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# Leap, learn, earn: exploring academic risk taking and learning success across gender and socioeconomic groups

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## Abstract

**Background** The positive learning effects of academic risk taking (ART) in higher education has been discussed since the 1980s. However, this may not apply equally for all social groups. Men and women may differ in the way they use ART to construct their gender identity. Students with different socioeconomic status (SES) may differ in their ability to navigate academic risks due to differences in available cultural capital.

**Aims** This study examines gender and SES disparities in ART and their impact on learning success. It explores if ART mediates and is moderated by gender and SES effects. Additionally, it assesses if ART directly predicts learning success.

**Sample** A sample of  $N=381$  German university students was used.

**Methods** Data was analyzed following a structural equation modeling approach.

**Results** Men show more ART on the seminar group dimension, whereas women show more ART on the peer dimension. Being male indirectly predicts higher learning success via the seminar group dimension of ART. Furthermore, SES and gender moderate the effect between ART and learning success. Both ART dimensions directly predict students' learning success.

**Conclusions** Our research contributes to understanding the mechanisms of social disparities within higher education and offers implications for the development of inclusive teaching strategies and research on aspects of intersectionality.

**Keywords** Academic risk taking · Learning success · Disparities · Gender · Socioeconomic status · Higher education

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## Introduction

### What is academic risk taking?

When people face risks, they are generally confronted with multiple options of action, each carrying uncertain consequences with varying degrees of likelihood (Betsch et al., 2011). While in educational contexts the focus has largely been on negative risks such as absenteeism (Halpern, 2007) or antisocial behavior (Kiran & Cengiz, 2021), taking risks is not inherently harmful (Fryt et al., 2022). Academic risk taking (ART) is a special type of student behavioral engagement, which is characterized by students' uncertainty regarding the correctness and the outcome of their contribution (Beghetto, 2009; Clifford, 1991). As this behavior is assumed to be conducive to learning, ART is an example of positive risk taking (Duell & Steinberg, 2019). For instance, students share ideas they are uncertain about in front of the whole seminar, or ask peers for feedback on term papers that still need editing (Hübner & Pfof, 2023). Hence, the risk lies in making errors while learning and being perceived as less competent by peers and instructors. Yet, students may also have something to gain from taking academic risks, as ART is thought to be beneficial for academic performance by fostering deep learning (Krochmal & Roth, 2017). Particularly when students are faced with problems in understanding the content, taking academic risks such as discussing their perceptions and inferences with competent others can lead to the identification and correction of misconceptions and thus to better learning. Even committing errors in the ART process may be beneficial for learning, for example through the acquisition of negative knowledge (Oser & Spychiger, 2005). This means that by making errors, students see not only how things work, but also how they do not work which is thought to be an integral part of understanding and learning.

Research interest in ART within higher education is growing, but structural conditions in universities differ from those found in school settings. Higher education environments afford students a considerable degree of autonomy to shape their learning experiences (Goppert et al., 2021). Moreover, universities serve as hubs for disseminating complex content, contributing to an environment, where the certainty of knowledge is not guaranteed (Prieler et al., 2022). Considering these structural realities, traditional measures of ART (e.g., Clifford, 1988) may prove inadequate in capturing the intricacies of risk taking among university students. A new self-report approach (Hübner & Pfof, 2023) considers the fact that individuals tend to take on different roles in front of different people, and may disengage when they experience identity-threat (Lund Dean & Jolly, 2012). For example, a student may perceive themselves as a *'clever debater'* and feel comfortable discussing content with selected peers who have a similar level of knowledge. However, that student may experience identity-threat in the presence of an instructor. They have a higher level of knowledge and may therefore see even small errors as deficits and consider the student to be less competent. In this situation, the role of a *'quiet listener'* may become more prevalent. Being asked, directly or indirectly, to take academic risks may therefore elicit different responses in the two roles. The instrument accommodates the possibility that the same student may have different context-specific ART propensities and distinguishes two contexts: The seminar group dimension, which includes situations in which peers and an instructor are present, and the peer dimension, which includes situations in which only peers are present.

## Are there disparities in academic risk taking?

When researching ART as a type of behavior that is beneficial to learning and generally worth promoting, it is important to consider whether the introduction of new teaching methods that incorporate ART create new barriers, especially for students from traditionally disadvantaged social groups. Research on disparities in ART is scarce, especially in the context of higher education. We contribute to close this research gap by focusing on two markers of disparity, namely students' gender and their socioeconomic status (SES).

