical background

Educational researchers seem to agree that there are three dimensions of engagement: behavioral, emotional, and cognitive engagement (Fredericks et al. 2004). Whereas behavioral engagement refers to active involvement in learning and academic tasks and includes behaviors such as effort, persistence, concentration, attention, asking questions, and contributing to class discussion (Birch and Ladd 1997; Finn et al. 1995; Skinner and Belmont 1993); emotional engagement refers to identification with school (Finn 1989; Voelkl 1997), and students’ affective reactions in the classroom (Skinner and Belmont 1993). Finally, cognitive engagement has been defined as the psychological investment in and effort directed toward learning, understanding, and mastering the knowledge and skills taught in schools (Newmann et al. 1992; Wehlage et al. 1989).

Schaufeli et al. (2002) proposed a slightly different approach to engagement. They defined enduring study engagement as a positive, fulfilling state of mind that is characterized by vigor, dedication, and absorption. Vigor refers to high levels of energy and resilience while studying. Dedication is characterized by being strongly involved in one’s studies and experiencing a sense of significance and enthusiasm. Absorption is the state of being fully concentrated and happily engrossed in one’s study activities. Thus, consistent with other conceptualizations of student engagement, Schaufeli et al.’s conceptualization entails a behavioral-energetic (vigor), an emotional (dedication), and a cognitive (absorption) component. Engaged students have high levels of energy and are enthusiastically involved in their studies. Moreover, they are often fully immersed in their study activities so that time flies. Several studies have provided evidence for the validity of this conceptualization of study engagement (Salanova et al. 2010; Schaufeli et al. 2002; Vasalampi et al. 2009; Zhang et al. 2007).

As alluded to before, engaged students may also have their off-days. Therefore, in the present study, we focus on weekly fluctuations in engagement. To the best of our knowledge, state student engagement has not been investigated before, but there is evidence for the validity and meaningfulness of state engagement in a work context. Sonnentag (2003) was the first to argue and show that levels of engagement may vary within the same person from day to day in response to specific situational and personal conditions. In a recent review of the literature, Xanthopoulou and Bakker (2012) concluded that the average amount of variance in engagement that may be attributed to (daily) within-person fluctuations is no less than 42 %. In what follows, we will discuss the possible short-term antecedents of weekly student engagement.

Weekly resources, engagement, and performance

Several between-person studies have shown that resourceful study environments can foster student engagement. For example, Salanova et al. (2010) showed that organizational and social facilitators (e.g., access to student language learning services, social support from family and friends) were positive predictors of study engagement. Similarly, Skinner and Belmont (1993) found that teacher provision of autonomy, support, and optimal structure predicted children’s engagement across the school year. Student engagement may be also influenced by perceptions of teachers’ behaviors (Assor et al. 2002). In their study among children and early adolescents, the latter authors found that students’ behavioral and cognitive engagement increased when teachers fostered understanding and interest.

Skinner and Belmont (1993) have argued that environmental resources are good predictors of engagement, because they satisfy students' needs for relatedness, autonomy, and competence. In addition, resources can be instrumental in reaching one's goals (Bakker 2011). In the present study, we will investigate weekly autonomy, performance feedback, opportunities for development, and social support from fellow students, family and friends as possible resources that may facilitate weekly student engagement. Studies in the work context have shown that such resources can facilitate engagement and have a positive impact on performance, also on a weekly basis (Bakker and Bal 2010; Xanthopoulou et al. 2009).

Engagement is a good predictor of academic performance because engaged students invest high levels of effort and energy, are dedicated to their studies, and they are often immersed in their study activities. The persistent focus on study activities makes engaged students goal oriented, and increases the likelihood that they learn well. Indeed, earlier survey research has provided evidence for an engagement—performance link in a study context (Fredericks et al. 2004; Lee and Shute 2010; Salanova et al. 2010; Schaufeli et al. 2002), and in a work context (Christian et al. 2011). For example, in their study among university students from Spain, Portugal, and the Netherlands, Schaufeli et al. (2002) found that study engagement was positively related to academic performance (i.e. the number of passed exams relative to the total number of exams in the previous term). Moreover, Vasalampi et al. (2009) used Schaufeli et al.'s (2002) conceptualization of engagement and found that a high level of school engagement during upper secondary school predicted girls' success in the educational transition after upper secondary school.

Translated to the week-level, we expect that students will show most active learning behaviors during the weeks they have access to most study resources, since in these weeks they will experience the highest levels of energy, be most strongly dedicated, and be most immersed in their study activities.

Hypothesis 1 Weekly study resources are positively related to weekly active learning, through weekly study engagement.

Connell's (1990) process model of motivation reflects the idea that both contextual and self-related variables have to be considered to provide a complete picture for understanding school engagement. Indeed, in addition to study resources, previous research suggests that *personal* resources (e.g., self-efficacy, optimism, and self-esteem) are important predictors of student engagement. Personal resources are positive self-evaluations that are linked to resiliency and refer to individuals' sense of their ability to

successfully control and have an impact on their environment (Hobfoll et al. 2003). It has been shown that such positive self-evaluations predict goal setting, motivation, and performance (Judge et al. 2004; Luthans et al. 2007; Xanthopoulou et al. 2009). The reason for this is that the higher an individual's personal resources, the more positive that individual's self-regard and the more goal self-concordance is expected to be experienced. Individuals with goal self-concordance are intrinsically motivated to pursue their study goals, and as a result they perform better.

