frontiers | Frontiers in Education

TYPE Brief Research Report
PUBLISHED 07 November 2022
DOI 10.3389/feduc.2022.992067

OPEN ACCESS

EDITED BY
Juergen Seifried,
University of Mannheim, Germany

REVIEWED BY
Michael Goller,
University of Paderborn, Germany
Eveline Wuttke,
Goethe University Frankfurt, Germany

*CORRESPONDENCE
Vanessa Hübner
vanessa.huebner@uni-bamberg.de

SPECIALTY SECTION
This article was submitted to Educational Psychology, a section of the journal Frontiers in Education

RECEIVED 12 July 2022
ACCEPTED 24 October 2022
PUBLISHED 07 November 2022

CITATION
Hübner V and Pfost M (2022) University students' beliefs about errors predict their willingness to take academic risks.
Front. Educ. 7:992067.
doi: 10.3389/feduc.2022.992067

University students' beliefs about errors predict their willingness to take academic risks

Vanessa Hübner* and Maximilian Pfost

Department of Educational Research, University of Bamberg, Bamberg, Germany

Students' beliefs about errors have become a field of interest within higher education research. Studies show that these are associated with students' GPA as well as their learning strategies. Whether students' beliefs about errors are associated with their willingness to engage in learning situations in which making errors is likely, is still an open question. To address this research gap, we measured error beliefs on three dimensions (affect, cognition, and behavior) on a sample of N = 159 university students. Applying stepwise linear regression and using academic risk taking as dependent variable for learning behavior that is characterized by a risk of making errors, this article shows that beliefs about errors influence students' willingness to engage in error-prone situations within seminar settings. Students who do not show negative affect after making errors tend to take more academic risks within seminar settings, and students who are behaviorally apt to work with their errors take less academic risks. In contrast, beliefs about errors do not seem to relate to students' engagement in academic risks in front of their peers. These results contribute to a deeper understanding of the role of students' beliefs about their errors for educational dynamics and processes. They also offer implications for practitioners such as promoting strategies for emotional regulation following errors.

KEYWORDS

academic risk taking, goal orientation, academic self-concept, error beliefs, higher education

Introduction

An error may be defined as a preventable result deviating from an anticipated target (Frese and Fischer, 2015). As errors can hardly be avoided during learning processes, dealing with errors in educational settings is a topic that has received an increasing amount of interest, and treating errors as learning opportunities has gained relevance (Chott, 1999; Soutter and Clark, 2021). Although the manifestation of an error itself is usually proclaimed to be domain-specific (Oser and Spychiger, 1999),

structural similarities across domains can be identified. Those go along with structural similarities of handling such errors in different domains. Taxonomically, error types such as knowledge errors (the necessary information in order to execute a plan of action is not available), judgment errors (feedback on an action is misinterpreted), or habit errors (a routine action plan which does not fit the situation is executed) can be differentiated (Zapf et al., 1999). Therefore, we can assume that due to past experiences with errors in educational contexts, university students may have established individual beliefs about making and handling errors that are relatively stable over time and situationally independent (Aronson et al., 2014) and which may guide students' behavior in specific learning situations.

Together with error management strategies, students' beliefs about errors are the focus found within the context of higher educational research most frequently. Beliefs describe the entirety of an individual's opinions regarding a certain object and, according to the theory of reasoned action (Ajzen and Fishbein, 1975), are measured on three dimensions: The dimension of affect includes emotions associated with the issue at hand (e.g., fear of making errors). The cognitive dimension includes thoughts and knowledge about the issue (e.g., recognizing errors as a learning opportunity), and the behavioral dimension includes the tendency to behave in a particular way concerning the issue (e.g., revising relevant course material after making errors). Positive beliefs supposedly lead to higher and more frequent engagement in behaviors in which the issue of the belief is prevalent. In accordance, Leighton et al. (2018) developed a generic instrument measuring university students' beliefs about errors. They found that positive affect and behavioral commitment toward errors predict students' GPA positively, although the mechanism behind is left unexplained. Similarly, Cillarege et al. (2003) found that error management training for older learners, which also included questioning one's own error beliefs, leads to more positive affect after making errors as well as higher performance test scores. Furthermore, a beneficial association between affective-motivational adaptivity and learning from errors was also found by Zhao et al. (2018) within a sample of adult apprentices in the Swiss dual training system. Finally, using latent profile analysis, Reindl et al. (2020) observed that students who are able to reinterpret their errors in a positive way, tend to use more deep-level learning strategies compared to the other two learner profiles identified. Positive beliefs about errors may thus prompt students to engage in learning situations beneficial for academic outcome, despite the risk of making errors in the process.