### Gender

Contemporary theories of gender identity, such as Spence's (1993) *multifactorial gender identity theory*, or Bem's (1981) *gender schema theory* recognize gender as not biologically determined, but as learned and dynamic. From an early age, individuals are socialized into gender roles and internalize the characteristics each gender should possess within their societal context (Silva & Alves, 2020). Various traits, appearances, and mannerisms contribute to an individual's *gender identity* i.e., their sense of masculinity or femininity, and individuals incorporate gendered actions and signifiers into their everyday social interactions, known as *doing gender* (Vantieghem et al., 2014). Within this reiterative process, virtually anything can become a signifier for doing gender, including ART. Based on these assumptions and findings from research on gender stereotypes, we can make a theoretical case for both, female and male students perceiving identity-threat or identity-confirmation when displaying ART. On the one hand, femininity has traditionally been associated with traits like submissiveness, shyness and supportiveness, which still persist (Meyer et al., 2017). Consciously or unconsciously, females may therefore try to minimize their own presence within seminars and display less ART than their male counterparts. Likewise, women are said to be creative and imaginative (Bhatia & Bhatia, 2021), which aligns with the characteristic of ART to think beyond the content provided by the instructor. On the other hand, men are often perceived as assertive and daring (Bhatia & Bhatia, 2021; Meyer et al., 2017), which fits well with the risk taking aspect of ART. However, there is a distinct lack of attributes implying vulnerability associated with masculinity (Cryan et al., 2020). Conversely, the word 'uncertain' (Meyer et al., 2017) was found to be especially antithetical to masculinity. Males may therefore try to avoid ART as this requires them to accept their uncertainty, the possibility to make errors and becoming vulnerable in front of others.

Only little empirical research exists on the association between ART and gender, with conflicting results. While researchers found no association in secondary school students (Avcı & Özenir, 2016; Beghetto, 2009; House, 2002), Byrnes et al. (1999) meta-analysis found a significant effect size of  $d=0.40$  across all observed age groups (<9 years old; 10–13 years old; 18–21 years old); males taking more academic risks than females. It is important to note, that this meta-analysis incorporated papers published between 1964 and 1997 and a shift of gender stereotypes towards the acceptance of traditionally male attributes in females (Donnelly & Twenge, 2017) may explain the non-effects in newer studies. Additionally, recent research in related fields shows that women tend to take more positive risks than men (Fryt et al., 2022). Furthermore, they participate less within higher education seminars (Aguillon et al., 2020; Daugherty et al., 2020). Even in female-dominated study programs, their participation in discussions is disproportionately low (Aguillon et al., 2020; Eddy et al., 2014).

Overall, existing theory and empirical evidence does not allow to paint a clear picture concerning the association between ART and gender, especially with respect to higher education students. However, a slight trend in favor of men may be discernible in the discussion above. In the present study, we explore whether there are systematic differences in ART between men and women.

### Socioeconomic status

Bourdieu's *theory of human capital* assumes that individuals possess a set of knowledge, skills, and abilities acquired through socialization and life experience (Bourdieu, 1986). *Cultural capital*, as an integral component of this theory, further expands on this by emphasizing the importance of adaptive cultural and social competencies, such as familiarity with institutional contexts and social conventions, language proficiency, and the construction of appropriate strategies of action (Edgerton & Roberts, 2014). It can contribute to the reproduction of educational and social inequality, as individuals who possess less or the wrong cultural capital for the field they need to navigate face barriers to upward mobility (Bourdieu, 2003). Cultural capital is not equally distributed across the socioeconomic spectrum and the cultural capital available to high-SES individuals usually holds higher value within the academic field (Edgerton & Roberts, 2014). High-SES students are therefore likely to possess a sense of fitting in (Lehmann, 2007), high self-confidence (Engstrom et al., 2023), higher goal persistence (Hu et al., 2020), and higher academic achievement (Rodríguez-Hernández et al., 2020). Likewise, a mismatch between an individual's cultural capital and the requirements of their field can lead to insecurity and disengagement (Edgerton & Roberts, 2014). This mismatch may create a conflict between the desire for comfort and security, and the willingness to take academic risks. Low-SES individuals may find themselves reluctant to embrace academic challenges and potentially avoid them altogether, particularly in academic environments with potential exposure in front of an audience. Empirically, low-SES students tend to be less familiar with academic practices compared to their high-SES peers. The former report a lack of organizational skills, of learning methods and an overall less successful university entry preparation (Tzafea, 2021). This apparent mismatch between academic requirements and available resources seems to translate into disengagement. Low-SES students show a reduced willingness to join in course discussions (Qiu & Ye, 2023; Wang & Huang, 2021) and are less involved in extracurricular student groups (Walpole, 2003). Furthermore, Jack (2016) found that low-SES school students are more concerned about being judged by instructors and deal less well when confronted with conflicting ideas. This could contribute to their avoidance to take academic risks.

In summary, the presented theoretical and empirical evidence suggests that low-SES students would display less ART than their high-SES peers. However, to our knowledge, this association has not yet been tested empirically. Therefore, we will examine whether there are differences in ART between the two SES groups. Doing so holds significant implications for understanding educational inequality. Additionally, identifying potential variations in ART across SES can inform targeted interventions tailored to the needs of students from diverse socioeconomic backgrounds.

## Who benefits from academic risk taking?

Despite the theoretical argument concerning the beneficial effect of ART for learning, there is only marginal empirical evidence for this assumption. A study by Özbay and Köksal (2021) has produced positive correlations for the association between ART and academic achievement for school students. Within the higher education context, Hübner and Pfof (2023) found positive correlations between ART and learning success using the two-dimensional ART approach previously described. Students who displayed more ART on the seminar group dimension showed higher learning success. The same is true for the peer dimension. Further analysis is needed given the small sample size and the study's exclusive reliance on correlations. Important covariates like SES, gender, and prior academic achievement were not considered.

