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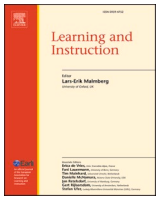

Academic risk taking and teaching quality in higher education

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ABSTRACT

Background: Academic risk taking (ART) is a type of learning-beneficial student engagement with a risk of making errors. Students for example respond to questions during seminars, even though they are not sure about the correctness of their answer. Next to a trait-component, ART is assumed to have a state component which can change depending on the context.
Aims: In this study, we explore whether students' ART differs by seminar belonging, and whether teaching quality explains these differences. Additionally, we consider the association between students' goal orientation and ART.
Sample: For this purpose, a sample of 381 university students nested in 38 seminars and instructors was acquired.
Methods: Data was analyzed following a two-level structural equation modeling approach.
Results: We find significant differences in students' ART by seminar group, explaining between 11.0% and 16.3% of variance. Reproduction orientation in teaching seems to discourage ART.
Conclusions: Our results contribute to an understanding of the multidimensional dynamics of teaching and learning, and offer implications for teaching quality development.

1. Introduction

1.1. Conceptualization and relevance of academic risk taking

Academic risk taking (ART) is a specific type of student behavioral engagement, which is characterized by students' uncertainty regarding the correctness and the outcome of their contributions (Clifford, 1991). Consequently, when students display ART, they risk making errors and appearing less competent in front of their peers and instructors (Beghetto, 2009). To illustrate, university students who display ART, for instance, ask peers for feedback on papers that still need editing or share their ideas during seminars, even when they are unsure about the idea's quality (Hübner & Pfost, in press). In educational contexts, attention and research interest has been brought especially towards negative risk taking behaviors, such as alcohol use, school dropout (Kıran & Cengiz, 2021), or absenteeism (Halpern, 2007). In contrast, ART covers behavior that is socially acceptable and constructive, and can therefore be classified as a positive risk (Duell & Steinberg, 2019). Both positive and negative risks involve a conscious decision and carry the possibility of costs and rewards; the probability of both scenarios is often unclear (Duell & Steinberg, 2019). Positive risks are usually not reactive but planned by the individuals in question, and motivated by longer-term goals, such as seeking self-exploration and personal growth (Fryt et al., 2022), or by the prospect of social rewards, like receiving others' approval or praise (Fryt & Szczygiel, 2021). Furthermore, the costs of positive risks are usually mild in severity when failure occurs (Duell & Steinberg, 2019). However, risk propensity and risk aversion vary inter-individually (Rohrmann, 2005) and whether a risk, positive or negative, is taken is therefore also subject to an individual's weighing of costs and rewards.

Prior ART research has largely focused on secondary education. In terms of operationalization, researchers often administered school relevant tasks of varying difficulty to their participants, observed their choice patterns and related them to their academic performance and other variables of interest (Clifford, 1988; Clifford & Chou, 1991), or observed students' behavior during natural classroom settings (Clifford et al., 1990). This approach fits in with the structured nature of educational settings in schools, where knowledge is assumed to be highly certain and strongly dictated by the curriculum (Kauffman, 2005). The researchers found that school students generally tend to avoid taking academic risks and prefer a high likelihood of success to a moderate challenge. In addition, ART benefits students' learning outcomes (Özbay & Köksal, 2021).

Research interest in ART has now moved to higher education

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contexts, where learning environments differ significantly from those in school contexts in terms of students' autonomy, complexity of educational settings, and depth of content exploration. Specifically, learning in higher education is expected to be less externally regulated (Goppert et al., 2021; Oolbekkink-Marchand et al., 2014). Students therefore need to be able to identify important content and to take self-regulatory action when they have difficulty understanding complex topics. Thus, the number of situations in which ART may be an appropriate strategy for learning is significantly higher. Furthermore, learning networks tend to be more ephemeral at university in terms of the composition of students and instructors (Goppert et al., 2021). According to the model of identity-based disengagement, Lund Dean and Jolly (2012) suggest that students take on different roles in front of different people and adjust their behavior fittingly. This makes it necessary to extend current conceptualizations of ART by taking these different roles in relation to different people into account. Lastly, universities are ideologically committed to the idea that there are no limits to inquiry and that all knowledge is open to criticism (Barnett, 2000). Therefore, knowledge in higher education is not necessarily certain but can take on gray shades, especially in advanced courses. Compared to the school context, this allows for a greater depth of exploration and more opportunities to take academic risks.

