Academic self-efficacy, self-esteem, and grit in higher online education: Consistency of interests predicts academic success

Joyce Neroni[1,2] · Celeste Meijs[1] · Paul A. Kirschner[1,3] · Kate M. Xu[1] · Renate H. M. de Groot[1,4]

Abstract

Academic self-efficacy, self-esteem, and grit (i.e., perseverance of effort and consistency of interests) have all separately shown to predict academic success within traditional education. In higher online education, information on these relationships is lacking, while this group of learners is growing in size and importance. We therefore investigated the total as well as the unique predictive value of academic self-efficacy, self-esteem, and grit on academic success in higher online education. Moreover, mediation effects were investigated. Students of a higher online education university in the Netherlands participated ($N = 2027$, age 18–80 years) in this observational study. Participants filled out online questionnaires on the variables of interest and potential confounding variables at baseline. Academic success was measured objectively through information provided by the exam registration office and operationalized in three variables: exam attempt, study progress, and academic performance. Logistic regression analyses showed that consistency of interests significantly predicted exam attempt ($B = .43$, $p < .001$). Generalized multiple linear regression analyses with negative binomial distribution showed that consistency of interests was a significant predictor of study progress ($B = .16$, $p < .001$). Mixed model analyses revealed no significant predictors for academic performance ($ps > .06$). The fact that of our three predictors solely consistency of interests was found to be predictive for academic success indicates that online educational institutes should pay attention to consistency of interests of their students to improve the academic success rates.

Keywords The ALOUD study · Higher online education · Consistency of interests · Academic success

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✉ Joyce Neroni
  joyceneroni@gmail.com

Extended author information available on the last page of the article

1 Introduction

To keep up with the fast-changing society, it is important to continue learning during the life span. Online education plays an important role in life-long education for adults (Schlosser & Simonson, 2010). This student population is often characterized by combining a part-time or full-time job, family responsibilities, and social life, resulting in a busy life (Eurydice, 2011). By means of online education, they can choose their own pace and place to study. A prevalent problem within higher education, and particularly in online education, is the low retention (i.e., continuing enrolment in the educational program) and, consequently, high dropout rate (Berge & Huang, 2004; Yukselturk et al., 2014). To increase retention and decrease dropout rates, it is important to investigate which factors play a role in students' participation in online education, in sustaining their studies and in achieving academic success. Beyond the impact of cognitive factors (e.g., content knowledge, executive functions), research has shown the critical importance of non-cognitive factors (i.e., behaviours, skills, attitudes, and strategies) for achieving academic success (Farrington et al., 2012).

There is a wealth of evidence showing that motivation and beliefs about one's own competence and expectancy of success are important ingredients for achieving academic success (Eccles & Wigfield, 2002). Students' expectancy of success motivates them to study and learn from the study material, which affects academic success (Wigfield, 1994). Academic self-efficacy is such an expectancy belief-factor shown to predict academic success (Asakereh & Yousofi, 2018; Honicke & Broadbent, 2016; Robbins et al., 2004). It is defined as believing in one's ability to successfully perform/carry out a given task or to gain academic success (Bandura, 1977; Duncan & McKeachie, 2005). Another factor that helps students to remain motivated in their studies is grit. Grit can be defined as being perseverant and having passion for attaining long-term goals (Duckworth et al., 2007). Several studies found a positive link between grit and academic success (Credé et al., 2017; Duckworth et al., 2007), which led to schools incorporating it into their curriculum (Kirchgasler, 2018). Additionally, research has shown that self-esteem has a major positive impact on the motivation for students to strive for achieving their academic goals (Baumeister et al., 2003).

Most studies focussed on the impact of either academic self-efficacy, self-esteem, or grit on academic success separately, and, to our knowledge, these predictors have never been combined in one single study. It is not clear yet which factor is most important in predicting academic success. In addition, it is not known how the factors potentially overlap in predicting academic success. Moreover, most studies have been conducted among children, adolescents, and traditional college students (e.g., Asakereh & Yousofi, 2018; Credé et al., 2017; Honicke & Broadbent, 2016), while research in higher online education is limited (e.g., Hwang et al., 2017; Radovan, 2011). Furthermore, the question arises whether academic self-efficacy, self-esteem, and grit uniquely contribute to academic success directly, or whether the relationship between grit and academic success is an indirect relationship mediated by either academic self-efficacy or self-esteem

(Usher et al., 2019; Wolters & Hussain, 2015). The present study was conducted to investigate (1) the total predictive value of academic self-efficacy, self-esteem, and grit on academic success, (2) the unique predictive values of academic self-efficacy, self-esteem, and grit respectively on academic success, and (3) whether the relationship between grit and academic success is mediated by either academic self-efficacy or self-esteem in higher online education.

1.1 Academic success in higher online education

Being able to adapt to the fast-changing technology and society, it is important to be able to keep on learning through the life span (Cedefop, 2010). In 2015, approximately 10% of adults between 25 and 64 years participated in formal higher online education (Eurostat, 2016). These adult students typically enrol in college or university after a delay in their studies, study part-time, and often struggle with combining their studies with a busy family and career life (Eurydice, 2011). Many students have already obtained some sort of a higher education degree, and are studying for self-improvement or career advancement. This is in contrast to traditional, campus-based college students, who typically enrol in college or university directly after completing high school, study full time, and are still dependent on the financial support of their parents or on scholarships, or work part-time to finance their studies (U.S. Department of Education, National Center for Education Statistics 2002). Their core focus is on studying, which will enable them to start their career life. For adult students, it is often impossible to attend classes (either part-time or full-time) or study/attend those classes at fixed times. Online education could be a solution as students can study from their own home, often at their own chosen pace and on their own time schedule. A specific type of online education—individualised, higher online education—takes place temporally synchronously (e.g., virtual classes) or asynchronously (e.g., e-mail contact, assignments, pre-recorded video), and students and teachers are physically at different locations (Schlosser & Simonson, 2010).