Taking academic risks does not necessarily lead to the confirmation of assumptions and positive feedback for correct and adequate contributions, but also inherently involves the possibility of failure or setback. To reap the learning benefits of ART, errors made during the process need to be corrected, and the gained knowledge needs to be reintegrated into the existing knowledge. It is possible that there are systematic differences between social groups in their ability to do so. Making errors that reveal incorrect reasoning and misconceptions can lead to negative feelings such as frustration, anxiety or anger (Hübner & Pfof, 2022; Takashiro & Clarke, 2020) as well as thoughts of inadequacy or brooding (Reindl et al., 2020). Research has shown that the availability of adaptive task-related and socially focused coping strategies is helpful in dealing with errors (Santor et al., 2020). Therefore, students who can regulate their negative reactions generated by ART may be better equipped to deal with their errors constructively, and benefit more from displaying ART. While there is a wealth of general research on coping strategies following errors (e.g., Cillarege et al., 2003; Tulis et al., 2011, 2016), there is a research desideratum regarding possible SES and gender differences when dealing with and learning from errors. However, gender differences in the ability to regulate negative emotions in favor of women (Renk & Creasey, 2003) and a higher availability of support networks for high-SES students (Tzafea, 2021) may lead to systematic differences in dealing with and learning from errors after displaying ART.

Therefore, we will first aim to expand the knowledge on the benefits of ART for student learning by focusing on the association between ART and learning success. Within this context, we will examine whether differences in ART due to SES and gender translate into differences in learning success i.e., whether ART mediates the relationship between SES and learning success, as well as gender and learning success. Then, we will also explore whether SES and gender change the strength of the learning beneficial effect of ART i.e., whether the relationship between ART and learning success is moderated by SES and gender.

## Research objectives

We assume that ART generally has a positive effect on students' learning. However, this may not be true for all students equally. On the one hand, students from different social groups may have different inclinations to engage in ART. On the other hand, the beneficial effect of ART on learning success may vary depending on social group affiliation and the resources each group possesses. Previous academic success in school is a strong predictor for academic success in higher education (Cerdeira et al., 2018). For an accurate analysis of

how SES, gender, ART and learning success relate to each other, we therefore use students' higher education entry qualification (HEEQ) as a general competency baseline measure. This allows us to control for possible differences in e.g., (meta-)cognitive ability, academic proficiency, or self-regulation (see Galla et al., 2019 for such an argument), which may have an influence on their learning success. We state the following research questions and objectives:

1. Are there significant differences in ART levels according to students' social group affiliation?
  - a. We expect that male students take more academic risks on the seminar group dimension than female students.
  - b. We expect that male students take more academic risks on the peer dimension than female students.
  - c. We expect that high-SES students take more academic risks on the seminar group dimension than low-SES students.
  - d. We expect that high-SES students take more academic risks on the peer dimension than low-SES students.
2. Does ART predict students' learning success?
  - a. We expect the seminar group dimension of ART to predict learning success directly and positively.
  - b. We expect the peer dimension of ART to predict learning success directly and positively.
3. Are there significant indirect effects of social group affiliation on learning success via ART (mediation)?
4. Are there significant differences in the strength of the relationship between ART and learning success according to students' social group affiliation (moderation)?

## Materials and methods

### Sample

The sample used in this study consists of  $N=381$  German university students (female = 71.7%, high-SES = 55.1%,  $M_{\text{age}} = 22.97$  years,  $SD_{\text{age}} = 6.04$  years) recruited during winter semester 2021/22 and summer semester 2022. Of the students in the sample, 40% studied within the faculty of humanities, 42% within the faculty of cultural sciences, and 18% within the faculty of social sciences. In the acquisition process, instructors conducting weekly face-to-face seminars were contacted, informed about the goals and content of the survey, and kindly asked for an appointment to conduct the survey in their seminar. In total, 38 seminars were visited towards the end of the session, and the attending students asked to participate in the survey. Relative to the number of students attending the seminar on the day of the survey, the response rate was 71.2%-100%. Study participation was voluntary, all participants provided informed consent. The dataset was initially utilized by Hübner and Pfost (2024) to explore ART with a structural equation modeling approach, focusing on contextual influences of teaching quality. Our study builds upon this

foundation but with a distinct emphasis on individual factors impacting both, ART and students' learning outcomes. By revisiting this dataset, we aim to broaden the understanding of ART by analyzing the influence of individual-level variables, thus complementing existing knowledge on contextual factors.