Currently, there is little empirical evidence for the positive learning effect of ART in higher education, although it has been discussed (Clifford, 1991) and appears plausible from a theoretical perspective. Cohen et al. (1955) argue that people have the inherent need to meaningfully structure and understand their experiences. A lack of understanding will lead to frustration and active efforts to make sense of the situation. Taking academic risks may be an adequate strategy to counteract problems of comprehension and increase learning outcomes. When displaying ART, students are often confronted with challenging content and navigate the area between what they can do unaided and what they can do with assistance, which Lev Vygotsky calls the *zone of proximal development* (Van de Pol et al., 2010). In these cases, scaffolding provides a valuable framework for problem-solving (Holton & Clarke, 2006). The theoretical connection between ART and Vygotsky's zone of proximal development has been previously established (Abercrombie et al., 2021; Clifford, 1991), and we posit that ART and scaffolding are complementary processes. For instance, scaffolding offers students abundant opportunities to take academic risks. An instructor may begin by providing instructional scaffolding, explaining a theoretical model, and then tasking the students with its application to real-world scenarios. This prompts students to generate potential solutions, and then validate their deductions through discussions with peers or instructor. They "take a risk and make a prediction, assess their position, fail with purpose, and […] change ideas when the data demand" (Krochmal & Roth, 2017, p. 119). Hence, by making their deductions visible, students actively use an opportunity to either confirm their assumptions or to spot and correct their misconceptions and thus, gain an understanding that exceeds the provided knowledge. Conversely, instances where students take academic risks and encounter challenges or errors can serve as signals to the instructor that additional scaffolding is warranted. This iterative process not only yields academic benefits, but ART also fosters qualities like self-agency, purposeful communication with others, and resilience in the face of failure (Ravert & Schneller, 2019).

To summarize, ART which we define as a type of visible behavioral engagement with a risk of making errors in front of others, may have substantial effects on students' academic development and needs to be considered when analyzing educational processes in higher education. The research field of ART is still new, so it is somewhat unclear which individual and contextual variables influence students' willingness to take academic risks. This study addresses this issue and aims to contribute to a better understanding of interindividual differences in university students' ART.

1.2. Variables explaining individual differences in ART

1.2.1. Variables at the person level

Students and instructors believe that ART is worthwhile (Teagarden et al., 2018), but even though the age group of university students generally tends to be risk takers (Duell et al., 2018), students often hesitate to display ART (Ravert & Schneller, 2019). This observation underscores a significant limitation of the conventional rationalist approach to risk taking, which centers on a cost-benefit analysis. If ART were as straightforward as merely weighing costs against benefits, we would expect students to undertake academic risks more frequently. While the identification of the exact mechanism behind this phenomenon needs more clarification, the risks-as-feelings-hypothesis (Loewenstein et al., 2001) provides a compelling theoretical framework for understanding it. This hypothesis highlights the pivotal role of anticipated affect in shaping individuals' responses to risky situations. Thereby, emotions serve not only as an outcome of the risk taking process, but act as mediators between the cognitive assessment of the risky situation and subsequent risk taking behavior. This dynamic also remains active when emotions operate subconsciously, manifesting as a "gut feeling". When displaying ART, students make a visible academic contribution and potential success will inevitably be as visible as potential errors. Given that failure can evoke strong emotional responses, ART is assumed to carry a high emotional risk (Ellis, 2015). Consequently, during the ART process, the heightened visibility of students' knowledge (deficits) coupled with the anticipated negative affect associated with such scenarios may discourage students to take academic risks (Fritschner, 2000) despite a favorable cognitive evaluation. These assumptions are supported findings of Hübner and Pfost (2022) who found that students anticipating negative affect such as shame following errors tend to show less ART. Regarding further variables on the individual level that might relate to ART, students' goal orientation is of high interest. Students align their educational decisions and their behavior with overarching learning goals. In this context, a model that differentiates three types of achievement goals is often assumed appropriate (Elliot & Harackiewicz, 1996). Students with high mastery goal orientation aim to improve their skills for the sake of learning, while students with high performance-approach goal orientation aim to demonstrate their skills in front of their peers, and students with high performance-avoidant goal orientation aim to hide their lack of skills from their peers (Becker et al., 2018; Middleton & Midgley, 1997). ART places a potential visibility of knowledge deficits at its center, therefore it is to be expected that especially high performance-avoidant goal orientation will inhibit students from displaying ART, whereas the other two goal orientations should not be a hindrance. Existing research rather shows high levels of mastery goal orientation to be beneficial for ART (Dachner et al., 2017), possibly mediated by preferred task difficulty. Abercrombie et al. (2021) found that students who are mastery goal oriented tend to prefer difficult tasks and therefore take more academic risks. In contrast, students who have high performance-avoidant goal orientation tend to show less ART (Dachner et al., 2017; Hübner & Pfost, 2022). Concerning ART and performance-approach goal orientation, research paints an arbitrary picture, finding positive associations (Abercrombie et al., 2022), or none (Hübner & Pfost, 2022). In this study, we revisit the link between ART and goal orientation as a collateral focus, and contribute to a better understanding of the connection between individual student characteristics and ART.

1.2.2. Teaching quality

From a conceptual point of view, ART is a type of engagement which, next to having a trait component, possesses a state component (Fredricks et al., 2004; Hübner & Pfost, in press). Authors assume this state component to be affected by contextual variables such as the teaching quality of the seminar the students attend (Leach, 2016; Quin et al., 2017). Empirically, the influence of teaching quality on student engagement in general and ART in particular, is not well understood in

higher education. We know that active teaching methods (Sawers et al., 2016) and positive rapport with peers (Fredricks et al., 2004) benefit students' general engagement in terms of heightened class participation, interest, and reduced dropout. Concerning ART in particular, Dachner et al. (2017) investigated a possible association and found that students take more academic risks when instructors grant more autonomy and pose high performance expectations on their students. In short, conceptually, teaching quality in higher education has often been treated unsystematically and is thus a vague concept. Empirically, research on the importance of teaching quality for student behavior appears fragmented. To address this research gap, we chose one comprehensive model of teaching quality for our study, which we describe next.