In order to extend the knowledge within the field of error research, the present article aims to answer the question whether students with positive beliefs about errors tend to engage more in situations in which making errors is likely and therefore enhance academic achievement. Academic risk taking (ART) serves as a low-threshold example for being engaged in error-prone learning situations. ART is a type of student behavioral engagement that is characterized by students' uncertainty regarding the correctness of their contribution (Clifford, 1991). They share ideas on a difficult topic during courses or ask peers for feedback on a term article that still needs editing. When displaying ART, students risk making errors and may receive explicit or implicit negative feedback, which ultimately may lead to their peers or instructors perceiving them as less intelligent (Beghetto, 2009). Therefore, ART is also dependent on the people present in the error-prone situation and observing the behavior, e.g., peers within a study group or the full seminar group including the instructor (Lund Dean and Jolly, 2012). Additionally, this study offers the opportunity to explore the question why students tend to avoid taking academic risks (Teagarden et al., 2018) even though they might perceive ART to be worthwhile (Ravert and Schneller, 2019). This phenomenon is largely unexplained, though Ellis (2015) identified a high perceived emotional risk, which poses a threat to students' self-concept, to be a barrier that discourages students from engaging.

Based on the assumption that positive beliefs about errors may contribute to the intention of becoming engaged in error-prone learning situations, we hypothesize all dimensions of error beliefs to correlate positively with students' ART (H1). In this study, students' ART was measured on two dimensions: ART in in front of the complete seminar group, including the instructor; and ART solely in peer situations. When academic self-concept, goal orientation, age, and gender are held constant, we hypothesize all three dimensions of error beliefs to predict students' ART on the seminar group dimension (H2) and on the peer dimension (H3) positively. We consider these variables as controls as previous studies have shown that on the one hand high academic self-concept, which is a mental representation of students' own academic abilities, predicts students' engagement positively (Guo et al., 2022). On the other hand, learners align their decisions and actions with overarching achievement goals, often measured trichotomously: Students with high mastery goal orientation aim to improve their competences for the sake of learning, while students with high performance-approach goal orientation aim to demonstrate their own skills in front of their peers, and students with high performance-avoidant goal orientation aim to hide their lack of skills from their peers (Middleton and Midgley, 1997; Becker et al., 2018). Abercrombie et al. (2022) found that mastery goal orientation and performance-approach goal orientation, but not performance-avoidant goal orientation predict ART significantly (see also Dachner et al., 2017). Additionally, female students (Karademir and Akgul, 2019) and older students (Beghetto, 2009) were found to display less ART. We had no assumptions concerning differences in relations of students' error beliefs for the two ART dimensions.

Materials and methods

Sample

Between May and July 2021, 116 students of a German university within the fields of social sciences or humanities responded to an online questionnaire, and 43 responded to a paper-pencil version (total N = 159 students). Both modalities were identical in item content and order. The mean age was 24.92 years (SD = 6.20 years). A total of 45% of them were bachelor students, 23% master students, 23% students aiming for state examination, and 9% did not specify their studies. A total of 72.3% of participants were females.

Measures

Beliefs about errors

The instrument for evaluating beliefs about errors includes items of the Attitudes Toward Mistakes Inventory (Leighton et al., 2018), translated into German and adapted by the authors, German items by Tulis et al. (2018), as well as further items by the authors. In line with our theoretical assumptions and Leighton et al.'s (2018) conceptualization, we operationalized errors as not domain-specific. The items were reduced in a stepwise process, taking into consideration factorial structure, internal consistency, item discrimination, and item difficulty. Originally consisting of 39 items, this process resulted in a three-dimensional instrument with seven items on each dimension. The factorial structure was tested and confirmed, using exploratory factor analysis with target-rotation. The affective dimension captures emotions following errors [e.g., "I feel embarrassed when I give a wrong answer during the seminar" (inverted)] and reaches an internal consistency of $\alpha = 0.90$. The cognitive dimension captures thoughts and knowledge about making errors (e.g., "Making errors is an important part of learning") and reaches $\alpha = 0.88$. The behavioral dimension captures behavior following errors ("When I have made an error I should discuss it with my peers") and reaches $\alpha = 0.76$. Participants answered the items on a 5-point Likert scale from 1 (*completely disagree*) to 5 (*completely agree*). Negatively formulated items were inverted, so high values indicate positive (i.e., adaptive) beliefs about errors.