## Measures

**Academic risk taking** ART was measured using the two-dimensional academic risk taking measure by Hübner and Pfof (2023). The instrument measures students' willingness to take academic risks on two dimensions by asking them to rate the likelihood to engage in the proposed behavior (instruction: "The following statements focus on different types of seminar participation. Assess how likely you are to engage in the following behavior in this specific seminar"). The six items of the seminar group dimension reflect the presence of peers and instructors while taking academic risks (e.g., "To engage in seminar discussion actively, even if I feel that the content is above my level of competence";  $\alpha=0.79$ ) and the four items of the peer dimension reflect the presence of only peers (e.g., "To ask fellow students to proofread my written work, even though I am unsure about its quality";  $\alpha=0.63$ ). All items were answered by the students with respect to the seminar they just attended on a 5-point Likert scale from 1 (*very unlikely*) to 5 (*very likely*).

**Learning success** The participants were asked to rate their overall subjective learning success within the seminar they just attended (instruction: "How would you rate your learning success within this seminar so far?") on a 7-point Likert-scale from 1 (*very low*) to 7 (*very high*). Learning success was centered at the seminar mean for each student to eliminate any cluster specific differences or reference norms.

**Gender** The students were asked to indicate their gender (*female; male; diverse*). Five participants indicated diverse, which is too small of a sample to include in statistical analyses. We therefore used binary coding, 1 represents females and 0 represents males.

**SES** We asked students to indicate their parents' educational level, which is a common proxy measure for cultural capital (e.g., Wang & Huang, 2021) and SES (Rodríguez-Hernández et al., 2020). We use a binary coding system, 1 indicating a high SES (*at least one parent went to university*), 0 indicating a low SES (*neither parent went to university*).

**Higher education entry qualification (HEEQ)** As a general control variable, students specified their previous academic success as the grade they reached within their HEEQ. The German grading system ranges from 1 (very good) to 6 (insufficient). Therefore, higher values indicate poorer grades.

## Analysis strategy

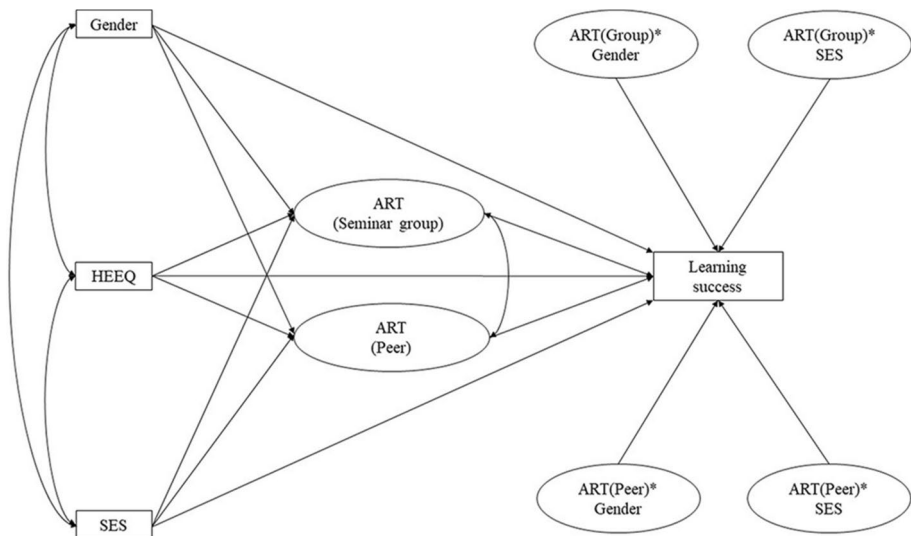
We used *R Version 4.2.1* (R Core Team, 2022) for data analyses.<sup>1</sup> First, we conducted descriptive statistics, applying chi-squared test to confirm statistical independence

<sup>1</sup> A minimal dataset, a codebook and the R analysis script are available on PsychArchives: <https://doi.org/10.23668/psycharchives.15386> and <https://doi.org/10.23668/psycharchives.15387>

between students' gender and SES. Single factor analysis of variance (ANOVA) was applied to examine differences in ART between men and women as well as high-SES students and low-SES students. Kendall's Tau correlation was used to observe first associations between ART and learning success.

Second, we applied structural equation modeling using *lavaan* (Rosseel, 2012) as this approach allows for estimations free of measurement error. We used the WLSMV estimator for ordinal data. To confirm that the assumption of measurement invariance holds between the social groups, the two ART dimensions were specified as two latent factors within a baseline model. Testing for measurement invariance involves estimating the baseline model separately for each group, introducing restrictions in a stepwise process and formally comparing the model fits against each other (Van de Schoot et al., 2012). If the fit between models differs significantly, there are systematic differences across groups in how the latent construct is measured and that the assumption of measurement invariance is violated.

Third, we specified a structural equation model to test direct, indirect, and total effects of ART, gender, and SES on learning success. Then, we introduced students' HEEQ as an additional variable. In a second model, we additionally explored whether gender and SES moderate the effects between ART and learning success. We tested the moderation effects using double mean centered variables as indicators for latent interactions (Lin et al., 2010). Within this approach and using *semTools* (Jorgensen et al., 2022), the moderator variables (i.e., gender; SES) as well as the independent variables' (i.e., the two dimensions of ART) indicator variables are centered and then multiplied, which creates the interaction terms. These interaction terms are centered again and then used as indicators for the latent mediation variable. The final model is displayed in Fig. 1. To determine whether our results are statistically meaningful, we adhere to the conventional 5%-level of significance. This signifies that there is a probability of less than 5% that the observed relationships occurred merely by chance.