Consistent with this reasoning, Connell et al. (1994) argued and showed that perceived parental involvement impacted students' self-efficacy, self-esteem, and responsibility and that those personal resources played a significant role in the development of students' academic engagement. In a similar vein, Ouweneel et al. (2011) found that the experience of positive emotions predicted students' future personal resources, which subsequently predicted study engagement. Students who were self-efficacious regarding their study, and who were hopeful and optimistic about their future, showed highest levels of study engagement. Also, results from a study among high school students revealed that goal orientation and self-efficacy were positively related to student engagement (Caraway et al. 2003). On the basis of this overview, we formulated the next hypothesis:

Hypothesis 2 Weekly personal resources (self-efficacy, optimism, and self-esteem) are positively related to weekly active learning, through weekly student engagement.

The ultimate test of academic performance is students' achievement on course exams. Previous research has convincingly shown that problem-based learning and active learning behavior is positively related to academic achievement (e.g., Loyens et al. 2007; Wood 2003). However, all these studies used a between-person study design and used conventional surveys to test their hypothesis. In the present diary study, we will link the aggregated weekly observations of learning activities to the overall course grade to test the hypothesis that active learning behavior is related to academic achievement.

Hypothesis 3 Active learning activities during the group meetings are positively related to the course grade.

The role of trait openness

Openness to experience is one of the Big Five Factors of personality, next to Conscientiousness, Extraversion, Agreeableness, and Neuroticism. The Openness factor has also been called Intellect, Intellectence, and Culture (Barrick and Mount 1991; Digman 1990). Traits commonly associated with this dimension are being cultured, curious,

broad-minded, intelligent, and artistically sensitive. Highly open people are seen as imaginative, sensitive to art and beauty, emotionally differentiated, behaviorally flexible, intellectually curious, and liberal in values (McCrae and Sutin 2009). In contrast, closed people are down-to-earth, uninterested in art, lacking curiosity, and traditional in values. Like the other basic factors of personality, Openness shows high levels of stability across the adult lifespan (Terracciano et al. 2006).

A central goal of the present study is to examine the role of Openness to experience in the weekly resources–weekly student engagement relationship. We expect that Openness will strengthen the relationship between weekly resources and weekly engagement. One important reason for this is the congruence between trait Openness and state study and personal resources. Bem and Funder (1978) refer to the “personality of the situation” and describe this interaction in terms of “template matching”. Accordingly, individuals respond to situations to the extent that its features match important dispositional templates. Consistent with such a congruence model, Reis et al. (2000) found that daily need satisfaction was particularly important for daily well-being when individuals also had higher scores on trait need satisfaction. They argued that high scores on a dispositional variable reflect heightened concern about, or sensitivity to, a given process and, consequently, a relatively stronger reaction to environmental events relevant to that process.

In the present study, this means that students who score high on Openness to experience will be most engaged during weeks they have access to many study resources (social support, feedback, autonomy, opportunities for development), and when their personal resources (self-efficacy, optimism, and self-esteem) are elevated. Situations that foster these resources will better match the personality of students who are high (vs. low) on Openness to experience. Consistent with this view, McCrae and Sutin (2009) have argued that the flexibility, perspective-taking ability, and willingness to tolerate differences of opinion of open people may facilitate communication. Open individuals are verbally fluent, humorous, and expressive in interpersonal interactions (Sneed et al. 1998), and this may increase the quality of the support received from others. This means that weekly social support from fellow students, family and friends will have a stronger impact on student engagement for those high (vs. low) in Openness.

Furthermore, the creativity and intellectual curiosity of open individuals implies that they have a high need for variety. Such a need can particularly be satisfied during weeks that students experience autonomy and opportunities for development. When they have the decision latitude regarding their study activities and opportunities to learn in different ways, open students are expected to be most enthusiastic and dedicated toward their studies. Finally,

those who score high on Openness generally have a positive attitude towards learning experiences (McCrae and Sutin 2009). Such an attitude can be particularly useful in a resourceful learning environment that provides constructive feedback. On the basis of this reasoning, we formulated the final two hypotheses:

Hypothesis 4 Openness to experience moderates the relationship between weekly study resources and weekly student engagement. The relationship between weekly study resources and weekly engagement will be positive if openness is high (vs. low).

Hypothesis 5 Openness to experience moderates the relationship between weekly personal resources and weekly student engagement. The relationship between weekly personal resources and weekly engagement will be positive if openness is high (vs. low).

Method

Participants and procedure

Participants were first-year psychology students from a university in the Netherlands. All participants were enrolled in the same first-year introductory course in personality psychology. This course is part of a problem-based learning (PBL) curriculum. In PBL, students discuss under supervision of a tutor pre-composed problems concerning the subject matter, in this case problems concerning the main theories in personality psychology. The course took 5 weeks and included eight sessions in which students deliberated the subject matter and formulated learning goals. Between these sessions, students had 3–4 days to reach their learning goals studying the relevant theories. The course was concluded with a multiple-choice exam assessing the main topics of personality psychology.