Academic risk taking

Students' ART levels were measured using a new instrument developed by the authors Hübner and Pfost (accepted[1]). Factor analysis with target-rotation showed that two dimensions may be differentiated: Students' willingness to engage in academic risk taking (1) in front of the seminar group as well as (2) in front of their peers. A third dimension, engaging in ART solely in interaction with the instructor, was not found. Test items and data on psychometric properties of the scales will be published in the above mentioned article. Both dimensions, the six-item seminar group dimension (e.g., "To participate in seminar discussions, even on difficult topics"; $\alpha = 0.86$), and the four-item peer dimension (e.g., "To discuss difficult seminar content with fellow students after courses"; $\alpha = 0.82$) are considered for analyses. All items are answered on a 5-point Likert scale from 1 (*very unlikely*) to 5 (*very likely*).

Goal orientation

We used scales developed by the StEG study (Leibnitz-Institut für Bildungsforschung und Bildungsinformationen, 2020a,b,c) and slightly adjusted them to fit the university context. Using a 4-point Likert scale, mastery goal orientation (e.g., "For me, studying is about learning something new"; $\alpha = 0.62$) and performance-approach goal orientation (e.g., "For me, studying is about receiving better grades than my peers"; $\alpha = 0.87$) were measured by five items, performance-avoidant goal orientation ("For me, studying is about not embarrassing myself in front of my peers"; $\alpha = 0.84$) by four items.

Academic self-concept

We used a scale by Dickhäuser et al. (2002), developed for university contexts. In order to keep the total number of items low, we used the absolute subscale with no reference-norm, which has five items (e.g., "I consider my aptitude for study to be. . . *low – high*"; $\alpha = 0.89$). Participants answered the items on a 7-point semantic differential.

Analysis strategy

For conducting analyses, we used *R Version 4.2.0* (R Core Team, 2022). For each of the scales we calculated a person-specific mean as estimator for the constructs. First, we observed the correlation pattern, using *corrplot 0.92* (Wei and Simko, 2021) and next, conducted stepwise linear regression, using *lm.beta 1.5–1* (Behrendt, 2014) for standardized regression coefficients. To test the model assumptions we used *lmtest 0.9–38* (Zeileis and Hothorn, 2002).

Results

Descriptive statistics

Table 1 shows means and standard deviations of all included variables, as well as their interrelations. With the exception of the correlation between the affective and the behavioral dimension, the three dimensions of error beliefs show significant positive

1 Hübner, V., and Pfost, M. (accepted). Operationalization of academic risk taking in university students. *J. Educ. Res. Online.*

TABLE 1 Means, standard deviations, and bivariate correlation of all variables.

		M	*SD*	1	2	3	4	5	6	7	8	9	10	11
1	EB aff	3.46	0.90	1										
2	EB cog	3.87	0.69	0.48**	1									
3	EB beh	3.71	0.53	0.08	0.30**	1								
4	ASC	5.02	0.99	0.23**	0.08	0.08	1							
5	Ma GO	4.38	0.46	0.10	0.29**	0.28**	0.25**	1						
6	Ap GO	2.04	0.90	−0.38**	−0.26**	−0.10	0.08	−0.08	1					
7	Av GO	2.76	1.02	−0.72**	−0.35**	−0.13	−0.21**	−0.12	0.49**	1				
8	ART (group)	3.15	0.86	0.55**	0.22**	−0.09	0.30**	0.27**	−0.12	−0.51**	1			
9	ART (peers)	3.33	0.99	0.22**	0.22**	0.15	0.19*	0.13	0.26**	−0.17**	0.27**	1		
10	Age	24.9	6.20	−0.01	−0.04	−0.21*	−0.12	−0.14	−0.01	0.03	0.02	−0.24**	1	
11	Gender			−0.11	0.09	0.27**	0.12	0.15	−0.02	0.19	−0.16	0.06	−0.15	1