**Fig. 1** Assumed structure of the final model

## Results

### Descriptive statistics

The correlation analysis ( $\tau = -0.05$ ,  $p = 0.361$ ) and chi-squared test ( $\chi^2 = 0.835$ ,  $p = 0.361$ ) show that students' gender and educational background are statistically independent. There are significant associations between students' HEEQ and their gender ( $\tau = -0.10$ ,  $p = 0.034$ ) as well as their educational background ( $\tau = -0.12$ ,  $p = 0.012$ ). Female students and high-SES students left school with better grades.

Single factor analyses of variance reveal that there are significant differences in ART on the seminar group dimension ( $M_{\text{male}} = 3.53$ ,  $M_{\text{female}} = 3.23$ ,  $F = 11.83$ ,  $p = 0.001$ ,  $d = 0.40$ ) and the peer dimension ( $M_{\text{male}} = 3.27$ ,  $M_{\text{female}} = 3.49$ ,  $F = 5.58$ ,  $p = 0.018$ ,  $d = 0.28$ ) between male and female students with small to moderate effect sizes. High-SES students and low-SES students do not differ significantly regarding their ART levels on the seminar group dimension ( $M_{\text{low-SES}} = 3.26$ ,  $M_{\text{high-SES}} = 3.33$ ,  $F = 0.74$ ,  $p = 0.390$ ,  $d = 0.09$ ) or the peer dimension ( $M_{\text{low-SES}} = 3.39$ ,  $M_{\text{high-SES}} = 3.45$ ,  $F = 0.51$ ,  $p = 0.476$ ,  $d = 0.07$ ).

Furthermore, positive associations between learning success and ART on both the seminar group dimension ( $\tau = 0.15$ ,  $p < 0.001$ ) and peer dimension ( $\tau = 0.15$ ,  $p < 0.001$ ) are found. Students who engage more in ART report higher learning success. There are no significant correlations between students' social group affiliation and their learning success.

### Measurement invariance

In a next step, we specified the latent measurement models of ART and tested them for measurement invariance across the two gender groups and the two SES groups.<sup>2</sup> Formal model comparisons using chi-squared tests produced non-significant results for gender ( $\Delta\chi^2_{\text{metric-configural}} = 12.736$ ,  $p = 0.121$ ;  $\Delta\chi^2_{\text{scalar-metric}} = 8.477$ ,  $p = 0.292$ ;  $\Delta\chi^2_{\text{strict-scalar}} = 6.930$ ,  $p = 0.644$ ). Strict measurement invariance applies for gender, which indicates that comparisons on the latent variable are valid across the two groups.

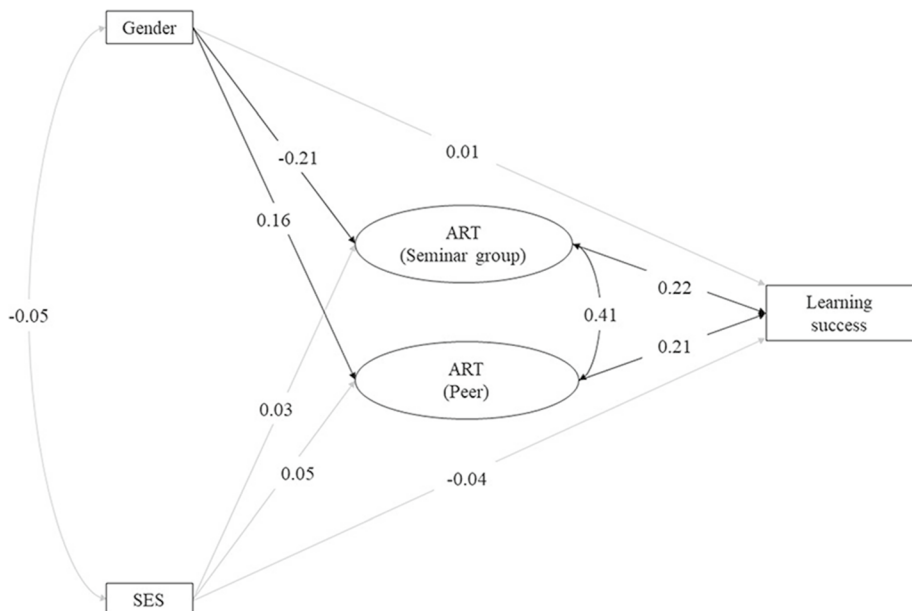
Concerning SES, chi-squared test shows that the metric measurement invariance model with restricted factor loadings fits the data significantly better than the scalar measurement invariance model with restricted factor loadings and intercepts ( $\Delta\chi^2_{\text{scalar-metric}} = 24.360$ ,  $p = 0.001$ ), which suggests that there is systematic variation in the latent variable across the two groups. In these cases, van de Schoot et al. (2012) suggest to establish partial measurement invariance by releasing the parameters that differ across groups. Further analysis shows that three intercepts differ across groups. Releasing these parameters in the adjusted scalar measurement invariance model results in a model fit, which does not differ significantly from the metric measurement invariance model. Strict measurement invariance could be established by adding residuals to the equality constraints of the adjusted scalar measurement invariance model. Thus, after consideration of the above-mentioned parameter restriction adjustments, we can assume measurement invariance for SES.