1.3. The SSCO model

One of the rare comprehensive models that addresses teaching quality within the higher education context is the SSCO model (Schaeper & Weiß, 2016; for a general review of the history and development of the SSCO model), which aims to adequately reflect the stratification of the higher education system and therefore assumes a multilayered perspective on teaching quality. Contrary to an *objectivist perspective* which captures structural characteristics such as the regional context (e.g., GDP per capita) or the institutions' characteristics (e.g., the number of students enrolled), the *subjectivist perspective* addressed in our study aims to capture the environment on the individual-level as it is perceived by the actors, instructors as well as learners, involved. The subjectivist component covers four facets of teaching quality and offers the potential to research their impact on a more extensive level. *Structure* (1) refers to the degree of security, stability, and rule transparency. In a highly structured seminar, students know what to expect from the learning situation, but they also know what is expected of them. For example, structure can include the instructor setting transparent learning objectives at the beginning of the semester, which are examined at the end of the semester. Support (2) refers to the degree of support students receive during the learning process in terms of content, but also the degree of emotional support that students receive, and the degree of social integration. In a supportive seminar, students receive help to develop their competencies, to gain autonomy, to cope with study requirements, and receive opportunities to be socially involved in seminar activities, inside and outside the classroom. *Challenge* (3) refers to the degree to which students are cognitively activated to promote a deep understanding of the content and to prevent knowledge that is exclusively superficial. Critical thinking is encouraged. In seminars with a high level of challenge, transfer of theoretical knowledge to practical situations may be required. Instructors thus demand a deep understanding and linking the material with prior knowledge. In contrast, in seminars with a low level of challenge, instructors pass on content and require its memorization. In both cases, high performance pressure, which is another aspect of challenge, may be present. *Orientation* (4) refers to the degree to which instructors follow a constructivist or a traditional learning philosophy. Seminars with a constructivist learning philosophy allow learners to construct their knowledge in a collaborative process while seminars with a traditional learning philosophy require learners to listen to the instructor as the expert. Schaeper and Weiß (2016) tested this particular model in terms of reliability and factorial structure. As of now however, no results concerning the association with other relevant variables within learning processes are available.

There has been much discussion about what good teaching in higher education means and the answer tends to be that it depends on the specified target criteria (Götz, 2016). The elements of the SSCO model are not considered to be hierarchically ordered along a better-worse spectrum, but rather as equally useful depending on the learning goals. For example, high levels of structure may help instructors to convey large amounts of content, but it may come at the cost of limited individual in-depth elaboration. Especially students who are familiar with the basics may feel restricted inasmuch as high structure may leave no space for novel ideas. Likewise, high levels of challenge may enable students to gain a deep understanding of specific aspects of a topic, but it may presuppose a basic understanding of the topic already. From the perspective of teaching quality development, answering the question whether and how different teaching approaches are associated with specific forms of student engagement such as ART is of interest and the main focus of this study.

1.4. Research questions

We assume that different aspects of teaching quality prompt different manifestations of student behavior, namely different levels of ART. However, the same may be true for learning objectives that students set for themselves, which may make the display of ART more or less necessary and likely. Therefore, when researching differences in students' ART, we consider both teaching quality on the contextual level, but also students' goal orientation on the individual level.

Our research questions are thus, (1) whether a significant difference in students' ART is observable between seminars, and whether those differences are attributable to seminar belonging. We expect significant differences between seminars regarding students' ART i.e., a significant intraclass correlation (ICC). We are further interested in (2) whether differences in students' ART between seminars can be explained by differences in the eight dimensions of teaching quality based on the SSCO model. Namely, structure, rapport with instructors, rapport with fellow students, knowledge construction, knowledge transmission, meaning orientation, reproduction orientation, and pressure to perform. Lastly, we will investigate (3) whether students' individual goal orientation explains ART within seminars. We expect to replicate the patterns of performance-avoidant goal orientation predicting ART negatively, and mastery goal orientation predicting ART positively. Due to the very limited and inconclusive amount of prior research findings, we do not formulate directional hypotheses concerning the association between teaching quality and ART, and performance-approach goal orientation and ART.