EB aff, affective beliefs about errors; EB cog, cognitive beliefs about errors; EB beh, behavioral beliefs about errors; ASC, academic self-concept; Ma GO, mastery goal orientation; Ap GO, performance-approach goal orientation; Av GO, performance-avoidant goal orientation; ART, general academic risk taking (seminar group dimension; peer dimension); reference category for gender: female.
*$p < 0.05$ and **$p < 0.01$.

associations with one another. The same is true for the two ART dimensions. Furthermore, positive correlations between the seminar group dimension of ART and the affective ($r = 0.55$) as well as the cognitive ($r = 0.22$) dimensions of error beliefs are found. There is a non-significant correlation between the behavioral dimension of error beliefs and ART, which is close to zero. Concerning the peer dimension of ART, a comparable pattern is observed.

Regression analysis

We conducted stepwise linear regression in order to test the hypothesis of all three dimensions of error beliefs predicting students' ART on the seminar group dimension (Table 2) as well as on the peer dimension (Table 3). We estimated five models, the first model including all control variables. In models 2–4, we added one dimension of error beliefs, respectively, and model 5 includes all controls and all dimensions of error beliefs.

Concerning the seminar group dimension, model 1 explains 30% of variance in ART. When adding the affective dimension of error beliefs in model 2, we observe a significant 7% increase of explained variance for the seminar group dimension. The coefficient is significant with a medium effect size (β = 0.40). Adding the cognitive dimension in model 3 does not result in an increase of explained variance compared to model 1. The cognitive dimension shows a zero effect in the regression model. Adding the behavioral dimension in model 4 increases the amount of explained variance significantly by 3% as compared to model 1. Contrary to the correlation analysis, we observe a significant and negative regression coefficient for the behavioral dimension of error beliefs (β = −0.21). In model 5, which takes all variables simultaneously into account, we observe a significant 11% increase of explained variance compared to model 1. Performance-avoidant goal orientation predicts the criterion negatively (β = −0.25), while mastery goal orientation predicts ART positively (β = 0.24). Concerning the three dimensions of error beliefs, there are no great changes in the coefficients compared to models 2, 3, and 4. Students who show less negative affect following errors display higher levels of ART (β = 0.43), while students who are behaviorally oriented toward working with errors show lower levels of ART (β = −0.20). The cognitive dimension does not influence students' ART.

Concerning the peer dimension, model 1 explains 6% of variance and only the cognitive dimension in model 3 adds to the amount of explained variance significantly (β = 0.27). In model 5, however, age is the only significant predictor (β = −0.20).

Discussion

Interpretation of results

Beliefs describe how individuals subjectively judge an issue and include emotions, knowledge, and options for action. Individuals whose beliefs have a positive valence are expected to show more willingness to engage in behavior in which the subject of the beliefs is prevalent. In this article, we set out to show the predictive power of students' beliefs about errors on their willingness to take academic risks.

In conformity with the first hypothesis, we find the affective and the cognitive dimensions of error beliefs to correlate positively with students' ART, on the peer dimension as well as on the seminar group dimension. Students who do not display negative affect after making errors are more likely to engage in

TABLE 2 Stepwise linear regression predicting academic risk taking (seminar group dimension).