<sup>2</sup> Tables with the exact model fit values of the individual models as well as more detailed explanations can be found in the electronic supplement provided on PsychArchives: <https://doi.org/10.23668/psycharchives.15388>

## Main effects and interaction effects

Using the adjusted latent ART measurement models, we estimated a structural equation model with the two latent ART dimensions as mediators between students' social group affiliation and learning success (Fig. 2). The model fit is good ( $N=360$ ,  $df=58$ ,  $\chi^2=100.263$ ,  $p<0.001$ ,  $RMSEA=0.039$ ,  $TLI=0.990$ ,  $CFI=0.993$ ,  $SRMR=0.047$ ). Within the model, gender predicts ART on the seminar group dimension ( $\beta=-0.21$ ,  $p<0.001$ ) and on the peer dimension ( $\beta=0.16$ ,  $p=0.032$ ) significantly, men taking more academic risks on the seminar group dimension, and women taking more academic risks on the peer dimension. SES does not have a significant association with ART. Furthermore, we observe a significant positive relationship between learning success and both the seminar group dimension ( $\beta=0.22$ ,  $p=0.004$ ), and the peer dimension ( $\beta=0.21$ ,  $p=0.009$ ) of ART. Students who take more academic risks report higher learning success. Regarding mediation effects (Table 1), the path between gender, the seminar group dimension of ART and learning success is significant ( $\beta=-0.04$ ,  $p=0.015$ ). This indicates that the difference in ART between male and female students does indeed contribute to variations in learning outcomes in favor of men. The sum of all indirect effects on learning success is not significant, neither for gender, nor for SES.

Adding students' HEEQ as additional predictor of ART and learning success leads to minor alterations of our results in terms of regression weights and model fit. It results in a significant regression between HEEQ and the seminar group dimension of ART ( $\beta=-0.25$ ,  $p<0.001$ ), students with poorer HEEQ grades displaying less ART. Furthermore, HEEQ indirectly predicts learning success via the seminar group dimension of ART ( $\beta=-0.06$ ,  $p=0.016$ ).



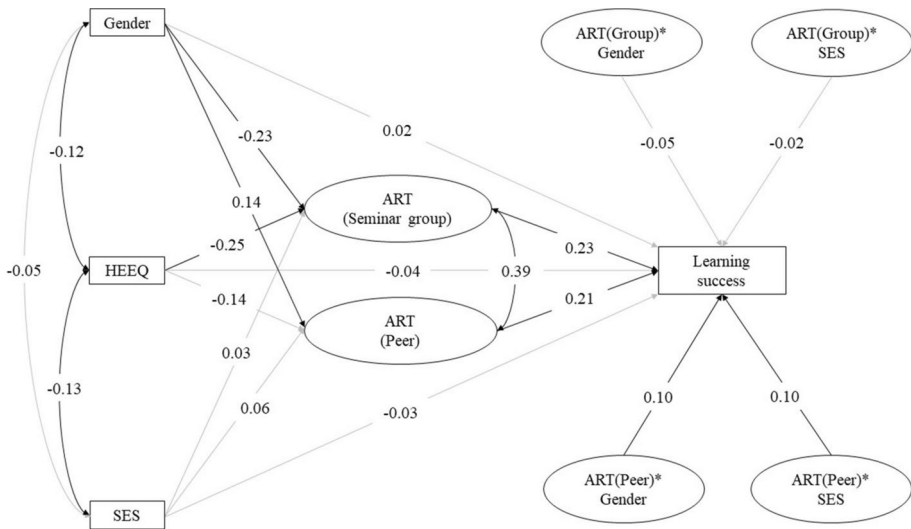
Note. Black paths are significant on the 5%-level

Fig. 2 Structure and results of the mediation model

**Tab 1** Indirect effects and total effects on learning success

	UC [95%CI]	SC	SE
<b>Indirect effects on learning success</b>			
Gender → ART (Group dimension)	-0.09* [-0.19; -0.03]	-0.04	0.04
Gender → ART (Peer dimension)	0.07 [0.01; 0.13]	0.03	0.04
SES → ART (Group dimension)	0.01 [-0.05; 0.05]	0.01	0.02
SES → ART (Peer dimension)	0.02 [0.04; 0.07]	0.01	0.03
<b>Total effects on learning success</b>			
Gender	0.01 [-0.23; 0.22]	0.00	0.11
SES	-0.04 [-0.23; 0.15]	-0.02	0.10

UC, unstandardized coefficient; SC, standardized coefficient; SE, standard error of the unstandardized coefficient; 95%CI, 95% confidence interval; the results for indirect and direct effects are the same for the mediation model and the full interaction model; ‘\*’  $p < 0.05$ , ‘\*\*\*’  $p < 0.01$