The participants discussed personality theories twice a week (on Mondays and Thursdays) in small group sessions (10–12 students) under guidance of a tutor. Each group discussion took 3 h including a 15-min break. The course included eight such sessions, however, the first and last session are different from the 2nd–7th session. In the first session, the students only discuss the main theories and subject at hand, after which they search for and read relevant literature about the subject. In the last (8th) session they only discuss the literature they have read beforehand. The six sessions in-between all have the same schedule: first the students discuss the relevant topics they have read about in the literature; thereafter, they discuss new topics relevant to the subject about which they are going to read literature in the next days before discussing them in the next session. Because these six sessions (session 2–7)

follow the same procedure, the data for the present study was gathered with regard to these six sessions. So, participants filled out six diaries on the day they followed a session regarding their study behavior 3–4 days before this session. Tutors observed the participants during each session and rated participants' behavior just after each session.

We constructed a web-based survey, including a general and a diary questionnaire. Participants received instructions about how to fill in the questionnaires and were asked to start by filling in the general questionnaire. After that, they were kindly requested to fill in the diary questionnaire over a period of 3 weeks, twice per week—on the days they had tutorial group meetings. In addition, during each of the days on which they had tutorial group meetings, the tutors ($N = 14$) evaluated each student's learning activities. Students and tutors filled in their diary questionnaires in relation to sessions 2–7 (total = 6 sessions), because during these sessions the students' study activities were most representative (a practical, obligatory for all first year students did not take place during sessions 1 and 8). Please note that there was only one tutor per group.

A total of 55 students were approached—they all agreed to participate. However, 10 of them could not be included because they did not respond to the weekly survey. Thus, the final sample was composed of 45 students (response rate = 82 %). In total, 89 % of the participants were female. Mean age of the participants was 19.35 years ($SD = 1.95$). Most participants had completed pre-university education (68.9 %), followed by a higher vocational education (15.6 %), and university studies (8.9 %). The majority did not follow another study next to Psychology (97.8 %) and lived at home with parents/family (66.7 %). Mean time spent per week on preparing the tutorial group meetings was 7.59 h ($SD = 4.18$). Those students who had an additional job (60 %) worked an average of 6.09 h per week ($SD = 6.97$).

Measures

General questionnaire

We assessed socio-demographic information as well as trait openness through a general questionnaire that had to be completed once, before the weekly surveys. We included age, living situation (“living away from home, not with parents/family” and “living at home, with parents/family”), and former education (“pre-university education”, “higher vocational education”, “university”, “different”) as person-level control variables. We also included a single item asking whether participants were following another study next to Psychology.

Trait openness to experience was measured with the Dutch version of the HEXACO Personality Inventory (De

Vries et al. 2008). The latter study and Lee and Ashton's study (2004) has provided evidence for the validity of the HEXACO. This instrument assesses the six major dimensions of personality (Honesty, Emotionality, eXtraversion, Agreeableness, Conscientiousness, and Openness to Experience). We used the subscale Openness to Experience, which is composed of 32 items. Example items are: “I am interested in learning about the history and politics of other countries”, and “I would enjoy creating a work of art, such as a novel, a song, or a painting”. Questions were answered on a 5-point Likert-scale (1 = totally disagree, 5 = totally agree). Cronbach's alpha for this scale was 0.90.

Course grade At the end of the course, all students took a 40-item MC-test (4 alternatives per item). Based on the test statistics, course grades were constructed, with course grades ranging from 0 (no or very few answers correct) to 10 (very many or all answers correct).

Week-level variables

Study resources This measure was composed of four types of resources that were modeled after the job resources developed by Bakker et al. (2003; Bakker et al. 2004). The items were contextualized and adjusted so that they referred to the preceding 3–4 days—the time between two sessions. Social support was measured with six items, including “The last 3–4 days I could rely on my family”. Three items were used for the assessment of Performance feedback, for example “The last 3–4 days, I received sufficient information about the results of my study-related activities”. Autonomy was measured with three items, such as “The last 3–4 days, I could decide myself how and when to study”. Finally, three items were used to assess opportunities for development, for example “The last 3–4 days, I had the opportunity to develop my qualities”. The mean scores of the subscales were summed in order to form one index of study resources. All items were rated on a 7-point scale (1 = totally disagree, 7 = totally agree). Cronbach's alpha values for this scale across the 6 occasions range between 0.66 and 0.78.

Personal resources We included weekly measures of three types of personal resources. Self-efficacy was measured with a four-item scale based on Schwarzer and Jerusalem (1995). Again, the items were adjusted so that they referred to the preceding 3–4 days, for example “The last 3–4 days, I knew what to do, regardless of what happened”. Optimism was measured with a shortened, four-item version of the scale developed by Scheier et al. (1994). An example item is “The last 3–4 days, I felt optimistic about my future”. Self-esteem was measured with four items from Pierce et al. (1989). An illustrative

item of this scale is “The last 3–4 days, I thought that I had some good qualities”. All items were rated on a 7-point scale (1 = totally disagree, 7 = totally agree). The scores for self-efficacy, optimism and self-esteem were summed in order to form one index of personal resources. The Cronbach’s alphas for this scale across the 6 occasions range between 0.91 and 0.95.