A common problem in higher education, but especially in higher *online* education, is the high dropout rate (Berge & Huang, 2004; Yukselturk et al., 2014). Finding out which cognitive and non-cognitive factors determine whether students sustain in their studies and achieve academic success has been is the focus of many researchers for many years (see Hattie, 2009, for a synthesis on 800 meta-analyses about influences on student achievement). In the present study, three of the most investigated non-cognitive factors are studied with academic success: academic self-efficacy, self-esteem, and grit.

1.2 Academic self-efficacy

Bandura (1982) defined self-efficacy as "judgments of how well one can execute courses of action required to deal with prospective situations" (p. 122). Research has shown that self-efficacy is a very important contributor to academic success (Alivernini & Lucidi, 2011; Muenks et al., 2017; Stajkovic et al., 2018; Yip, 2012). Within an academic setting, self-efficacy is mostly referred to as one's confidence

in having the knowledge, skills, and abilities needed to perform well in a specific course or on a specific task, which is often called academic self-efficacy, performance self-efficacy, or self-efficacy for learning and performance (Duncan & McKeachie, 2005). Academic self-efficacy is considered as a course and task-specific construct.

Most studies that investigated the relationship between academic self-efficacy and academic success found significant positive relationships (for a systematic review, see Honicke & Broadbent, 2016) for traditional college students (Cassady, 2004; Diseth, 2011; Fenning & May, 2013; Stajkovic et al., 2018) as well as for online students (de Fátima Goulão, 2014; Ergul, 2004; Joo et al., 2013; Radovan, 2011). In their meta-analysis, Robbins et al. (2004) found that academic self-efficacy was moderately related to retention with a mean true-score correlation of $\rho = .359$, and moderately to strongly related to GPA ($\rho = .496$). These results suggest that academic self-efficacy plays an important role in predicting academic success. Academic success is mostly measured as grades or GPA. The question remains how academic self-efficacy is related to exam attempt, study progress, and academic performance in higher online education.

1.3 Self-esteem

Self-esteem can be defined as an individual's evaluation or general feelings regarding the self (Rosenberg et al., 1995). While academic self-efficacy is considered as domain or task-specific and focused on how well one believes to *perform on a specific task or assignment*, self-esteem is a global construct, focused on the self and feelings of self-worth *in general*.

Within traditional education, the relationship between self-esteem and academic success has been widely explored. Still, findings are inconsistent across studies. For instance, Booth and Gerard (2011) found a moderately positive association between self-esteem and several academic achievement scores. While this moderately positive association has been confirmed in a recent meta-analysis (Körük, 2017), Lackner (2015) only found a weak positive correlation in her meta-analysis. Other studies found only an indirect association between self-esteem and academic achievement (Di Giunta et al., 2013), or no effect at all (Trautwein et al., 2006). These results show that it is still unclear how self-esteem is related to academic success, making further research necessary. Moreover, these studies have been conducted among children, adolescents, and college students. To our knowledge, research on the association between self-esteem and academic success for higher online education students is lacking. Furthermore, it is not known whether self-esteem predicts all three aspects of academic success (i.e., exam attempt, study progress, and academic performance) in the same way.

1.4 Grit

Grit, defined as "trait-level perseverance and passion for long-term goals" (Duckworth et al., 2007, p. 1087) has been a hot topic of research over the last decade

(e.g., Cross, 2014; Kelly et al., 2014; Reed & Jeremiah, 2017). Grit entails two facets: perseverance of effort and consistency of interests (Duckworth & Quinn, 2009; Duckworth et al., 2007). Both facets are about long-term endurance, in which perseverance of effort is focussed on persisting even when facing obstacles and failure, while consistency of interests is focussed on the sustainability of long-term goals.

Grit has demonstrated to be an empirically relevant predictor for several academic success variables for high school and college students, for example, grade point average (GPA; Credé et al., 2017; Duckworth & Quinn, 2009; Hwang et al., 2017), retention (Cross, 2013; Duckworth et al., 2007; Saunders-Scott et al., 2018), and intent to persist in college (Bowman et al., 2015). Although the strength of the relationship between grit and academic success varies among studies, the found relationships are mostly positive (for a meta-analysis, see Credé et al., 2017; for a systematic review, see Christopoulou et al., 2018). Studies that made a distinction between perseverance of effort and consistency of interests mostly only found a positive relationship between perseverance of effort and academic success, and not between consistency of interests and academic success (e.g., Bowman et al., 2015; Datu et al., 2016). In some studies, only indirect relationships were found, in which perseverance of effort in relation to academic success was mediated by self-regulation (Wolters & Hussain, 2015), academic self-efficacy (Usher et al., 2019), or conscientiousness (MacCann & Roberts, 2010; Rimfeld et al., 2016).

In higher online education, to our knowledge, two studies investigated the relationship between grit and academic success. The study of Hwang et al. (2017) which was conducted at the Korean Open University showed that the perseverance of effort subscale of grit was related to academic success, but only indirectly: this relationship was mediated by academic maladjustment. Furthermore, they did not find a relationship between the grit facet consistency of interests and academic success. Notably, their sample existed only of female students. Why they chose to exclude male students is not clear. Furthermore, in the study of Cross (2013), participants were non-traditional doctoral students (i.e., comparable to higher online students in age and life circumstances). This study showed that grit, measured as one overall score, was a significant positive predictor of academic success, but only for females: the relationship for male students was not significant. All in all, research on grit and academic success in higher online education is limited.

1.5 Academic self-efficacy, self-esteem, grit, and academic success

In 1977, Bandura made clear that self-efficacy is in a way related to perseverance (i.e., one of the facets of grit), and stated that "efficacy expectations determine how much effort people will expend and how long they will persist in the face of obstacles and aversive experiences" (p. 194). A few studies have investigated the relationship between academic self-efficacy, grit, and academic success. Muenks et al. (2018) found that both academic self-efficacy and the grit scale perseverance of effort predicted academic performance uniquely. However, Wolters and Hussain (2015) found that the relationship between grit and academic performance for college students disappeared after adding academic self-efficacy, which suggests that

academic self-efficacy might act as a mediator between grit and academic performance. Usher et al. (2019) investigated two pathways: whether academic self-efficacy acted as a mediator between grit and academic performance, and whether grit acted as a mediator between academic self-efficacy and performance. They found the most compelling evidence for academic self-efficacy as mediator, and argued that grittier students will only perform better in school when they perceive themselves as capable (Usher et al., 2019).