**Fig. 3** Structure and results of the full interaction model with mediation and moderation

In a second structural equation model (Fig. 3), which fits the data very well ( $N=356$ ,  $df=520$ ,  $\chi^2=537.497$ ,  $p=0.289$ ,  $RMSEA=0.016$ ,  $TLI=0.982$ , and  $CFI=0.983$ ,  $SRMR=0.054$ ), we added the moderations between the ART dimensions and students’ social group affiliation. The indirect effects stay the same compared to the mediation model (Fig. 2), and the regression weights are subject to only minor changes. Furthermore, we

observe that both, the seminar group dimension ( $\beta=0.23$ ,  $p=0.004$ ), and the peer dimension ( $\beta=0.21$ ,  $p=0.009$ ) predict learning success significantly. Additionally, gender significantly moderates the association between the peer dimension and learning success ( $\beta=0.10$ ,  $p=0.004$ ), which means that female students tend to benefit more from displaying ART in front of peers compared to their male counterparts. Furthermore, SES moderates the association between the peer dimension and learning success ( $\beta=0.10$ ,  $p=0.018$ ), indicating a higher benefit of ART in front of peers for high-SES students.

## Discussion

### Interpretation of results

When examining educational practices within the higher education context, it is indispensable to consider possible systematic differences between social groups, as not everybody may benefit from changes to educational practices equally. This study is among the first to confirm gender differences in ART levels in the higher education context, as well as the learning-beneficial effects of ART using inferential statistical methods. In answering the four research questions proposed, we contribute to a better understanding of ART as well as the reproduction of educational inequalities.

First, we examined whether there are significant differences in students' ART levels according to students' gender and SES. Partially supporting our assumptions, ANOVA, correlation analysis and both structural equation models produced significant results for gender. Our hypothesis that males would exhibit greater academic risk taking was supported for the seminar group dimension (*research question 1a*) and aligns with our theoretical framework and previous research findings (Aguillon et al., 2020; Eddy et al., 2014). Yet, the observed positive association between students' HEEQ and the seminar group dimension of ART, coupled with the fact that female students reported better HEEQ, suggests an alternative explanation. In consequence, this observed gender difference may reflect a higher prevalence of imposter syndrome among female students (Shill-Russell et al., 2022). The opposite effect was observable for the peer dimension (*research question 1b*). In our sample, women took more academic risks in front of peers compared to men. Therefore, how students are doing gender not only seems to depend on the behavior itself, but also on the context in which it is displayed. Anderson and Williams (2001) suggest that identities are fluid and depending on the social context. It is therefore possible that women may not feel the need to fit the traditional gender image among supportive peers who may have a similar outlook on academic life. Therefore, doing gender in a non-traditional way may come easier to them in these situations than in front of a seminar group where they have less control and anticipate more criticism. The same may in fact be true for men who may not feel the need to dominate the setting when just being surrounded by peers. The expected differences in ART between high-SES students and low-SES students were not found (*research question 1c* and *research question 1d*).

Second, and in line with our expectations, we found that higher levels on the seminar group dimension of ART (*research question 2a*) and on the peer dimension of ART (*research question 2b*) significantly predicted higher learning success, irrespective of gender, SES and HEEQ, which may be considered as a proxy variable for students' cognitive abilities and self-regulation capabilities (Galla et al., 2019). This result aligns with prior theory (Krochmal & Roth, 2017) and correlative findings by Hübner and Pfost (2023).

Third, we explored whether differences in ART between social groups indirectly translate into learning success. A structural equation model showed that gender indirectly predicted learning success via the seminar group dimension of ART, favoring men (*research question 3*). This means that men's higher levels of ART during seminar sessions translated into higher learning success for them. By contrast, the gender difference on the peer dimension did not result in higher learning success for women, suggesting that the differences in how women and men take academic risks do not balance each other out in terms of learning success. The indirect effect of SES via ART on learning success was unsubstantial (*research question 3*). Based on our data, high-SES students and low-SES students in higher education seem to display equal levels of ART and ART related learning success.

Fourth, we examined whether there are significant differences in the learning benefit of ART according to students' gender and SES. We found that gender significantly moderated the association between the peer dimension of ART and learning success, favoring women (*research question 4*). This means that even when men and women showed equal levels of ART on the peer dimension, female students benefited more from this behavior than male students. This implies that they are somewhat better able to use the opportunities to learn from their errors within these ART situations than their male counterparts. The ability to self-regulate after errors have happened has often been associated with better learning (Cillarege et al., 2003; Reindl et al., 2020) and women generally seem to be better at regulating negative affect (Renk & Creasey, 2003). Similarly, high-SES students benefited more from taking academic risks in front of peers than low-SES students did (*research question 4*). This finding aligns with two empirical findings on differences between high-SES and low-SES students. Lubienski (2000) found that high-SES students report higher benefits from class discussions as they tend to focus on the underlying idea rather than on giving the correct answer, while low-SES students tend to be frustrated by conflicting information. Second, low-SES students tend to experience higher levels of imposter syndrome, which may come with an especially high emotional load after making errors in front of others (Nori et al., 2020). In sum, low-SES students may be more vulnerable during academic difficulties and hence profit less from academic risks and uncertainties while learning.