2. Material and methods

2.1. Sample

Data was collected in winter semester 2021/22 and in summer semester 2022 at an academic German university with a strong focus on the humanities as well as social and cultural sciences. The sample therefore exclusively includes students of these disciplines (40% humanities, 42% cultural sciences, 18% social sciences). Fig. 1 shows a flowchart of the acquisition process. A selection of 73 weekly face-to-face seminars was made via the course catalogue and the respective instructors contacted. The goal and content of the survey was specified, and they were kindly asked for an appointment to conduct the survey in their seminar. We conducted the survey as planned in 38 seminars towards the end of the session, which leaves us with a response rate of 54.3% relative to the number of instructors contacted. In addition to the instructors, students within these seminars were asked to participate in the survey. Study participation was voluntary, all participants provided informed consent. Finally, $N = 38$ instructors (female = 52.6%) as well as $N = 381$ students (female = 70.6%, $M_{age} = 23.0$ years, $SD_{age} = 6.0$ years) received a questionnaire. According to data provided by the university (Universität Bamberg, 2022), 69.0% of students graduating in 2021 within the faculties represented in our sample (humanities, cultural sciences, social sciences) were female. A chi-squared goodness of fit test yielded non-significant results ($\chi^2 = 2.620$, $p = 0.27$), suggesting that our sample represents the gender distribution of the total population of the three mentioned faculties well. In terms of study program, 51.4% of the students were enrolled in a bachelor's degree program, 19.2% in a master's degree program, and 27.6% in a state examination

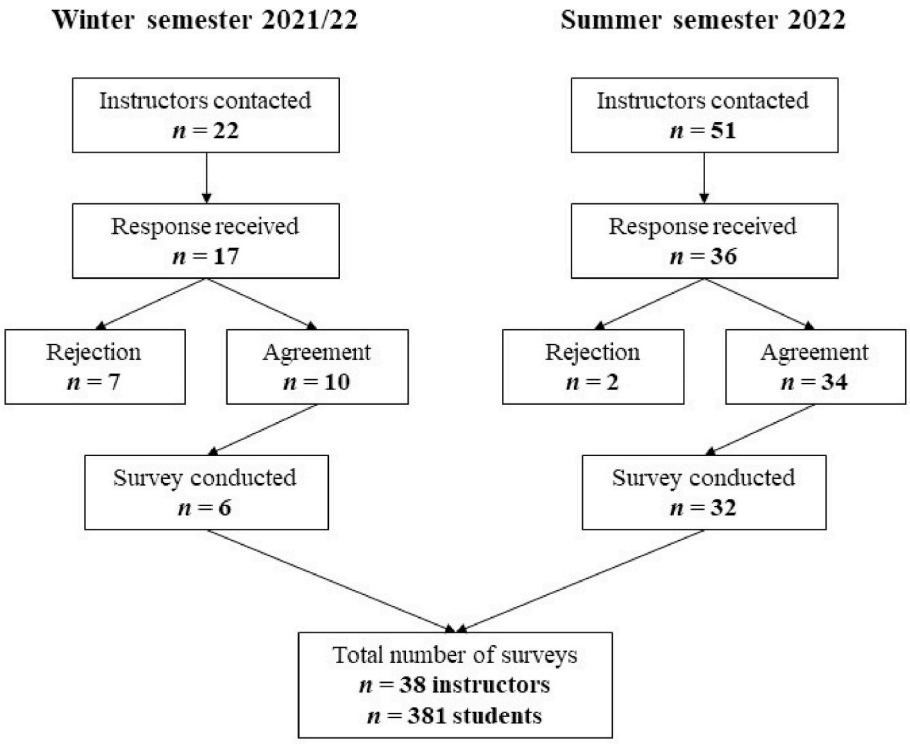

Fig. 1. Acquisition process.

program. Instructors and students are nested in $K = 38$ seminars, consisting of one instructor and at least two students. The average seminar consists of 10.0 student respondents ($SD = 5.3$, Min = 2, Max = 18).

The student response rate relative to the number of seminar registrations is 52.0%–69.5%, and the student response rate relative to the number of students present on the day of the survey is 70.6%–100%.

2.2. Measures

Academic risk taking: Students' ART was measured using the Academic-Risk-Taking-scale by Hübner & Pfost (in press). The instrument aims to measure university students' willingness to engage in ART by asking them to rate the likelihood of engaging in the behavior proposed (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 authors established that the ART scale meets psychometric standards. As the instrument considers the theory of identity-based disengagement (Lund Dean & Jolly, 2012), two dimensions are differentiated: Students' willingness to engage in ART (1) in front of the seminar group as well as (2) in front of their peers. In the present study, the six-item *seminar group dimension* (e.g., "To engage in seminar discussion actively, even if I feel that the content is above my level of competence"; α = .79), and the four-item *peer dimension* (e.g., "To ask fellow students questions about seminar content that remained unclear to me"; α = 0.63) are considered for analyses. 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*).

Teaching quality: Teaching quality was assessed by the seminar instructors and was measured based on the SSCO model introduced above (Schaeper & Weiß, 2016). The scales were adapted from the measures used within the NEPS study (Leibniz-Institut für Bildungsforschung und Bildungsinformationen, 2018). Due to a small number of items on some of the original subscales, we anticipated issues with internal consistency and added additional items.[1] The *structure* dimension was measured with one scale comprising four items (e.g., "At the beginning of a session, I provide a comprehensive introductory overview of the goals, process and structure"; α = 0.77). The support dimension includes two subscales: *rapport with instructors* (3 items; e.g., "I am cooperative and open-minded towards the students in my seminar"; α = 0.44), and *rapport with fellow students* (3 items; e.g., "I have the impression that the students in my seminar show solidarity with each other"; α = 0.62). The *challenge* dimension consists of three subscales: *pressure to perform* (3 items; e.g., "Compared to other seminars, my seminar is characterized by a very high examination load"; α = 0.80), *knowledge construction* (4 items; e.g., "I encourage students to think and reflect on the material"; α = 0.75), and *knowledge transmission* (3 items; e.g., "My seminar consists mainly of lectures given either by myself or the students"; α = 0.80). Lastly, the *orientation* dimension consists of two subscales: *meaning orientation* (4 items; e.g., "My seminar is about students thinking and working independently"; α = 0.58), and *reproduction orientation* (4 items; e.g., "To pass my seminar well, all you really need is a good memory"; α = 0.50). The instructors answer all items with respect to the seminar they just gave, taking all previous sessions into account (instruction:

[1] One item on knowledge construction: "I strive to activate the prior knowledge of the seminar participants in order to build on it when conveying my teaching content"; One item on rapport with fellow students (due to a lack of internal consistency this item was not integrated into the final subscale): "It is common in my seminar for students to work together on assignments"; Two items on reproduction orientation: "The ability to name concrete theories and concepts is a central criterion for passing my seminar"; "My seminar is about students memorizing key content".

"Considering all previous sessions, please rate the extent to which the following statements apply to the seminar you just gave"). The items were answered on a 5-point Likert-scale from 1 (*does not apply at all*) to 5 (*applies completely*).

Goal orientation: We used the scales developed by the StEG study (Leibniz-Institut für Bildungsforschung und Bildungsinformationen, 2020c;2020b;2020a) and slightly adjusted the instruction to refer to the university context, instead of the school 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"; $\alpha = 0.85$) are each measured by five items, and *performance-avoidant goal orientation* ("For me, studying is about not embarrassing myself in front of my peers"; $\alpha = 0.82$) by four items.

2.3. Analysis strategy

We used *R Version 4.2.1* (R Core Team, 2022). For both dimensions of ART, we calculated seminar specific means and standard errors on a manifest level, visualizing them using *ggplot2 3.3.6* (Wickham, 2016) and testing the mean differences between seminars for significance using ANOVA. Using latent variables for ART, we used *lavaan 0.6-12* (Rosseel, 2012) for a two-level structural equation baseline model in order to compute ICCs and determine the amount of variance in ART located between seminars. Lastly, we calculated the mean scores of each subdimension of teaching quality and goal orientation, and in a stepwise process, we added students' goal orientations on the within-level (level 1), and teaching quality on the between-level (level 2) to the baseline model as manifest variables.[2] The final model that was the subject of our analysis is shown in Fig. 2. Please note that for readability, the individual items loading on the latent ART factors are not displayed in the figure.

3. Results

3.1. Descriptive statistics

Table 1 shows means and standard deviations, as well as correlations of ART on the between-level, and teaching quality. Table 2 relates ART on the within-level to students' goal orientations. On a theoretical scale range between 1 and 5, students, on average indicate to be engaged in ART in front of peers ($M = 3.43$) as well as in front of the whole seminar group ($M = 3.30$). High mean values on the rapport with instructors scale, the knowledge construction scale and the meaning orientation scale are observed. This implies that instructors tend to think of themselves as open and approachable towards their students, and of their seminars as cognitively activating. Noticeably low values are found for the reproduction orientation scale, which indicates that memorization plays a subordinate role in instructors' teaching. Furthermore, students tend to have high mastery goal orientation. Performance-approach goal orientation and performance-avoidant goal orientation play a lesser role.

To address the first research question, Figs. 3 and 4 show manifest means and standard errors in ART on the seminar group dimension, and the peer dimension for each seminar as well as the sample mean. The figures show substantial variation in ART between seminars for both dimensions. Visually, the standard errors of some seminars do not overlap with the sample mean, or with the means of other seminars. Analyses of variance reveal that the differences in ART between seminars are significant for the seminar group dimension ($F(37, 341) = 2.758, p < 0.01$), and the peer dimension ($F(37, 341) = 1.823, p < 0.01$), respectively.

3.2. Two-level structural equation models

To determine the amount of variance in ART explained by seminar belonging, we computed a two-level baseline structural equation model (Table 3) with the two correlated latent ART variables on the between-level as well as on the within-level. On the between-level, the factor loadings, as well as the item variances for each latent variable, were fixed to be equal to avoid estimation problems. The assumed model structure fits the empirical data very well ($N = 369$, $K = 38$, $df = 84$, $\chi^2 = 92.239$, $p = 0.252$, RMSEA = 0.016, TLI = 0.987, and CFI = 0.988), and an additional analysis replicated the assumed preference of the two-factor ART model in comparison to a one-factor model with all items loading on one single ART factor ($N = 369$, $K = 38$, $df = 86$, $\chi^2 = 220.354$, $p < 0.001$, RMSEA = 0.065, TLI = 0.796, and CFI = 0.805; Chi-squared difference test: $\Delta\chi^2 = 128.115$, $\Delta df = 2$, $p < 0.001$). On the seminar group dimension, variance estimates are $\sigma^2_{between} = 0.079$ ($p = 0.02$) on the between-level and $\sigma^2_{within} = 0.406$ ($p < 0.01$) on the within-level. On the peer dimension, variance estimates are $\sigma^2_{between} = 0.024$ ($p = 0.12$) on the between-level and $\sigma^2_{within} = 0.309$ ($p = 0.01$) on the within-level. ICCs computed herewith reveal that 16.3% of variance in ART (seminar group dimension), and 11.0% of variance in ART (peer dimension) are attributable to the clustered structure of the data.