The relationship between academic self-efficacy and self-esteem and how they predict academic success when combined has been explored in a few studies within traditional education. For instance, Lane et al. (2004) found that academic self-efficacy was a significant predictor of performance, but that self-esteem was not when they were jointly included in the analysis. However, Gębka (2014), as well as Phan (2010), showed in their studies that neither self-esteem nor academic self-efficacy significantly predicted performance when simultaneously included in the model. It is still not clear how academic self-efficacy and self-esteem combined predict academic success. Furthermore, data on this relationship for higher online education is lacking.

To our knowledge, Weisskirch (2018) is the only study that explored the relationship between grit and self-esteem with academic performance. Weisskirch (2018) found that for undergraduate students, perseverance of effort as well as self-esteem predicted the subjectively estimated grade, but not the actual achieved final grade. He also showed that self-esteem was positively correlated with both of the grit scales. However, the potential mediating role of self-esteem in the relationship between grit and academic success has not been explored. Still, self-esteem has shown to mediate the relationship between grit and life satisfaction (Li et al., 2018). In this line of reasoning, people high in grit are able to persist when things get difficult, and are consistent in their interests on the long term, which could give them a positive boost in their self-evaluation (i.e., self-esteem), which in turn could foster their academic success. In contrast, people who are low in grit, who are not able to persist and adhere to their interests or goals for the long run, might evaluate themselves as inadequate, which could in turn hinder their academic success. Furthermore, it remains unclear how academic self-efficacy, self-esteem, and grit together predict academic success in higher online education, and what the remaining unique predicting value is after controlling for each other.

1.6 Possible confounders

To investigate the relationships in question, it is important to preclude possible spurious relations by controlling for possible confounders. One of those possible confounders is age. For instance, Credé et al. (2017) showed in their meta-analysis that grit scores increase with age. Moreover, self-esteem seems to change with age, with an increase from adolescence until the age of 60 years, and a decline after that (Orth et al., 2015). Furthermore, age was related to several academic success variables before (Clifton et al., 2008; Lee & Choi, 2011; Richardson et al., 2012).

Another potential confounder is gender. It is shown that overall, males score higher on academic self-efficacy (Huang, 2013) and self-esteem (Di Giunta et al., 2013), and lower on grit (Kannangara et al., 2018) than females. Furthermore, females tend to score higher on academic performance than males (Duckworth & Seligman, 2006; Richardson et al., 2012; Robbins et al., 2004). Thus, these two variables are taken into account as covariates in the present study.

1.7 Present study

The present study looks at the relationship of academic self-efficacy, self-esteem, and grit with academic success in higher online education. The aim was three-fold: to investigate (1) the total predictive value of academic self-efficacy, self-esteem, and grit (i.e., measured as two subscales: perseverance of effort and consistency of interests) on exam attempt, study progress, and academic performance respectively, (2) the unique predictive values of academic self-efficacy, self-esteem, and grit respectively on each of the three academic success aspects, and (3) whether academic self-efficacy and/or self-esteem mediate the relationship between grit and each of the three academic success aspects. Furthermore, it investigated the extent to which the predictors are different concepts by exploring the overlap between them.

2 Methods

2.1 Design

The study is part of the ALOUD study, in which in total 2040 students took part. In this observational longitudinal study, several biological and psychological determinants of academic performance in higher online education were investigated. For detailed information regarding the design, see Neroni et al. (2015). The ALOUD study was approved by the Ethics Committee of the higher online education university and all participants gave their informed consent in advance of the study.

2.2 Setting

All data were collected from students participating in higher online education in the Netherlands. The only requirement for admission to this university is a minimum age of 18 years (i.e., no prior diplomas are required). The educational programme of this university consisted of seven educational bachelor and six master programs: Law, Management Science, Computer Science, Environmental Science, Cultural Science, Learning Sciences (only a master program), and Psychology. Until September 2014, students could enrol in one or more individual courses separately, or in a full-length degree program, and could choose from nearly 300 courses. A course consisted of one or more study modules, each corresponding to 4.3 European Credits (ECs; i.e., 120 h of studying). Students could enrol in a course at any moment and were able

to choose their own pace of study during a period of 14 months at which time the enrolment (i.e., the right to take an exam and receive the ECs) was terminated.

Researchers studying academic success at traditional colleges and universities mostly focused on academic achievement and school performance, measured by grades, grade point average (GPA), previous GPA, or retention rates (i.e., continuing enrolment in the educational programme). However, in higher online education, academic success is not as easily defined or measured. For instance, at the institution where the present study was carried out, students were allowed to enrol in either one or more courses or could choose for a full degree programme. The students were allowed to start their courses whenever they wanted and could determine their own study pace within a 14-month period. Furthermore, registering for another course within the 14-month period lengthened the study period for the former courses. For example, take a student enrolled in course A on January 1, 2013. Initially, the student had 14 months to finish the course, i.e., until February 28, 2014. However, if this student enrolled in a second course, course B, on July 1, 2013 (i.e., enrolment in course B occurred within the 14-month period of course A), the allowed study period for course A was lengthened to the finish date of course B, which is August 31, 2014. Another example is that some students are only enrolled in a course for personal or career related development, without the intention to take an exam attempt. These examples show that it is hard to define academic success in terms of a singular outcome variable.

2.3 Participants

Participants were all students from a higher online education university in the Netherlands. Students ($N = 4945$) who started studying at this university for the first time between August 6th, 2012 and August 5th, 2013 were invited to participate in the ALOUD study. In total, 2,040 students (57.5%) fully participated at baseline (780 males, 1260 females; $M_{age} = 36.7$ years, age range: 18–80 years).