Study engagement was measured with the 9-item engagement instrument developed by Schaufeli et al. (2002). The instrument was adapted so as to refer to short-term fluctuations in engagement and assessed the three sub dimensions of vigor, dedication, and absorption with three items each (see also Breevaart et al. 2012). Example items are: “The last 3–4 days, I was full of energy when studying” (vigor), “The last 3–4 days, I found my study useful and meaningful” (dedication), and “The last 3–4 days, I forgot everything around me when studying” (absorption). Questions were answered on a 7-point scale (1 = totally disagree, 7 = totally agree). The Cronbach’s alphas for this scale across the 6 occasions range between 0.78 and 0.93.

Observed Learning Activities was assessed with the “Participation” subscale of Loyens et al.’s (2007) questionnaire. Tutors’ rated students’ performance during each of the six sessions with seven items, including “The student took actively part in the brainstorm and problem analysis of the problem to be studied”, “The student brought profundity in the group discussion by asking critical questions”, and “The student took actively part in the discussion of the problem”. Tutors rated their students for each of these items on a scale ranging from 1 (student did not show these activities at all) to 5 (student showed these activities to a large extent). The Cronbach’s alphas for this scale across the 6 occasions range between 0.71 and 0.85.

Finally, we also included number of hours spent per week on preparing tutorial group meetings as a week-level control variable.

Strategy of analysis

This diary study includes six repeated measurements (Level 1; $N = 270$ occasions) nested within persons (Level 2; $N = 45$ participants). In the case of students observed learning activities, scores were reported by tutors and we had three level of analysis (Level 1; $N = 270$ occasions) nested within persons (Level 2; $N = 45$ participants), nested within tutors ($N = 14$ tutors). Following Ohly et al.’s (2010) method of centering, person-level control variables and trait Openness were centered at the grand mean, whereas week-level control variables and week-level predictors (personal resources, study resources, study engagement, and observed learning activities) were centered at the respective person mean.

To support the use of Multilevel Modeling, we examined whether our dependent variables showed sufficient variability at the between and within levels of analysis. To that end, we calculated the intraclass correlations with the intercept-only model. For study engagement, 50.31 % of the total variance could be attributed to within-persons variations and 49.69 % to between-persons variations. For student’s active learning behavior, 52.67 % of the total variance could be attributed to within-person variations, 11.23 % to between-person variations, and 36.10 % to tutor variations.

Results

Descriptive statistics

Table 1 reports means, standard deviations and correlations among the study variables. Overall, the pattern of correlations was in the expected direction. The socio-demographic characteristics that were related to any of the outcome variables were included in subsequent analyses. Gender was unrelated to any of the study variables (p 's $> .05$). Age and hours preparing tutorial group meetings were significantly related to weekly study engagement ($r = .13$, $p < .05$; $r = .14$, $p < .05$, respectively). Following another study next to Psychology showed a negative significant correlation with weekly study engagement ($r = -.14$, $p < .05$). Socio-demographic variables were unrelated to observed learning activities, and therefore excluded from the analyses where learning activities was the dependent variable.

In order to examine whether the study and personal resources could be discriminated, we conducted a confirmatory factor analysis (CFA). Results showed that a two-factor model with the four study resources loading on one factor and the three personal resources loading on another factor fit significantly better to the data as compared to a one-factor model, $\Delta\chi^2(1) = 13.004$, $p < .001$. The two-factor model showed a very reasonable fit to the data, $\chi^2(14) = 51.470$, CFI = .96, NFI = 0.93, RMR = 0.05, RMSEA = 0.08. This means that study and personal resources can be empirically distinguished and that the measured, specific resources are good indicators of the two underlying latent factors.

Test of mediation hypotheses

Hypotheses 1 and 2 stated that study resources and personal resources would be related to observed learning activities through the mediation of study engagement. As can be seen in Table 2, three models were compared. The Null Model included the intercept as the only predictor.

Table 1 Means, standard deviations and correlations between the study variables (N = 45 participants, N = 270 occasions)

	M	SD	1	2	3	4	5
1. Day-level study resources	4.98	0.46	–	0.53**	0.51**	0.16*	
2. Day-level personal resources	4.85	0.96	0.64**	–	0.59**	0.16*	
3. Day-level study engagement	4.54	0.76	0.62**	0.70**	–	0.30**	
4. Day-level observed learning activities	3.53	0.47	0.15	0.14	0.31	–	
5. Trait openness	3.01	0.50	–0.10	0.07	0.22	0.18	–
6. Course grade	6.86	1.15	0.00	0.00	0.27	0.55**	0.18

Correlations below the diagonal are person-level correlations (N = 45). Day-level variables were averaged across the six occasions

Correlations above the diagonal are day-level correlations (N = 270)

* $p < .05$; ** $p < .01$

Table 2 Multilevel estimates for models predicting students’ learning activities (as reported by the tutor): study engagement as mediator