Addressing research question 2, we added the teaching quality scales to the baseline model and estimated correlations between all variables (Table 1). The teaching quality scales were treated as manifest variables to avoid overcomplexity and estimation problems. The model fits the data very well ($N = 343$, $K = 36$, $df = 148$, $\chi^2 = 167.011$, $p = 0.136$, RMSEA = 0.019, TLI = 0.962, and CFI = 0.971). Due to the small sample size in terms of between-level variables ($K = 36$ seminars), a 10% threshold for significance is further flagged significant. Reproduction orientation correlates with the group factor of ART significantly ($r = 0.42$, $p = 0.06$). This means that in seminars, which place a higher emphasis on memorization and reproduction, students tend to display less ART in front of the whole group.

Next, we added teaching quality to the baseline model as predictors of ART on the between-level (Table 4). The model fits the data very well ($N = 343$, $K = 36$, $df = 148$, $\chi^2 = 167.011$, $p = 0.136$, RMSEA = 0.019, TLI = 0.966, and CFI = 0.971). First, the more structure a seminar has, the less ART students display in front of the whole seminar group ($\beta = 0.35$, $p = 0.10$). Second, the more a seminar emphasizes memorization and reproduction, the less ART in front of the whole seminar is observed in students ($\beta = 0.41$, $p = 0.04$). Third, in seminars that are characterized by high performance pressure students tend display more ART in front of their peers ($\beta = 0.48$, $p = 0.08$).

Addressing research question 3, we first added students' goal orientations as covariates to the within-level of the baseline model (Table 2). The model fits the data very well ($N = 369$, $K = 38$, $df = 108$, $\chi^2 = 125.324$, $p = 0.122$, RMSEA = 0.021, TLI = 0.979, and CFI = 0.981). We observe a significant correlation between the seminar group dimension of ART and performance-avoidant goal orientation ($r = 0.53$, $p = <0.01$), as well as mastery goal orientation ($r = 0.17$, $p = 0.01$). Concerning the peer dimension of ART and performance-avoidant goal orientation, the same pattern is observable ($r = 0.17$, $p = 0.02$). Students, who wish to avoid a lack of skills becoming visible, tend to display less ART in front of the whole seminar group, but also in front of peers. We find a significant positive correlation for mastery goal orientation ($r = 0.46$, $p < 0.01$), which means that students who are motivated by the process of learning itself, tend to display more ART in front of their peers.

Next, we added the three goal orientations as within-level predictors to the baseline model (Table 5). The model fits the data very well ($N = 369$, $K = 38$, $df = 108$, $\chi^2 = 125.324$, $p = 0.122$, RMSEA = 0.021, TLI = 0.979, and CFI = 0.981). High performance-approach goal orientation predicts significantly more ART in front of the whole seminar group,

[2] A minimal dataset and the analysis script are available on PsychArchives: https://doi.org/10.23668/psycharchives.14075 (dataset), and https://doi.org/10.23668/psycharchives.14076 (analysis script)