2.4 Procedure

Students who registered for a course for the very first time between the 6th of August 2012 and the 5th of August 2013 were invited by e-mail to participate in the ALOUD study. Participants were asked to fill out an online questionnaire, which took approximately 45 min to complete. Before starting the questionnaire, they had to tick a box to provide informed consent. It was allowed to pause the questionnaire and continue at a later time. Non-completers and non-responders received a reminder after 2 weeks and a last reminder after 1 more week via e-mail. Non-completers and non-responders were approached by phone 1 week after the last reminder. As an incentive, gift coupons of 20 euros were allotted, with a winning chance of 5%. In addition, after 14 months, the exam database of the university was utilised for data extraction on the examination grades of the participants. The period of 14 months was chosen because this is the standard subscription period when

registering for a course. For full details on the content, as well as the procedure of the ALOUD study, see Neroni et al. (2015).

2.5 Measurements

2.5.1 Independent variable measures

To measure academic self-efficacy, the Self-Efficacy for Learning and Performance scale, a subscale of the MSLQ-A (Pintrich et al., 1993) was used. This subscale consists of 8 items (e.g., I'm confident I can learn the basic concepts taught in this course) measured on a 7-point scale, ranging from 1 (*totally disagree*) to 7 (*totally agree*). As students were able to follow several courses at once, students were asked to answer these items for one of the courses they were about to start or just started. One overall mean score for academic self-efficacy was calculated. Pintrich et al., (1993) reported a Cronbach's alpha of .93.

Self-esteem was measured with the Rosenberg Self-esteem Scale (Rosenberg, 1965). This scale consists of 10 items (e.g., I am able to do things as well as most other people) measured on a 4-point scale, ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). Five items were negatively worded and therefore reversed scored. One mean score was computed, with a higher score reflecting higher self-esteem. Fleming and Courtney (1984) reported a Cronbach's alpha of .88.

Grit was measured with the Grit Scale (Duckworth & Quinn, 2009). This instrument consists of two subscales with six items each: (1) Perseverance of effort (e.g., Setbacks don't discourage me), and (2) Consistency of interests (e.g., My interests change from year to year). All items were answered on a 5-point scale, ranging from 1 (*totally disagree*) to 5 (*totally agree*). After recoding six reversed-scored items, mean scores per subscale were calculated, with higher scores reflecting more perseverance of effort and consistency of interests. Duckworth and Quinn (2009) reported Cronbach's alphas of .70 and .77 for perseverance of effort and consistency of interests, respectively.

2.5.2 Dependent variable measures

Academic success was operationalized in three ways. The first outcome variable was exam attempt, which was defined as continued enrolment in the educational program measured by at least one exam attempt in the 14-month period for any course they were enrolled in. Reasons for not taking an exam attempt could vary greatly (e.g., having test anxiety, not having the original goal to take an exam but just registering for the course out of interest or to master knowledge, or the course being harder or less interesting than expected), which makes it hard to make a statement on whether these students did or did not drop out. However, it was presumed that participants taking an exam attempt within 14 months retained studying.

The second measure was study progress, which is a sum of the number of completed modules after 14 months. A course that students were enrolled in consisted of one or more modules, with each module corresponding to 4.3 European

Credits (ECs; i.e., 120 h of study load). As the study progress for students without an exam attempt is zero, and because it is unclear whether students without an exam attempt did or did not study, students with no exam attempt were excluded from the analyses with the outcome variable study progress.

The third measure was academic performance, in which students' grades were compared. Sufficient as well as insufficient grades were included. Because of the complexity of the educational system in higher online education mentioned in the introduction, taking the average of the courses per student would give a distorted view, as some students only took one course within the 14-month period, whereas others might have studied several courses at the same time. Therefore, academic performance was calculated as grade per course nested within students. To calculate performance scores, courses with only a pass/fail exam were excluded from the analyses with the outcome variable academic performance. A flowchart with the number of participants per outcome measure is displayed in Fig. 1.

2.5.3 Covariates

Age and gender were inquired by the online questionnaire the participants completed.

Fig. 1 Flowchart of the number of participants per outcome measure
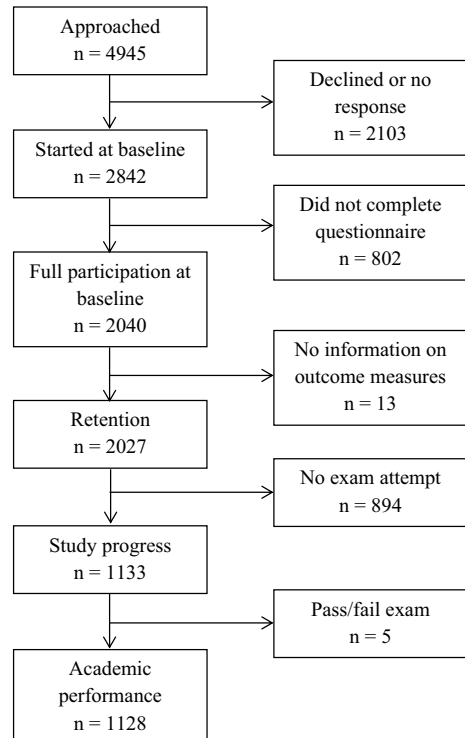
2.6 Statistical analyses