Variable	Null model			Main model			Mediation model		
	Estimate	SE	t	Estimate	SE	t	Estimate	SE	t
Intercept	3.514	0.072	48.805***	3.504	0.075	46.720***	3.502	0.074	47.324***
Daily study resources				0.083	0.077	1.077	0.024	0.078	0.307
Daily Personal Resources				0.133	0.056	2.375**	0.084	0.058	1.448
Daily Study Engagement							0.150	0.054	2.777**
–2X log		365.875			336.422			328.902	
Dif –2X log					29.453***			7.520**	
df					2			1	
Level 1		0.197 (0.020)			0.196 (0.021)			0.189 (0.020)	
Intercept variance									
Level 2		0.042 (0.054)			0.031 (0.048)			0.035 (0.050)	
Intercept variance									
Level 3		0.135 (0.068)			0.154 (0.067)			0.148 (0.067)	
Intercept variance									

(N = 45 Participants, N = 270 Occasions)

* $p < .05$, ** $p < .01$, *** $p < .001$

The Main Model included the predictor variables (study resources and personal resources). Finally, in the mediation model, study engagement was included.

To analyze this mediating effect, we first tested whether study and personal resources were significantly related to study engagement. As Models 1 in Tables 3 and 4 show, study resources and personal resources were both significantly related to study engagement ($t = 6.051, p < .001$; $t = 6.529, p < .001$, respectively). Second, we tested whether study engagement was related to observed learning activities. As can be seen in Table 2, the relationship between study engagement and observed learning activities is significant ($t = 2.777, p < .01$). In a final step, we examined whether the predictor variable was significantly related to the dependent variable—this relationship should turn into non-significance after the inclusion of the

mediator. It should be noted that this condition for mediation is not always met. Nevertheless, as suggested by Mathieu and Taylor (2006), mediating effects can be also examined when the predictor and the dependent variable are not directly related. As can be seen in Table 2, the effect of personal resources on observed learning activities became non-significant when study engagement was added to the model (from $t = 2.375, p < .01$ to $t = 1.448, ns$), and in the case of study resources, although it was not significantly related to observed learning activities, there was also a reduction in the effect when study engagement was included in the model (from $t = 1.077$ to $t = 0.307$).

To confirm these mediating effects, we used the Monte Carlo Method, which has been applied to multilevel models by Bauer et al. (2006). We used the estimate and standard error of the IV predicting the mediator (a), and the estimate

Table 3 Multilevel estimates for models predicting weekly study engagement

Variable	Null model		Model 1		Model 2		Model 3		
	Estimate	SE	t	Estimate	SE	t	Estimate	SE	t
Intercept	4.571	0.113	40.451***	4.573	0.109	41.954***	4.578	0.113	40.513***
Age				0.069	0.055	1.254	0.056	0.058	0.965
Following other studies				-0.994	0.726	-1.369	-1.123	0.721	-1.557
Hours preparing tutorial group				0.034	0.016	2.125*	0.034	0.016	2.125*
Weekly Personal resources				0.444	0.068	6.529***	0.301	0.077	3.909***
Weekly Study resources							0.412	0.105	3.923***
Trait Openness							0.435	0.233	1.866
Study resources x Openness									
-2 X Log (lh)				603.197	555.630		494.121	489.295	
Difference of -2 X Log					47.567***			4.826*	
df					4			1	
Level 1 intercept variance (SE)				0.478 (0.047)	0.385 (0.038)		0.370 (0.039)	0.361 (0.038)	
Level 2 intercept variance (SE)				0.472 (0.119)	0.449 (0.111)		0.438 (0.113)	0.440 (0.113)	

(N = 45 participants, N = 270 occasions)
 * $p < .05$; ** $p < .01$; *** $p < .001$

and the standard error of the mediator predicting the DV when the IV is also included (b). Using the parameters and standard errors, random draws from the a and b distributions are simulated and the product of these values is computed. This procedure is repeated 20,000 times, and the resulting distribution is used to estimate a confidence interval of 95 % for the indirect effect. The mediating effect is significant when the distribution of possible estimates for the mediator lies above or below zero. The Monte Carlo test showed that study engagement was a significant mediator of the relationship between study resources and observed learning activities (lower bound [LB] = 0.024, upper bound [UB] = 0.164, $p < .05$). Similarly, the Monte Carlo test showed that study engagement was a significant mediator of the relationship between personal resources and observed learning activities (LB = 0.018, UB = 0.120, $p < .05$). Thus, Hypotheses 1 and 2 are both supported.

According to Hypothesis 3, observed learning activities during the group meetings are positively related to the course grade. Given that the final grade is at the highest level of analysis (Level 2), we aggregated tutors' ratings of learning activities to the person level and performed the analysis (cf. Ohly et al. 2010). Results showed that observed learning activities was positively and significantly related to the final grade obtained in the course ($t = 7.15$, $p < .001$). This means that Hypothesis 3 is accepted.

Test of moderation hypotheses

Hypotheses 4 and 5 stated that trait openness would moderate the relationship between study resources/personal resources and student engagement. Specifically, we proposed that students would benefit more from study and personal resources in terms of engagement if their trait openness was high rather than low. As can be seen in Tables 3 and 4, we compared three nested models. We included first the intercept as the only predictor (Null Model). In Model 1, we included control variables both at the person and at the week-level. In Model 2, we added the predictor and the moderator variables. Finally, in Model 3 the interaction term was included.