	Model 1			Model 2			Model 3			Model 4			Model 5		
	b	β	*p*	*b*	β	p	*b*	β	*p*	*b*	β	*p*	*b*	β	*p*
ASC	0.13	0.15	0.055	0.10	0.11	0.128	0.13	0.15	0.056	**0.13**	**0.15**	0.050	0.09	0.11	0.130
Ma GO	**0.33**	**0.17**	0.022	**0.35**	**0.18**	0.011	**0.33**	**0.17**	0.024	**0.41**	**0.22**	0.004	**0.45**	**0.24**	0.001
Ap GO	0.10	0.11	0.218	0.13	0.14	0.094	0.10	0.11	0.213	0.10	0.11	0.188	0.12	0.13	0.095
Av GO	**−0.40**	**−0.49**	<0.001	**−0.18**	**−0.22**	0.038	**−0.40**	**−0.49**	<0.001	**−0.43**	**−0.52**	<0.001	**−0.20**	**−0.25**	0.019
Age	0.01	0.06	0.371	0.01	0.06	0.390	0.01	0.07	0.373	0.00	0.04	0.621	0.00	0.03	0.654
Gender	−0.18	−0.08	0.264	−0.15	−0.07	0.304	−0.17	−0.08	0.271	−0.08	−0.04	0.633	−0.04	−0.02	0.768
EB aff				**0.37**	**0.40**	<0.001							**0.40**	**0.43**	<0.001
EB cog							−0.01	−0.01	0.939				−0.07	−0.05	0.474
EB beh										**−0.33**	**−0.21**	0.007	**−0.32**	**−0.20**	0.007
R^2 (adj.)	0.30			0.37			0.30			0.33			0.41		
ΔR^2				**0.07** (p = <0.001)			0.00 (p = 0.939)			**0.03** (p = 0.007)			**0.11** (p = <0.001)		

ASC, academic self-concept; Ma GO, mastery goal orientation; Ap GO, performance-approach goal orientation; Av GO, performance-avoidant goal orientation; EB aff, affective beliefs about errors; EB cog, cognitive beliefs about errors; EB beh, behavioral beliefs about errors; reference category for gender: female. Findings significant on the 5%-level are bold. Changes in R^2 were tested using ANOVA.

TABLE 3 Stepwise linear regression predicting academic risk taking (peer dimension).

	Model 1			Model 2			Model 3			Model 4			Model 5		
	b	β	*p*	*b*	β	*p*	*b*	β	*p*	*b*	β	*p*	*b*	β	*p*
ASC	0.12	0.12	0.197	0.10	0.10	0.264	0.12	0.12	0.190	0.12	0.12	0.196	0.11	0.11	0.233
Ma GO	0.04	0.02	0.836	0.05	0.02	0.797	−0.04	−0.02	0.823	−0.01	−0.01	0.953	−0.05	−0.02	0.798
Ap GO	0.07	0.07	0.508	0.08	0.08	0.435	0.10	0.09	0.364	0.07	0.06	0.512	0.10	0.09	0.361
Av GO	−0.16	−0.17	0.106	−0.05	−0.06	0.668	−0.11	−0.12	0.268	−0.14	−0.15	0.147	−0.05	−0.05	0.703
Age	**−0.03**	**−0.21**	0.015	**−0.03**	**−0.21**	0.014	**−0.03**	**−0.21**	0.014	**−0.03**	**−0.19**	0.026	**−0.03**	**−0.20**	0.020
Gender	0.16	0.07	0.454	0.17	0.07	0.423	0.12	0.05	0.565	0.10	0.04	0.652	0.10	0.04	0.652
EB aff				0.18	0.16	0.175							0.11	0.10	0.429
EB cog							**0.27**	**0.18**	0.042				0.21	0.14	0.157
EB beh										0.20	0.11	0.230	0.13	0.07	0.455
R^2 (adj.)	0.06			0.06			0.08			0.06			0.07		
ΔR^2				0.00 (p = 0.175)			**0.02** (p = 0.042)			0.00 (p = 0.229)			0.01 (p = 0.157)		

ASC, academic self-concept; Ma GO, mastery goal orientation; Ap GO, performance-approach goal orientation; Av GO, performance-avoidant goal orientation; EB aff, affective beliefs about errors; EB cog, cognitive beliefs about errors; EB beh, behavioral beliefs about errors; reference category for gender: female. Findings significant on the 5%-level are bold. Changes in R^2 were tested using ANOVA.

academic risks, and students who believe errors to be a learning opportunity are more likely to take academic risks. However, the behavioral dimension shows a zero correlation, the aptness to work with errors not being related to ART and therefore only partially supporting our hypothesis. The correlation pattern shifts in the regression analysis.