Analyses were conducted using SPSS (Version 25.0). First, descriptive statistics were given with means and standard deviations for the continuous variables, and counts and percentages for categorical variables. Second, correlation analyses were conducted to investigate how the covariates and predictor variables were related, and tests for multi-collinearity were conducted. Third, as the outcome measure exam attempt is a dichotomous variable, a hierarchical logistic regression analysis was conducted with all the predictor variables together in one model, to analyse the total predictive value of the predictors as well as the unique predictive value of each of the predictors. Fourth, a generalized multiple linear regression analysis with a negative binomial distribution was conducted within the subgroup of participants who did an exam attempt, to test whether academic self-efficacy, self-esteem, and grit predicted study progress, operationalized as the number of credit points gained after 14 months of studying. This analysis was used because the data was highly positively skewed and over-dispersed. Fifth, a mixed model regression analysis was conducted to investigate the total predictive value as well as the unique predictive value of academic self-efficacy, self-esteem, and grit respectively on academic performance (i.e., course grades). As students were free in the number of courses they enrolled in during the study period of 14 months, the analysis was not run with an average of all exam grades, but with a mixed model regression with courses nested under students. In this way, the correlation of course grades for different courses within an individual was taken into account. The final model for this analysis was constructed using the following steps: (1) A null model was built with only a fixed intercept, ignoring the hierarchical structure; (2) Covariates as fixed variables were added; (3) Predictors as fixed variables were added; (4) Random intercepts were added; (5) Random slopes were added. Each next step was only taken if the previous step was found to improve the model significantly, which was tested with a chi-square model comparison. Sixth, mediation effects were considered following the approach recommended by Kenny et al. (1998): (1) grit being the predictor and academic self-efficacy being the mediator, with all covariates taken into account, for each of the three outcome variables; and (2) grit being the predictor and self-esteem being the mediator, with all covariates taken into account, for each of the three outcome variables. Prior to the mediation analyses, bivariate analyses were conducted. This is necessary as a mediation analysis is only useful when (1) the predictor is significantly related to the outcome; (2) the predictor is significantly related to the mediator; and (3) the mediator is significantly related to the outcome (Kenny et al., 1998). If one of these three steps is not met, a mediation effect is not possible and will not be analysed.

3 Results

3.1 Descriptive statistics

An overview of the descriptive information on the relevant variables of the present study as well as internal consistency values of the independent variables are given in Tables 1 and 2 for $n = 2027$ and $n = 1128$ respectively. An independent samples t test

revealed a significant difference between the two samples for age, $t(3153) = 2.44$, $p = .02$. The effect size Cohen's d was calculated to interpret the effect size of the t test, $d = .09$. According to Cohen (1998), values between .20 and .50 are considered as a small effect, between .50 and .80 as a moderate effect, and above .80 as a large effect, which means that the mean difference of age between the two samples is trivial.

For Perseverance of effort, the internal consistency value is rather low (i.e., $\alpha = .67$). Therefore, item-total correlations were taken into account, which should be $\geq .30$ (Field, 2009). For this subscale, item-total correlations ranged from .30 to .48, which justified to include the Perseverance of effort subscale in the main analyses.

3.2 Correlations

Table 3 shows the relationships between the predictor variables and the covariates. All predictor variables are significantly correlated with each other, with correlations ranging from .06 to .38. According to Cohen (1992), effect sizes of Pearson's correlations with values between .10 and .30 are classified as small, between .30 and .50 as moderate, and between .50 and .70 as large. Values lower than .10 are negligibly small and therefore, considered trivial, even if the correlation is significant. Therefore, only significant effect sizes of .10 and above were interpreted as being meaningful.

Table 1 Descriptive statistics with means and standard deviations for the continuous variables, and counts and percentages for categorical variables; n = 2027

Variables	*M*	*SD*	Min–max	α
Academic self-efficacy	5.34	0.79	2.13–7.00	.91
Self-esteem	3.12	0.47	1.00–4.00	.88
Grit				
Perseverance of effort	3.82	0.55	1.83–5.00	.67
Consistency of interests	3.30	0.71	1.00–5.00	.82
Age (years)	36.67	11.15	18–80	
	Count			% of total
Exam attempt				
Yes	1133			55.9
No	894			44.1
Gender				
Male	774			38.2
Female	1253			61.8

Table 2 Descriptive statistics with means and standard deviations for the continuous variables, and counts and percentages for categorical variables; n = 1128

Variables	M	SD	Min–max	α
Academic self-efficacy	5.36	0.76	2.75–7.00	.90
Self-esteem	3.13	0.47	1.20–4.00	.88
Grit				
Perseverance of effort	3.82	0.55	1.83–5.00	.67
Consistency of interests	3.37	0.71	1.00–5.00	.82
Study progress[b]	2.63	2.55	0–20	
Academic performance[a]	6.31	1.71	1.00–10.00	
Age (years)	35.36	11.20	18–75	

	Count	% of total
Gender		
Male	420	37.2
Female	708	62.8

[a]First, a mean score per student was calculated. After that, the mean of academic performance was calculated

[b]n = 1133

Performance of effort, consistency of interests, and self-esteem were positively associated with age. Age was negatively associated to exam attempt, indicating that taking an exam attempt decreased with age. Age was positively associated with academic performance, suggesting that older students receive higher exam grades than younger students. Females obtained higher scores for perseverance of effort as well

Table 3 Pearson's zero-order correlations between predictor variables, covariates, and outcome variables; n = 2027

	1	2	3	4	5	6	7	8	9
1. Academic self-efficacy	–	.30**	.23**	.06**	.01	-.17**	.04	.05	.05**
2. Self-esteem		–	.38**	.19**	.13**	-.07**	.01	.04	.05*
3. Perseverance of effort			–	.33**	.16**	.11**	.00	.01	.03
4. Consistency of interests				–	.20**	.13**	.11**	.09**	.07**
5. Age					–	-.05*	-.13**	-.02	.12**
6. Gender[a,b]						–	.02	-.06*	-.05*
7. Exam attempt[b]							–	–	–
8. Study progress[c]								–	–
9. Academic performance[d]									–

[a]Females is coded as 1

[b]Dichotomous variable, indicating that the given Pearson's correlation is point-biserial

[c]n = 1133

[d]n = 2544

as for consistency of interests than males, while males scored higher on academic self-efficacy. Collinearity diagnostics showed that multicollinearity was no concern, with VIF scores ranging from 1.12 to 1.29, indicating that the predictors are all separate constructs.

3.3 Predicting exam attempt

A hierarchical logistic regression analysis was conducted to investigate the total predictive value of academic self-efficacy, self-esteem, and grit on exam attempt as displayed in Table 4. A test of the covariates model (i.e., model A) compared to the null model was significant, indicating that the covariates age and gender together distinguished between doing and not doing an exam attempt, χ^2 (2, $n = 2027) = 36.16$, $p < .001$. However, only age made a significant unique contribution to the prediction of exam attempt, Wald $\chi^2 = 34.58$, $p < .001$. Next, by adding the predictor variables academic self-efficacy, self-esteem, perseverance of effort, and consistency of interests, the model significantly improved, χ^2_{diff} (4, $n = 2027) = 41.27$, $p < .001$. Results show that, while controlling for the other predictors and the covariates, the grit subscale consistency of interests was a positive predictor of exam attempt, Wald $\chi^2 = 36.51$, $p < .001$. Academic self-efficacy, self-esteem, and perseverance of effort did not uniquely contribute to the model, with Wald χ^2 ranging from 0.07 to 2.54, ps $> .05$ (see Table 4).