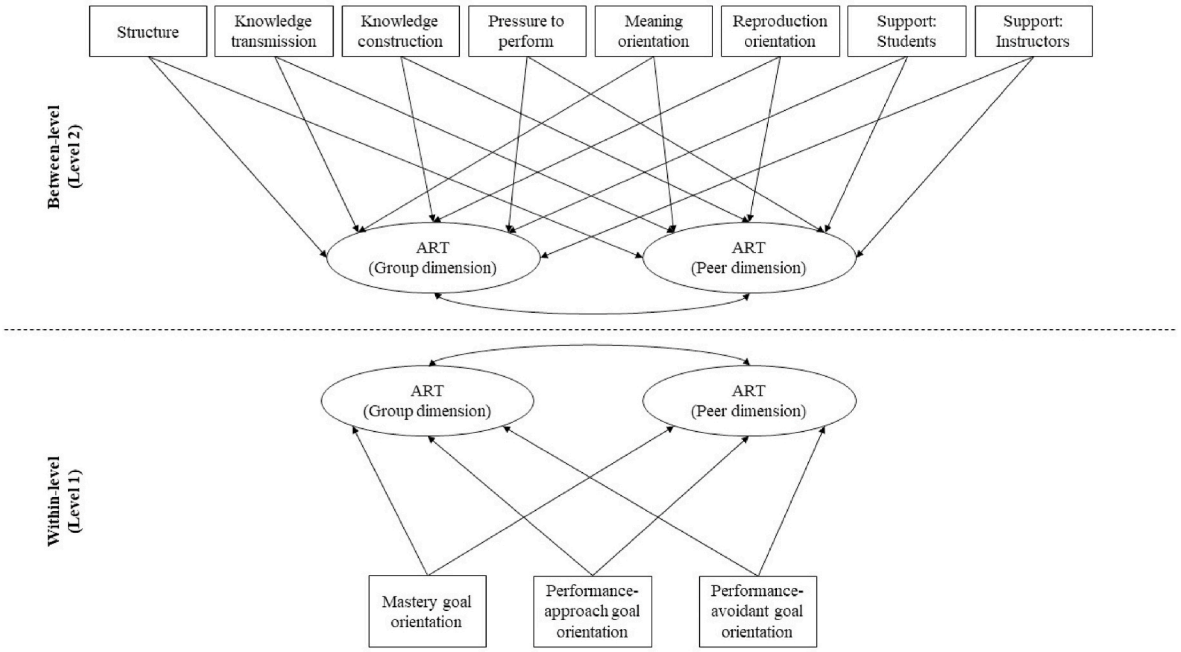

Fig. 2. Assumed two-level structural equation model with regressions predicting within-level ART, and between-level ART.

Table 1
Means, standard deviations, ranges and correlations between the between-level ART factors and teaching quality.

	M	*SD*	Range	1	2	3	4	5	6	7	8	9	10
Academic risk taking													
1 ART (seminar group)	3.30	0.76	1.17–4.83	1									
2 ART (peers)	3.43	0.78	1.00–5.00	0.06	1								
Teaching quality													
3 Structure	3.94	0.75	2.25–5.00	0.33	0.15	1							
Support													
4 Rapport with instructors	4.51	0.41	2.75–5.00	0.17	0.08	0.27	1						
5 Rapport with fellow students	3.93	0.55	3.33–5.00	0.00	0.43	0.02	0.10	1					
Challenge													
6 Pressure to perform	2.38	0.87	1.00–4.67	0.31	0.47	0.35*	0.13	0.11	1				
7 Knowledge construction	4.47	0.41	2.75–5.00	0.13	0.24	0.24	0.59**	0.10	0.10	1			
8 Knowledge transmission	2.32	1.01	1.00–4.67	0.02	0.10	0.17	0.01	0.16	0.17	0.19	1		
Orientation													
9 Meaning orientation	4.51	0.44	2.75–5.00	0.07	0.45	0.25	0.17	0.06	0.14	0.46**	0.13	1	
10 Reproduction orientation	2.02	0.54	1.00–3.50	0.42†	0.02	0.02	0.03	0.03	0.14	0.01	0.26	0.00	1

Note. Means and standard deviations are computed on a manifest level. Correlations are computed as standardized covariances on the between-level using SEM and the ART dimensions as latent constructs. '†' $p \leq 0.10$; '*' $p \leq 0.05$; '**' $p \leq 0.01$.

Table 2
Means, standard deviations, and correlations between the within-level ART factors and goal orientation.

	M	*SD*	Range	1	2	3	4	5
Academic risk taking								
1 ART (seminar group)	3.30	0.76	1.17–4.83	1				
2 ART (peers)	3.43	0.78	1.00–5.00	0.40**	1			
Goal orientation								
3 Mastery	4.31	0.46	2.75–5.00	0.17**	0.46**	1		
4 Performance-approach	1.82	0.80	1.00–4.80	0.08	0.01	0.05	1	
5 Performance-avoidant	2.57	0.89	1.00–5.00	0.53**	0.17*	0.10	0.39**	1

Note. Means and standard deviations are computed on a manifest level. Correlations are computed as standardized covariances on the within-level using SEM and the ART dimensions as latent constructs. '*' $p \leq 0.05$; '**' $p \leq 0.01$.

while high performance-avoidant goal orientation predicts significantly less ART. Concerning the peer dimension, mastery goal orientation predicts significantly more ART in front of peers, while performance-avoidant goal orientation predicts significantly less ART in front of peers.

Lastly, we added all previously mentioned predictors in a conjoint model (Table 6), which fits the data well ($N = 343$, $K = 36$, $df = 172$, $\chi^2 = 193.871$, $p = 0.121$, RMSEA = 0.019, TLI = 0.968, and CFI = 0.972). Compared to the two previous models, the coefficients on the between-level do not change in absolute terms, but structure ($p = 0.12$) and pressure to perform ($p = 0.12$) do not predict ART significantly anymore. On the within-level, we do not see any major changes in the predictors'