We will first report the results regarding study resources as the predictor variable. As Table 3 shows, Model 3 including the interaction term between study resources and trait openness fit the data significantly better than Model 2, where only weekly personal resources, weekly study resources, and trait openness were included as independent variables (difference of -2 X log = 4.826, $df = 1$, $p < .05$). Study resources were significantly related to engagement even when controlling for personal resources ($t = 3.788$, $p < .001$). In addition, we found a significant interaction between study resources and trait openness ($t = 2.213$, $p < .05$). For the significant

moderating effect, we conducted simple slope tests in order to examine the pattern of the interaction (Preacher et al. 2006). As can be seen in Fig. 1, for persons with a *high* level of trait openness, study resources were positively related to study engagement ($\gamma = 1.988$, $SE = 0.729$, $z = 2.724$, $p < .01$), whereas for persons with a *low* level of trait openness, study resources were unrelated to study engagement ($\gamma = -1.20$, $SE = 0.729$, $z = -1.646$, *n.s.*). Thus, we found support for Hypothesis 4.

As regards personal resources, results displayed in Table 4 show again that Model 3, which includes the personal resources \times trait openness interaction term, fit the data significantly better than Model 2, in which only weekly personal resources, weekly study resources, and trait openness were included as independent variables (difference of $-2 \times \log = 18.933$, $df = 1$, $p < .001$). Personal resources were significantly related to study engagement even when controlling for study resources ($t = 4.837$, $p < .001$). Moreover, there was a significant interaction effect of personal resources with trait openness ($t = 4.461$, $p < .001$). Again, we conducted simple slope tests in order to examine the pattern of the interaction (Preacher et al. 2006). As Fig. 2 shows, for persons with a *high* level of trait openness, personal resources were positively related to work engagement ($\gamma = 2.478$, $SE = 0.482$, $z = 5.141$, $p < .001$), whereas for persons with a *low* level of trait openness, personal resources were negatively related to work engagement ($\gamma = -1.762$, $SE = 0.482$, $z = -3.655$, $p < .001$). These findings are consistent with Hypothesis 5.

Discussion

The results of the present study show how students’ weekly psychological resources facilitate their study engagement (vigor, dedication, and absorption), and have a positive relationship with observed learning activities during educational group meetings—on a weekly basis. This weekly proactive learning behavior, in turn, is an important predictor of the course grade. Thus, our study shows the relevance of studying student engagement from moment to moment—the weekly study design offers a new means to study psychological processes in education that facilitate performance. Moreover, we showed that these processes are different for those low versus high in Openness to Experience. In what follows, we discuss the most important theoretical contributions of this study.

Theoretical contributions

The present study makes at least three theoretical contributions. First, we found that weekly study resources, as

Table 4 Multilevel estimates for models predicting weekly study engagement (N = 45 participants, N = 270 occasions)

	Null model			Model 1			Model 2			Model 3		
	Estimate	SE	t	Estimate	SE	t	Estimate	SE	t	Estimate	SE	t
Intercept	4.571	0.113	40.451***	4.573	0.109	41.954***	4.578	0.113	40.513***	4.578	0.113	40.513***
Age				0.069	0.055	1.254	0.056	0.058	0.965	0.055	0.058	0.948
Following other studies				-0.994	0.726	-1.369	-1.123	0.721	-1.557	-1.123	0.72	-1.559
Hours preparing tutorial group				0.037	0.016	2.312*	0.034	0.016	2.125*	0.031	0.015	2.066*
Weekly Study resources				0.593	0.098	6.051***	0.412	0.105	3.923***	0.397	0.1	3.970***
Weekly Personal resources							0.301	0.077	3.909***	0.358	0.074	4.837***
Trait Openness							0.435	0.233	1.866	0.434	0.233	1.862
Personal resources x Openness										0.58	0.13	4.461***
-2 X Log (lh)	603.197			560.614			494.121			475.188		
Difference of -2 X Log				42.583***			66.493***			18.933***		
df				4			2			1		
Level 1 intercept variance (SE)	0.478 (0.047)			0.394 (0.039)			0.370 (0.039)			0.334 (0.035)		
Level 2 intercept variance (SE)	0.472 (0.119)			0.447 (0.111)			0.438 (0.113)			0.443 (0.113)		

* $p < .05$, ** $p < .01$, *** $p < .001$

well as weekly personal resources predict student engagement and have an indirect relationship with weekly active learning behavior in tutorial groups. More specifically, in addition to such study resources as weekly social support from important others, autonomy, feedback, and opportunities for development; we found that personal resources including self-efficacy, optimism, and self-esteem were related to engagement and learning activities. These findings are unique in an educational setting, although the within-person effects are consistent with previous piece-meal between-person findings in education (Caraway et al. 2003; Connell et al. 1994; Ouweneel et al. 2011). In addition, the findings are consistent with the motivational process proposed by the Job Demands–Resources (JD-R) model (Bakker 2011; Bakker and Demerouti 2008)—a model that was originally developed in a work context. Accordingly, environmental and personal resources foster a fulfilling state of engagement (vigor, dedication, absorption), which, in turn, has a positive impact on active learning and performance. Thus, our findings add to the validity of the JD-R model. The results suggest that the model can be expanded to the study domain, just like it has been expanded to the home domain (Demerouti et al. 2010). Future studies need to establish whether the present findings are also applicable to other types of education and other age groups.