3.4 Predicting study progress

To predict study progress, a generalized multiple linear regression with a negative binomial distribution was conducted, with the sum of the number of modules

Table 4 Results of the hierarchical logistic regression analysis

Variables	Model A			Model B		
	B	SE	OR	B	SE	OR
Constant	1.14***	0.16	3.14	-0.09	0.45	0.91
Age	-0.02***	0.00	0.98	-0.03***	0.00	0.97
Gender	0.06	0.09	0.94	-0.02	0.10	0.98
Academic self-efficacy				0.09	0.06	1.10
Self-esteem				0.03	0.11	1.03
Perseverance of effort				-0.15	0.10	0.86
Consistency of interests				0.43***	0.07	1.53
Nagelkerke pseudo r^2	2.4%			5.0%		
χ^2	36.16, $df = 2$, $p < .001$			77.43, $df = 6$, $p < .001$		

Model A is the covariates only model; Model B is the full model including covariates and predictor variables

B unstandardized regression weight; *SE* standard error; *OR* odds ratio

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

completed as a proxy for study progress. A test of the full model (i.e., Model B) showed to be significantly better than the covariates-only model (i.e., Model A), χ^2_{diff} (4, $n = 1133$) = 17.01, $p = .001$. As Table 5 shows, consistency of interests was the only predictor uniquely contributing to the explained variance in study progress (Wald $\chi^2 = 14.27$, $p < .001$), while controlling for the other predictors and covariates. The prediction of academic self-efficacy (Wald $\chi^2 = 1.01$, $p = .32$), self-esteem (Wald $\chi^2 = 0.62$, $p = .43$), and perseverance of effort (Wald $\chi^2 = 0.51$, $p = .48$) for study progress was non-significant.

3.5 Predicting academic performance

Table 6 displays the results of the linear mixed model to predict academic performance. A model including all predictors with random intercepts varying across participants (i.e., Model 3) showed to be the best fitting model. Although Model 3 shows to be a significantly better fit for the data than Model 2 (i.e., the model with predictors as fixed variables) and Model 1 (i.e., covariates-only model), none of the predictors significantly predicted academic performance, with $F(1, 1058.35) = 0.31$, $p = .58$ for academic self-efficacy, $F(1, 983.51) = 0.26$, $p = .61$ for self-esteem, $F(1, 997.47) = 0.05$, $p = .82$ for perseverance of effort, and $F(1, 992.37) = 3.65$, $p = .06$ for consistency of interests.

3.6 Mediation analyses

For a mediation effect to occur, a main effect between the predictor and outcome variable as well a main effect between the mediator and the outcome variable must be present (Kenny et al., 1998). Previous analyses show that only consistency of

Table 5 Results of the generalized multiple linear regression with a negative binomial distribution analysis predicting study progress

Variables	Model A			Model B		
	B	SE	OR	B	SE	OR
Intercept	1.12***	0.10	3.06	0.45	0.29	1.56
Age	-0.00	0.00	1.00	-0.00	0.00	1.00
Gender	-0.13*	0.06	0.88	-0.14*	0.06	0.87
Academic self-efficacy				0.04	0.04	1.04
Self-esteem				0.05	0.06	1.05
Perseverance of effort				-0.04	0.06	0.96
Consistency of interests				0.16***	0.04	1.17
χ^2	5.68; $df = 2$, $p = 0.06$			22.69, $df = 6$, $p = .001$		

Model A is the covariates only model; Model B is the full model including covariates and predictor variables

B unstandardized regression weight; *SE* standard error; *OR* odds ratio

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

Table 6 Fixed effects for models of the predictors of students' grades

	Estimate	SE	95% CI
Model 0 ($\chi^2 = 10,028.25$; $df = 2$)			
Intercept	6.58***	0.03	[6.52, 6.65]
Model 1 ($\chi^2 = 9987.87$; $df = 4$)			
Intercept	5.88***	0.12	[5.64, 6.11]
Age	0.02***	0.00	[0.01, 0.02]
Gender	0.16*	0.07	[0.03, 0.30]
Model 2 ($\chi^2 = 9972.49$; $df = 8$)			
Intercept	4.73***	0.36	[4.02, 5.45]
Age	0.02***	0.00	[0.01, 0.02]
Gender	0.16*	0.07	[0.02, 0.31]
Academic self-efficacy	0.10*	0.05	[0.00, 0.20]
Self-esteem	0.06	0.08	[-0.10, 0.21]
Perseverance of effort	-0.01	0.07	[−0.15, 0.13]
Consistency of interests	0.15**	0.05	[0.05, 0.25]
Model 3 ($\chi^2 = 9456.93$; $df = 9$)			
Intercept	4.86***	0.49	[3.90, 5.83]
Age	0.01**	0.00	[0.01, 0.02]
Gender	0.13	0.10	[-0.07, 0.34]
Academic self-efficacy	0.04	0.07	[-0.10, 0.17]
Self-esteem	0.06	0.11	[-0.17, 0.28]
Perseverance of effort	0.02	0.10	[-0.17, 0.22]
Consistency of interests	0.14	0.07	[-0.00, 0.28]

Estimate unstandardized regression weight; *SE* standard error; *CI* confidence interval; *Model 0* model with only a fixed intercept, ignoring the hierarchical structure; *Model 1* covariates as fixed variables were added; *Model 2* predictors as fixed variables were added; *Model 3* random intercepts were added

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

interests is a significant predictor of retention and study progress respectively, and that none of the grit subscales predicted academic performance. Furthermore, both academic self-efficacy and self-esteem did not predict exam attempt or study progress. Therefore, a mediation effect was not possible, and consequently, was not analysed.