Though we do not see the second hypothesis fully supported in the regression, we find evidence that beliefs about errors do affect students' learning behavior and subsequently, their opportunities to learn from potential errors (Oser et al., 1999). When analyzed in the joint model, the affective dimension still shows an association with ART on the seminar group dimension in the expected direction and, out of the three error belief dimensions, adds the largest amount of explained variance. This result is coherent with the theoretical assumption that positive beliefs about an object lead to heightened intention to engage in behavior in which the object of the belief is prevalent (Ajzen and Fishbein, 1975). The cognitive dimension does not predict ART on the seminar group dimension, the correlation being fully explained through the control variables. Both those results serve as explanations concerning why students tend to avoid ART even if they perceive it to be beneficial (Ravert and Schneller, 2019). The mere rational knowledge that errors are a learning opportunity is not sufficient to prompt

students to take academic risks. Therefore, the decision to engage in ART may not exclusively be based on rational decisions concerning optimal learning. Instead, students may perceive the worry of making errors and subsequently having to experience negative affect as a barrier to take academic risks, supporting Ellis' (2015) assumption of emotional risk playing a role in ART.

The behavioral dimension, contrary to our hypothesis, predicts ART on the seminar group dimension negatively when controlling for goal orientation, academic self-concept, age, and gender. Correlations reveal that mastery goal orientation is related positively to both variables, the behavioral dimension of error beliefs as well as ART. Therefore, after controlling for this variable, students who believe they should work on their errors likewise avoid error-prone situations, possibly with the goal to minimize the work they need to put into their studies. However, this is just a first hypothesis requiring further research. Furthermore, the minor standard deviation of the behavioral beliefs subscale implies that our sample is fairly homogenous regarding their behavioral tendencies following errors. Thus, this negative relation within the regression model could also be a statistical artifact.

Contrary to our third hypothesis, relations regarding students' ART in front of their peers with students' beliefs about errors were not found when analyzed in a joint regression model. It might be possible that making errors is no a major threat to students in exclusive peer situations. Peers usually come together based on sympathy or joint interests, which might reduce the expectation of possible negative effects of ART. In consequence, beliefs about errors might be less important for ART in such situations.

Limitations

First, the sample was collected during the COVID-19 pandemic, when German universities had been in partial lockdown for over a year and primarily conducting online seminars, which may affect students' engagement levels and ART. Even though synchronous online teaching was offered, there may have been fewer opportunities for interaction and taking academic risks during seminars, as well as fewer peer-to-peer situations than under normal teaching conditions. Second, the sample is rather small, which may result in a lack of statistical power, and only includes students studying within the fields of social sciences and humanities. Therefore, results may not necessarily generalize to other fields of study such as natural sciences. Third, and concerning the reliability of the instruments used, Cronbach's Alpha of mastery goal orientation was quite low as was its standard deviation. In terms of validity, when creating the instrument for error beliefs, we did not go through multiple iterations of translation. Furthermore, items of further sources were used for the composition of the applied scales. Therefore, direct comparisons with results reported by Leighton et al. (2018) are not advisable. Additionally, the scales on ART and error beliefs were developed within the same sample as the one used in the present analyses and a replication of the reported findings within an independent sample is an important research desideratum. Finally, error beliefs are operationalized in a generic way, although intra-individual fluctuations e.g., between different domains are thinkable.

Implications for future practice and research

Previous research suggests the importance of error beliefs within educational settings by showing an association with GPA and learning strategies (Leighton et al., 2018; Reindl et al., 2020). On a normative level, authors state that working with errors within educational contexts should be practiced (Chott, 1999; Soutter and Clark, 2021). Therefore, we consider it necessary to take beliefs about errors into consideration when empirically analyzing educational processes and planning interventions.

Following on from our results and those found in the literature, we see important research questions that we would like to address in the future. First, it should be established whether ART acts as a moderating factor between students' beliefs about errors and their academic achievement, shedding some light on the underlying mechanism concerning the association between error beliefs and GPA (Leighton et al., 2018). Second, a robustness check of our results taking into account additional possible factors of influence is in order. For example, the theory of reasoned action (Ajzen and Fishbein, 1975) considers perceived locus of control a determinant of the likelihood of performing behavior.