Second, we found that weekly learning activities during tutorial groups was positively related to the course grade. This replicates previous research showing that problem-based learning and active learning behavior is positively related to academic achievement (e.g., Loyens et al. 2007; Wood 2003). However, the present study expands previous research by showing the importance of weekly study engagement. Particularly during the weeks that students were full with energy, dedicated to and immersed in their study activities, they actively took part in the brainstorm and analysis of the problems to be studied. During these weeks, engaged students asked critical questions and actively took part in the discussion of the problems. In addition, they listened carefully to contributions of other group members. These active learning behaviors presumably helped them to store and memorize the relevant study material which could then be retrieved more easily during the course exam. The results clearly suggest that the tutor plays a crucial role by creating resources (e.g., feedback, support, self-efficacy, and self-esteem) for the students during tutorial meetings—on a weekly basis.

The third contribution of this study is that the Openness to experience personality trait qualified the main effect of weekly resources on weekly student engagement. This means that students who are generally broad-minded and intellectually curious, and who enjoy variety and challenge, profit most from the weekly resources that are available in

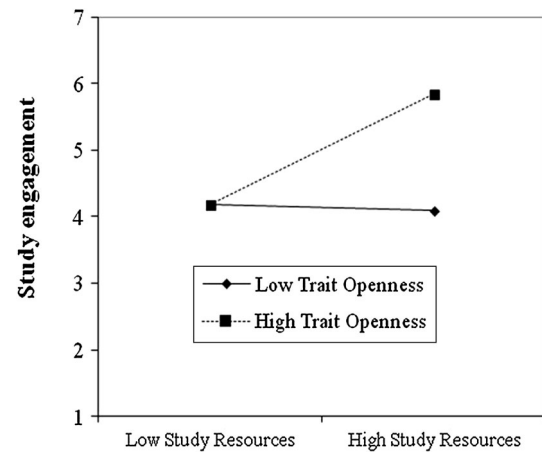


Fig. 1 Interaction effect of weekly study resources and trait openness in predicting weekly study engagement

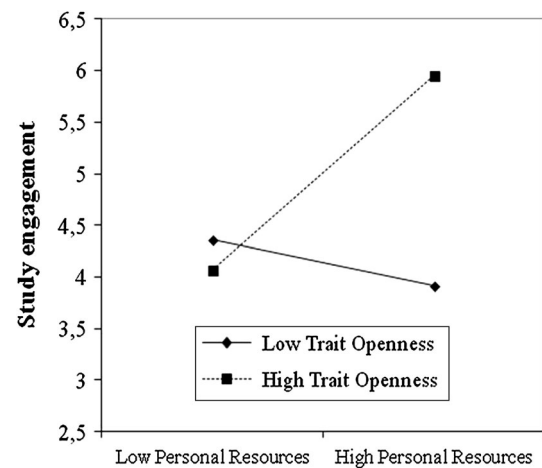


Fig. 2 Interaction effect of weekly personal resources and trait openness in predicting weekly study engagement

their study environment. These findings are consistent with the congruence model proposed by Reis et al. (2000; see also, Bem and Funder 1978). Accordingly, high scores on a dispositional variable reflect sensitivity to, a given process and, consequently, a relatively stronger reaction to environmental events relevant to that process. Resources like autonomy and opportunities for development seem to satisfy open students' curiosity and need for variety, which then further facilitates enthusiasm and vigor regarding the study activities.

Thus, even though Openness to experience is directly positively related to cognitive functioning (Soubelet and Salthouse, 2010) and intellectual activities (Chamorro-Premuzic and Furnham, 2004), it facilitates academic achievement in another way. Whereas intelligence may foster academic performance because intelligent students have the ability to think about ideas, analyze situations, and solve

problems (Rosander et al. 2011), openness seems to foster performance because open students are best able to profit from the weekly resources in their study environment, which fuels their enthusiasm and motivation to invest effort in their studies. Although openness has been positively related to intelligence (John and Srivastava 1999), the relationships between these variables are complex and future studies may investigate the differences between trait openness and intelligence in dealing with weekly study demands and resources. Scholars have already started to propose classifications of this term, dividing openness into a more creative and imaginative facet, and another facet more related to the reasoning aspect (DeYoung et al. 2007).