4 Discussion

This study aimed to gain insight into how the non-cognitive factors academic self-efficacy, self-esteem, and grit (i.e. perseverance of effort and consistency of interests) predicted academic success in higher online education. More specifically, the total predictive value of academic self-efficacy, self-esteem, and grit on the three academic success aspects exam attempt, study progress, and academic performance

was investigated. Moreover, the unique predictive value of each of the predictors on the three aspects of academic success was inquired. In addition, it was explored to what extent the predictors overlapped in predicting the academic success outcomes. Analyses revealed that consistency of interests, one of the subscales of grit, was the most important predictor, as it was found to be positively related to exam attempt and study progress after controlling for academic self-efficacy, self-esteem, and the grit subscale perseverance of effort. However, consistency of interests was not a significant predictor of academic performance. Furthermore, academic self-efficacy, self-esteem, and perseverance of effort did not uniquely predict any of the academic success variables. Moreover, academic self-efficacy, as well as self-esteem, did not mediate the relationship between consistency of interests and exam attempt and study progress respectively.

Overall, grit showed to be a positive predictor of academic success within traditional education (e.g., Credé et al., 2017; Datu et al., 2016; Duckworth & Quinn, 2009). These studies found that only the subscale perseverance of effort was a significant contributor in predicting academic success. Credé et al. (2017) stated in their meta-analytic study that perseverance of effort is a stronger predictor of exam attempt and performance than consistency of interests and overall grit (i.e., grit measured as a higher-order construct). In the present study, in contrast, consistency of interests was a significant predictor of two aspects of academic success (i.e., exam attempt and study progress), and perseverance of effort was not. There could be several reasons for this contradicting result. For one, most of the previous studies had GPA or similar outcome variables, which is different from the outcome variables exam attempt and study progress. Similar to the present study, Palczyńska and Świst (2018) found in their study that consistency of interests and not perseverance of effort was related to educational attainment (i.e., highest completed level of education). As they explained, not being able to maintain your interests for a long time (i.e., consistency of interests) might not make that much of a difference for one's grades (as was also shown in the present study), but it might make it more difficult to reach a higher educational level. In this reasoning, it is also possible that students with low consistency of interests switch more easily to another course or even drop out, which could result in not taking an exam or having low study progress. This can also explain why consistency of interests was not related to exam grades (i.e., academic performance). It does not however explain why perseverance of effort was not found to be a predictor of any of the academic success measurements in higher online education.

It could be speculated that the relationship was not found because grit was measured as a general rather than a domain-specific construct. Recently, researchers showed that grit measured in a specific academic domain was more strongly related to academic success than generally measured grit (Cormier et al., 2019; Schmidt et al., 2017). Furthermore, Neroni et al. (2019) showed that management of study time and effort was an important predictor of academic performance in higher online education. Items measuring management of effort (e.g., Even when course materials are dull and uninteresting, I manage to keep working until I finish) in their study are comparable to perseverance of effort (e.g., I finish whatever I begin) in the present study, with the difference of being study-specific instead of general. This indicates

even more that academic grit might be more strongly related to academic success than general grit. Future research on academic grit and academic success should establish whether this is the case in higher online education.

An additional explanation is that students in higher online education have a specific profile that is different from students in traditional education. Students in higher online education are on average older and often have family- and work obligations which is different from traditional higher education students (U.S. Department of Education, National Center for Education Statistics 2002). Furthermore, many students already have a higher education level degree, and very possibly enrolled in higher online education for self-improvement or career advancement. This could explain why being consistent in interests might be especially essential to increase academic success for students in higher online education.

Although many researchers see the merits of grit, this concept has received considerable criticism. For instance, the question has been raised whether grit and the personality trait conscientiousness are two different concepts or whether they are the same concept with different names. Credé et al. (2017) showed in their meta-analysis, conducted in traditional education, that many facets of grit and conscientiousness are strongly correlated, albeit stronger for conscientiousness and perseverance of effort than for conscientiousness and consistency of interests. Nevertheless, they showed that the perseverance of effort facet accounts for unique variance in academic performance after controlling for conscientiousness and consistency of interests, which indicates that perseverance of effort should be treated separately from conscientiousness. Furthermore, Credé et al. (2017) pointed out that grit is a significant positive predictor of retention, and that grit might be important in education where retention rates are problematic, as in higher online education. This indicates that grit might be more important in predicting exam attempt and study progress, and less important in predicting the level of the grade (i.e., academic performance).

Next, academic self-efficacy was not a significant unique predictor of any academic success variable. This is not in line with most of the previous studies, as academic self-efficacy was found to be positively related to academic success for college students (e.g., Diseth, 2011; Fenning & May, 2013; Stajkovic et al., 2018) as well as for higher online students (de Fátima Goulão, 2014; Ergul, 2004; Joo et al., 2013; Radovan, 2011). Some researchers found that academic self-efficacy acted as a mediator between other variables (e.g., grit) and academic success (Usher et al., 2019; Wolters & Hussain, 2015). However, for a mediation effect to occur, a direct main effect of academic self-efficacy on academic success is a prerequisite (Baron & Kenny, 1986), which was not present in the current study. One of the reasons for not finding a relationship between academic self-efficacy and academic success might be that students were asked to report their self-efficacy on one of the courses they were following at that moment. However, some students followed more than one course at the same time or followed multiple courses sequentially within the 14-month period. As academic self-efficacy is often seen as a state and course-dependent, future research should look at whether the results would be different if academic self-efficacy was measured separately for every course followed. Furthermore, it should be acknowledged that the instrument to measure academic self-efficacy, the MSLQ (Pintrich et al., 1993), was originally developed for traditional

college students. A previous study showed that the factor structure of the MSLQ-B (i.e., learning strategy use) for higher online students differed from the factor structure of the MSLQ-B for traditional college students (Meijs et al., 2019). It is possible that the factor structure of the academic self-efficacy subscale of the MSLQ is not suitable for higher online students.