Due to the crucial role of the affective dimension for students' decision to engage in ART, our findings suggest that practitioners might focus on improving the affective component of error beliefs. Psychological safety within courses has shown to minimize negative affect after making errors (Lee, 2020). Therefore, considering seminar climate as well as the role of strategies of emotional regulation in order to decrease negative affect following errors seems promising.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/ repositories and accession number(s) can be found

below: https://doi.org/10.23668/psycharchives.8303 and https://doi.org/10.23668/psycharchives.8304.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

Author contributions

VH was responsible for the data collection, performed the statistical analyses, and wrote the first draft of the manuscript. MP contributed to writing the manuscript. VH and MP were included in the revision of the first draft and approved the version submitted. Both authors contributed to the development of the questionnaire used and the design of the study.

Funding

Publication fees supported by Open-Access-Fund, University of Bamberg.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

Abercrombie, S., Bang, H., and Vaughan, A. (2022). Motivational and disciplinary differences in academic risk taking in higher education. *Educ. Psychol.* 42, 1–18. doi: 10.1080/01443410.2022.2076810

Ajzen, I., and Fishbein, M. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley.

Aronson, E., Wilson, T., and Akert, R. (2014). *Sozialpsychologie [Social Psychology]*. Hallbergmoos: Pearson.

Becker, S., Pfost, M., and Artelt, C. (2018). New challenge, new motivation? Goal orientation development in graduates of higher track schools and their peers in vocational training. *Front. Psychol.* 9:1371. doi: 10.3389/fpsyg.2018.01371

Beghetto, R. A. (2009). Correlates of intellectual risk taking in elementary school science. *J. Res. Sci. Teach.* 46, 210–223. doi: 10.1002/tea.20270

Behrendt, S. (2014). *lm.beta: Add Standardized Regression Coefficients to lm-Objects. R package version 1.5-1*.

Chott, P. O. (1999). Ansätze zur Förderung einer Fehlerkultur": Lernförderung in der Schule durch Fehlerprophylaxe und Fehlermanagement [Approaches for promoting an "error culture": Promoting learning at school through error prevention and error management]. *PÄDForum* 3, 238–248.

Cillarege, K. A., Nordstrom, C. R., and Williams, K. B. (2003). Learning from our mistakes: Error management training for mature learners. *J. Bus. Psychol.* 17, 369–385. doi: 10.1023/A:1022864324988

Clifford, M. M. (1991). Risk taking: Theoretical, empirical, and educational considerations. *Educ. Psychol.* 26, 263–297. doi: 10.1080/00461520.1991.9653135

Dachner, A. M., Miguel, R. F., and Patena, R. A. (2017). Risky business: Understanding student intellectual risk taking in management education. *J. Manag. Educ.* 41, 415–443. doi: 10.1177/1052562917695775

Dickhäuser, O., Schöne, C., Spinath, B., and Stiensmeier-Pelster, J. (2002). Die Skalen zum akademischen Selbstkonzept: Konstruktion und Überprüfung eines neuen Instruments [The academic self-concept scales: Construction and review of a new instrument]. *Zeitschrift für Differentielle und Diagnostische Psychologie* 23, 393–405. doi: 10.1024//0170-1789.23.4.393

Ellis, D. E. (2015). What discourages students from engaging with innovative instructional methods: Creating a barrier framework. *Innovat. Higher Educ.* 40, 111–125. doi: 10.1007/s10755-014-9304-5

Frese, M., and Fischer, S. (2015). "Errors," in *Wiley Encyclopedia of Management*, ed. C. L. Cooper (Chichester, UK: John Wiley & Sons, Ltd), 1–3. doi: 10.1002/9781118785317.weom110147

Guo, J.-P., Yang, L.-Y., Zhang, J., and Gan, Y.-J. (2022). Academic self-concept, perceptions of the learning environment, engagement, and learning outcomes of university students: Relationships and causal ordering. *Higher Educ.* 83, 809–828. doi: 10.1007/s10734-021-00705-8

Karademir, C. A., and Akgul, A. (2019). Students' social studies-oriented academic risk-taking behaviours and autonomous learning skills. *CJES* 14, 56–68. doi: 10.18844/cjes.v14i1.4038

Lee, W. S. (2020). An experimental investigation into the application of a learning-from-mistakes approach among freshmen students. *SAGE Open* 10:215824402093193. doi: 10.1177/2158244020931938

Leibnitz-Institut für Bildungsforschung und Bildungsinformationen (2020a). *Skala: Annäherungsleistungsziele [Scale: Performance-approach goals]*. Available online at: https://www.fdz-bildung.de/skala.php?erhebung_id=216&skala_id=6692