In an attempt to integrate the business and academic views on engagement, Macey and Schneider (2008) used a very broad description of engagement as "... a desirable condition [that] has an organizational purpose, and connotes involvement, commitment, passion, enthusiasm, focused effort, and energy" (p. 4). Their comprehensive framework for understanding engagement includes: (i) positive views of life and work, or "trait engagement" (e.g., conscientiousness, trait positive affect, proactive personality); (ii) feelings of energy and absorption or "state engagement" (e.g., satisfaction, involvement, empowerment); and (iii) extra-role behavior or "behavioral engagement" (e.g., organizational citizenship behavior, personal initiative, role expansion). In our study, we followed the JD-R approach of work engagement (Bakker and Demerouti 2008), and distinguished between self-reports of engagement as a state, and other-ratings of learning activities and objective course grade as the behavioral and observable outcomes of state engagement. We believe that the latter approach is to be preferred above the former in which traits, states, and behaviors are all seen as forms of engagement. By distinguishing between state engagement and its predictors and outcomes, we can start to build models with which we can predict state engagement.

Although our conceptualization of study engagement has been used successful in previous studies, all these studies used a between-persons study design (surveys). The present study is different in that it examined engagement fluctuations within students from week to week. Quantitative diary research seems very promising because it allows studying cognitive, emotional and behavioral components of engagement within a natural context (Ohly et al. 2010). Although the latter authors encourage researchers to use this type of design especially in the work context, future research should try to better utilize the flexible design and include causal pathways in educational settings as well. Thus, one could achieve a better understanding of which specific short-term characteristics of the study are hindering or fostering students' levels of engagement and in turn, academic performance, as well as which specific resources

could be provided on a weekly basis to help students during their courses.

Limitations and suggestions for future research

Some limitations of our study should be noticed. First, the sample was composed of psychology students in their first year and first semester. Although we showed that the level of engagement varies across weeks, we could not analyze whether the level of engagement increases or decreases from one semester to the next. Future studies could replicate this study combining a diary with a longitudinal study design. Second, the students were in a course of personality psychology. The question is whether they would be more or less engaged depending on the subject. Thus, other variables such as preferences could be taken into account. It is possible that students become less engaged and perform worse because they are not motivated with the course. For instance, in a study among faculty students, Goodman et al. (2011) found that motivated students exerted more effort, which in turn, increased academic performance. Students following other subjects and other studies should also be examined to establish external validity of the present findings.

Third, although we included a complete set of personal and study resources, future studies could also examine other predictors such as hindrance or challenge demands, in order to analyze their relationship with students' engagement and performance. For example, Salanova et al. (2009) showed in their survey study that study overload (e.g., too many tasks to do everything well), anticipated exam anxiety, and too high or too low temperature in common spaces were common obstacles for Spanish students. Such hindrance demands may undermine study engagement, because they lead to cynicism and exhaustion. Fourth, future research may examine the moderating role of other personality traits, in addition to openness to experience. For example, it is conceivable that trait extraversion facilitates the impact of weekly social support on study engagement. In addition, trait conscientiousness may turn a negative relationship between challenge study demands and engagement into a positive relationship. Future diary studies could test these intriguing hypotheses and build on our model of student engagement and performance.

Finally, there is an inherent missing data problem within any within-subjects (repeated measures) research design. Also in the present study, not all individuals filled in all the questions across all the occasions. However, we would like to note that we do not have systematic missing values in our data. As noted by Spooren (2010), there are techniques for dealing with missing data in multilevel analysis. However, these methods are not easy to implement and have limitations (Shafer and Graham 2002). For that

reason, and following the work of Spooren, we used the default option in the MIWin, so that missing values are automatically deleted. As noted by Ohly et al. (2010), missing values are a common problem in diary questionnaires, and in most cases they do not seriously invalidate the results.

Practical implications

The findings of this study reveal that students' engagement is a key factor in achieving academic performance. In addition, results showed that personal resources, study resources and levels of engagement may vary across weeks. This intra-individual variation affects tutor's ratings of each student's performance. From an educational point of view, it means that specific interventions can be implemented during the course so that students' resources and engagement increase. It has been widely recognized that teachers, family, and peers play a decisive role in this process (e.g., Berndt and Keefe 1995; Stipek 2002). When teachers do not create a psychological safety climate, where criticism and new ideas are welcomed, students' levels of engagement decrease (Assor et al. 2002).

As Fredricks et al. (2004) suggested, most educational interventions are aimed at increasing achievement without taking into account the importance of students' engagement. However, effective interventions should attend to this important variable, focusing on its antecedents. If teachers and family can help students improve their engagement, it will be easier to increase academic performance. Increasing resources should be the main intervention. We could achieve this objective by reducing students' fear of failure through positive reinforcement and frequent feedback (Caraway et al. 2003).

In addition, the present findings show the moderating effect of trait openness on the relationship between weekly resources and engagement. Although the Big Five personality dimensions (including openness to experience) tend to be more stable than other aspects of personality (Costa and McCrae 1997), personality may be influenced by the environment as well (Caspi and Roberts 2001). The family and the teachers may provide the student with the necessary opportunities to express their opinions and encourage them to be open to new ideas and experiences.

Conclusion

The present study showed how weekly study and personal resources triggered weekly variations in student engagement, and are predictive of study performance. In addition, we found that the Openness to experience personality trait boosted the impact of weekly study and personal resources

on weekly study engagement. The findings suggest that psychological resources are important for academic performance and that openness plays a important role in this process. Open individuals are behaviorally flexible and intellectually curious, and these qualities make them particularly sensitive to and appreciative of weekly study and personal resources.

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