## Limitations

While with our study, we provide important insights into structural differences in ART between different social groups, there are some limitations to our design as well as open questions that need to be considered.

First, it is an initial step to consider social disparities in ART separately for gender and SES, but the two may intersect in complex ways that influence how students approach ART. For example, cultural norms about gender roles and expectations may vary by SES. In fact, high-SES students tend to have more egalitarian gender norms, whereas traditional gender role attitudes are more prevalent in low-SES students (Schroeder et al., 2019). These norms may influence how students perceive and navigate ART. Additionally, other unobserved social roles, such as migration status or age, and the student composition within seminars (Tison et al., 2011) may be important.

Second, our results suggest that high-SES students and low-SES students do not differ significantly in their ART levels. It is possible that a more nuanced approach to measuring SES could better distinguish between status groups and reveal any underlying differences. However, this finding may also be influenced by selection processes that occur before students enter higher education. Bourdieu's (1986) theory of human capital

acknowledges that individuals from different backgrounds carry varying forms of cultural capital into educational environments. However, it leaves room for the assumption that low-SES students can acquire the resources that are necessary to thrive in an academic environment, before entering higher education. The non-significant SES differences in our data may therefore be a product of low-SES students, who exhibit similar behavioral tendencies to their high-SES counterparts, self-selecting into higher education.

Third, while self-report data allows for important insights into individuals' perceptions and experiences, it has its own set of drawbacks. It is not uncommon to use self-reported learning success, either as a unidimensional multiple item-measure (e.g., Ding & Zhao, 2020; Tzafilkou et al., 2021) or as a single-item measure (Daniels et al., 2021) as an indicator for students' academic achievement and learning success. However, students may have different criteria for what constitutes learning success. Some may focus on grades, while others may consider their understanding of the material or personal growth as more important. Furthermore, the relation between ART and learning success may be dependent on other variables such as interest or examination type. Therefore, future research might assess the variable of learning success on a multidimensional scale encompassing such different dimensions.

Fourth, it is important to note that the reliability of the peer dimension of ART is less than optimal. This suggests that a significant portion of the variance could be attributed to measurement error, leading to a less precise estimation of the associations between this latent construct and other variables.

## Outlook for future research

With our study, we offer important initial insights into the relationships between ART, learning success, and individual influencing variables. Future study designs could address some of the aforementioned limitations and further clarify these associations. For example, combining self-report questionnaires with other methodologies, such as objective test data for students' learning success and qualitative interviews, could provide deeper insights into students' experiences of uncertainty and risk taking within higher education. Additionally, longitudinal observations could track changes in ART over time, potentially reducing the impact of transient biases and clarifying potential self-selection processes occurring during educational transitions. We further recommend examining SES and gender in a more nuanced manner. Given the heterogeneity of the higher education context, it is essential to consider a stratified picture of socioeconomic backgrounds and associated risk factors, such as migration status, educational background, and financial circumstances. Utilizing these markers can provide a clearer understanding of students' origins and better predict their academic behaviors and outcomes. Likewise, moving beyond the current measurement of gender identity in two or three categories in favor of a more targeted approach, possibly also including qualitative data, may better capture students' sense of femininity or masculinity. Since an individual's gender identity may vary according to different domains, we believe that using multifactorial gender theory (Spence, 1993) as a framework is most appropriate. However, other stable character traits such as personality factors or individual response time should be considered as control variables.

## Practical implications

The potential learning benefits of ART for learners in higher education settings have been thoroughly discussed in the theoretical thematic literature. With our study, we now also offer empirical evidence for practitioners for this assumed association. For educational practice in higher education, the definition of complex learning criteria which require higher levels of cognitive processing (Adams, 2015) and the use of teaching practices which offer a wide range of possibilities for students to take academic risks, may therefore be considered. As students are somewhat reluctant to take academic risks (Ravert & Sch-neller, 2019), open communication concerning mutual expectations and the development of a psychologically safe environment (Lee, 2020) may be helpful.

However, structural differences in how female and male students take academic risks should not be neglected. Our data suggests that men have a significant advantage over women when ART is fostered during seminar sessions in terms of learning success. Our results additionally indicate that even if women exhibit higher levels of ART outside the classroom and benefit more from this behavior compared to their male peers, they are still not able to compensate for the advantage that men seem to have during seminar sessions. This highlights the importance of developing strategies to create inclusive learning environments that address gender disparities in seminar engagement (Eddy et al., 2014) and ART. Therefore, providing offers to take academic risks for students with different preferences and communication styles while keeping track of who takes up these offers to identify possible patterns or disparities seems like a promising first approach.

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## Declarations

**Conflict of interest** The authors declare that there exists no competing financial interest or personal relationships that could have appeared to influence the work reported in this paper.

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