Leibnitz-Institut für Bildungsforschung und Bildungsinformationen (2020b). *Skala: Lernzielorientierung [Scale: Mastery goals]*. Available online at: https://www.fdz-bildung.de/skala.php?erhebung_id=216&skala_id=6693

Leibnitz-Institut für Bildungsforschung und Bildungsinformationen. (2020c). *Skala: Vermeidungsleistungsziele [Scale: Performance-avoidant goals]*. Available online at: https://www.fdz-bildung.de/skala.php?erhebung_id=216&skala_id=6694

Leighton, J. P., Tang, W., and Guo, Q. (2018). Undergraduate students' attitudes towards mistakes in learning and academic achievement. *Assess. Evaluat. Higher Educ.* 43, 612–628. doi: 10.1080/02602938.2017.1387230

Lund Dean, K., and Jolly, J. P. (2012). Student identity, disengagement, and learning. *AMLE* 11, 228–243. doi: 10.5465/amle.2009.0081

Middleton, M. J., and Midgley, C. (1997). Avoiding the demonstration of lack of ability: An underexplored aspect of goal theory. *J. Educ. Psychol.* 89, 710–718. doi: 10.1037/0022-0663.89.4.710

Oser, F., and Spychiger, M. (1999). "Lernen aus Fehlern: Zur Psychologie 'negativen' Wissens," in *[Learning from errors: On a psychology of 'negative' knowledge] in Fehlerwelten: Vom Fehlermachen und Lernen aus Fehlern?; Beiträge und Nachträge zu einem interdisziplinären*

Symposium aus Anlaß des 60. Geburtstages von Fritz Oser, eds W. Althof and F. Oser (Opladen: Leske), 11–41.

Oser, F., Spychiger, M., and Hascher, T. (1999). "Lernen aus Fehlern: Zur Psychologie 'negativen' Wissens [Learning from errors: On the psychology of "negative" knowledge]," in *Fehlerwelten: Vom Fehlermachen und Lernen aus Fehlern. Beiträge und Nachträge zu einem interdisziplinären Symposium aus Anlaß des 60. Geburtstages von Fritz Oser*, ed. W. Althof (Opladen: Leske), 11–41.

R Core Team (2022). *R: A language and environment for statistical computing. R foundation for statistical computing*. Vienna: R Core Team.

Ravert, R. D., and Schneller, J. (2019). Risks worth taking: Advisors' views on risks that college students should take more often. *Educ. Rev.* 71, 792–799.

Reindl, M., Tulis, M., and Dresel, M. (2020). Profiles of emotional and motivational self-regulation following errors: Associations with learning. *Learn. Individ. Diff.* 77:101806. doi: 10.1016/j.lindif.2019.101806

Soutter, M., and Clark, S. (2021). Building a culture of intellectual risk-taking: Isolating the pedagogical elements of the Harkness Method. *J. Educ.* 54:002205742110377. doi: 10.1177/00220574211037747

Teagarden, A., Commer, C., Cooke, A., and Mando, J. (2018). Intellectual risks in the writing classroom: Navigating tensions in educational values and classroom practice. *Composit. Stud.* 46, 116–136.

Tulis, M., Steuer, G., and Dresel, M. (2018). Positive beliefs about errors as an important element of adaptive individual dealing with errors during academic learning. *Educ. Psychol.* 38, 139–158. doi: 10.1080/01443410.2017.1384536

Wei, T., and Simko, V. (2021). *R Package "Corrplot": Visualization of a Correlation Matrix (Version 0.84)*.

Zapf, D., Frese, M., and Brodbeck, F. C. (1999). "Fehler und Fehlermanagement," in *[Errors and error management] in Arbeits- und Organisations-Psychologie*, eds C. Hoyos Graf and D. Frey (Weinheim: Beltz), 398–411.

Zeileis, A., and Hothorn, T. (2002). Diagnostic checking in regression relationships. *R News* 2, 7–10.

Zhao, B., Seifried, J., and Sieweke, J. (2018). Trainers' responses to errors matter in trainees' learning from errors: Evidence from two studies. *JMP* 33, 279–296. doi: 10.1108/JMP-10-2017-0364