Moreover, self-esteem did not predict any of the academic success variables when controlled for academic self-efficacy and grit. This is in line with findings in traditional education, where researchers mostly failed to find a significant relationship between self-esteem and academic success (Fakari & Tafazzoli, 2015; Gębka, 2014; Phan, 2010; Trautwein et al., 2006) or found positive relationships with small effect sizes (for a review, see Baumeister et al., 2003). Baumeister et al. (2003) suggested that the effect sizes of self-esteem predicting academic success are small or non-significant because it is reasonable to believe that self-esteem is not predicting academic success but the other way around: high academic success leads to a boost for our self-esteem. However, based on data in the present study, it is not possible to investigate this, as self-esteem is measured at baseline and academic success is measured after 14 months. Also, the non-significant zero-order correlations between self-esteem and the three outcome variables already indicate that this is not a plausible explanation. Stupnisky et al. (2007) suggest in their study that self-esteem was not directly predicting college students' academic performance, but indirectly via perceived control. Future research should indicate whether this is also true in higher online education.

Not finding a unique predictive value of academic self-efficacy, self-esteem, and perseverance of effort on any of the academic success aspects could hypothetically be explained by an existing overlap between predictors. However, the results showed that the correlations mutually between the predictors are small to moderate. Furthermore, results showed that the zero-order correlations between these predictors and each of the academic success aspects were not significant or significant with insubstantially small effect size.

4.1 Strengths and limitations

This study has several strengths. First, it is the first study to our knowledge that examined academic self-efficacy, self-esteem, and grit in relation to academic success in relation to each other. Second, research into the factors underlying academic success in higher online education is limited, and the present study contributes to the literature on academic self-efficacy, self-esteem, and grit in higher online education. Third, because of the large sample size, statistical power was high (i.e., the chance of a type II error is small). Fourth, for the outcome variable, three operationalisations were used, for which three different, appropriate statistical analyses were performed: a hierarchical logistic regression analysis for the dichotomous outcome variable, a generalized linear model with a negative binomial distribution to properly model the count data variable, and a mixed model regression analysis for the

multilevel outcome variable. This contributed significantly to the robustness of the results.

Besides these strengths, some limitations should be noted. Because this study has an observational design, strong causal conclusions cannot be drawn. Furthermore, students were able to follow as many courses as they wanted within the 14 months period and followed all different kinds of courses, thus this may lead to inconsistency in how participants interpret some of the variables measured, and result in reduced strengths in associations with outcome variables. As mentioned earlier, students were asked to answer the questions on academic self-efficacy with keeping in mind one of the courses they were following but for what course they filled out the questionnaire was not inquired. Future research should reveal whether a relationship between academic self-efficacy and academic success exists when academic self-efficacy is measured for every taken course separately. In addition, the questionnaire that was used to measure academic self-efficacy was originally developed for traditional college students, and no normative data was found for using this questionnaire in an online student population in the age range of 18–80 years. It is possible that the factor structure of this questionnaire is different for higher online education students than for traditional college students. Further, academic success was restricted to the first 14 months of their studies in the present study. Although this is a reasonable duration because this is the typical duration for completing a course, it would be valuable to know whether these results remain the same when students are further in their academic careers. Lastly, nowadays, education for the population described in this study shifted from individualised to cohort-based education. Future research should focus on investigating whether these results still hold for the higher online education students in a cohort-based educational system.

4.2 General conclusion and implications

Academic self-efficacy, self-esteem, and perseverance of effort did not uniquely predict exam attempt, study progress, and academic performance in higher online education, which is not in line with previous studies in traditional education. Furthermore, academic self-efficacy and self-esteem did not mediate the relationship between grit and any of the academic success variables. Consistency of interests, however, was found to be an important and direct predictor of exam attempt and study progress in higher online education, even when academic self-efficacy, self-esteem, and perseverance of effort were controlled for. This is a unique finding, as most studies in traditional education did not find any relationship between consistency of interests and academic success. The higher online students at this institution have 14 months to finish a course, which is a long time compared to traditional education, so in a way, it is plausible that being able to maintain a focus of interest is an important aspect of studying successfully. For teachers and instructors, it is important to stimulate students as much as possible to keep them focussed on finishing their courses and eventually finishing the educational program.

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Joyce Neroni is a doctoral student at the Faculty of Educational Sciences, Open University of the Netherlands, and a teacher at the Faculty of Psychology and Neuroscience at Maastricht University, the Netherlands. Her research interests include psychosocial determinants of academic success, improvement of well-being, and positive psychology.

Celeste Meijs is an assistant professor at the Faculty of Educational Sciences, Open University of the Netherlands. Her research focuses on executive functions, sensory processing, learning strategy use and the relation with learning and academic performances.

Paul A. Kirschner is an Emeritus Professor of Educational Psychology at the Open University of the Netherlands, Visiting Professor at Thomas More University of Applied Sciences (Antwerp, Belgium), and holds an Honorary Doctorate (*doctor honoris causa*) at the University of Oulu, Finland. His expertise lies primarily in the area of researching how students can most effectively, enjoyably, and efficiently learn and how educational materials and teaching strategies can best facilitate this.

Kate M. Xu is an assistant professor at the Faculty of Educational Sciences, Open University of the Netherlands. Her research interests include motivational and self-beliefs in academic learning and achievements.

Renate H. M. de Groot is appointed as Full Professor Biopsychology of Learning at the Faculty of Educational Sciences, Open University of the Netherlands and head of the department Conditions for Lifelong Learning. Renate's scientific interest is centered on the bio-psychological determinants of learning and cognition in lifelong perspective. Both observational studies as well as intervention studies are part of her core business.

Authors and Affiliations

Joyce Neroni[1,2] · Celeste Meijs[1] · Paul A. Kirschner[1,3] · Kate M. Xu[1] · Renate H. M. de Groot[1,4]

[1]   Faculty of Educational Sciences, Open Universiteit, P.O. Box 2960, 6401 DL Heerlen, The Netherlands

[2]   Faculty of Psychology and Neuroscience, Maastricht University, Maastricht, The Netherlands

[3]   Expertise Centre Effective Learning (ExCEL), Thomas More University of Applied Sciences, Mechelen, Belgium

[4]   NUTRIM School of Nutrition and Translational Research in Metabolism, Maastricht University, Maastricht, The Netherlands