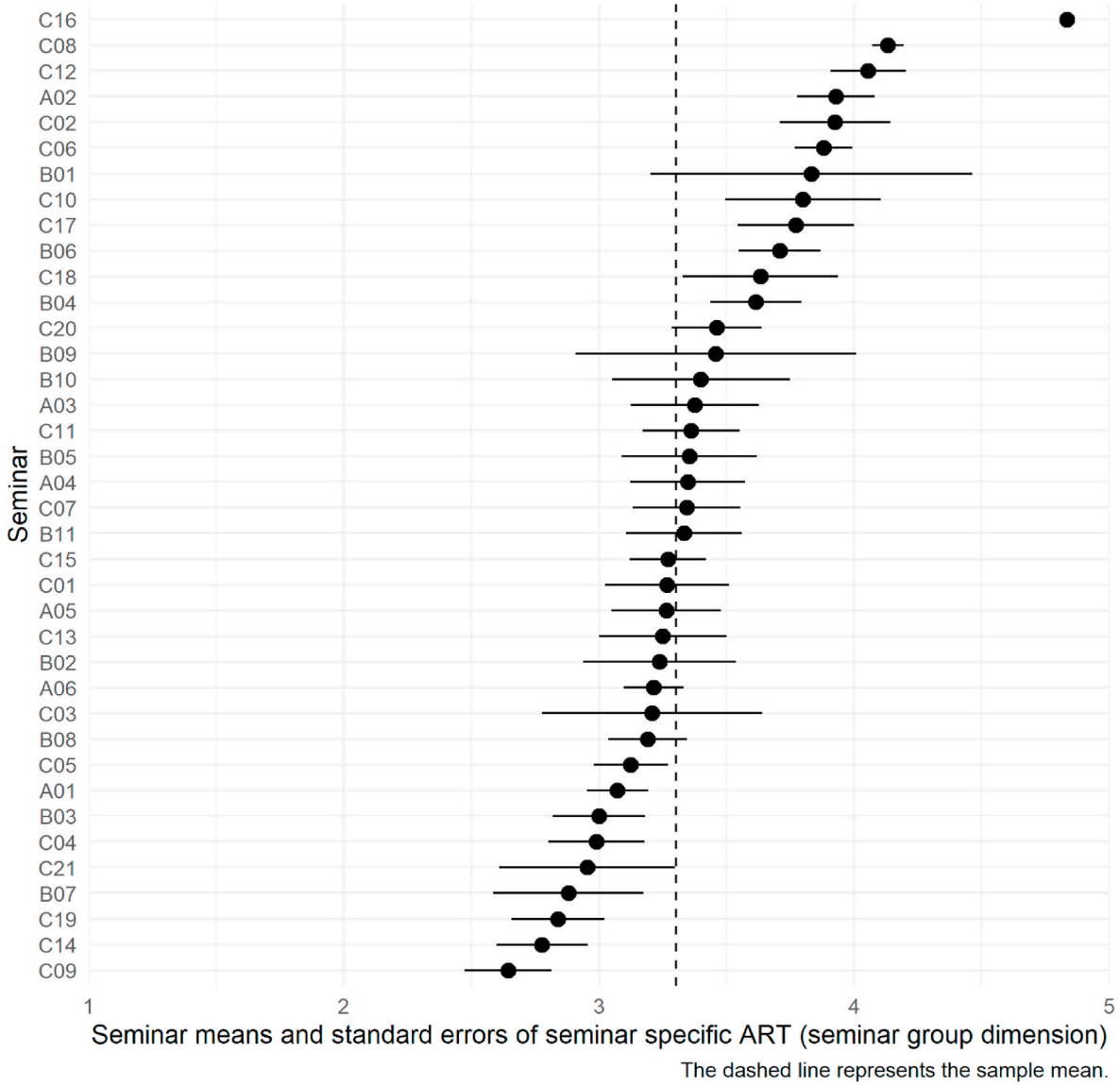

Fig. 3. Visualization of seminar means and standard errors of ART in ascending order (seminar group dimension).

coefficients concerning weight, sign, and significance, suggesting robustness of our results.[3]

4. Discussion

4.1. Interpretation of results

Especially when deep, elaborate learning is desired, we consider ART to be a useful type of behavior in that it contributes to students' access to new knowledge beyond what is formally provided by instructors. By focusing on a type of positive risk taking, we offer new insights on risk taking in educational contexts. Risk taking generally tends to peak during adolescence (Duell et al., 2018), and academic risk taking seems to be greater in students aged between 10 and 13 years than in those under 9 years (Byrnes et al., 1999). Also, in our sample we find that students generally take academic risks, the sample means of both scales being above the theoretical scale means. At the same time, we find that the propensity for ART shows substantial variability between students. While some students show high levels of ART, some students show less ART. Student behavior and thus also ART is not only influenced by individual differences between students, but also by contextual differences between learning situations (Ulrich, 2016). In this study, we explored whether significant differences in students' ART are observable between seminars and whether these differences can be explained by teaching quality. Furthermore, the association between ART and learning goal orientation is considered. Affirming our first research question, our results show that students' levels of ART do, indeed differ significantly by their seminar belonging. In descriptive terms, 16.3% of variance in ART on the group dimension, as well as 11.0% of variance in ART on the peer dimension, are attributable to the clustered nature of the data. Thus, some seminars seem to encourage students more to take academic risks than others.

Furthermore, results of a two-level structural equation model just with between-level regressions show that highly structured seminars are associated with lower levels of ART in students. This result is noteworthy, as previous research within school contexts tends to find positive associations between structure and general behavioral engagement.

[3] To check for robustness, we further estimated this final model without the potential outlier clusters B01 and C16 (see Figs. 3 and 4). The analysis script and detailed results are available as supplementary materials on PsychArchives: https://doi.org/10.23668/psycharchives.14077.

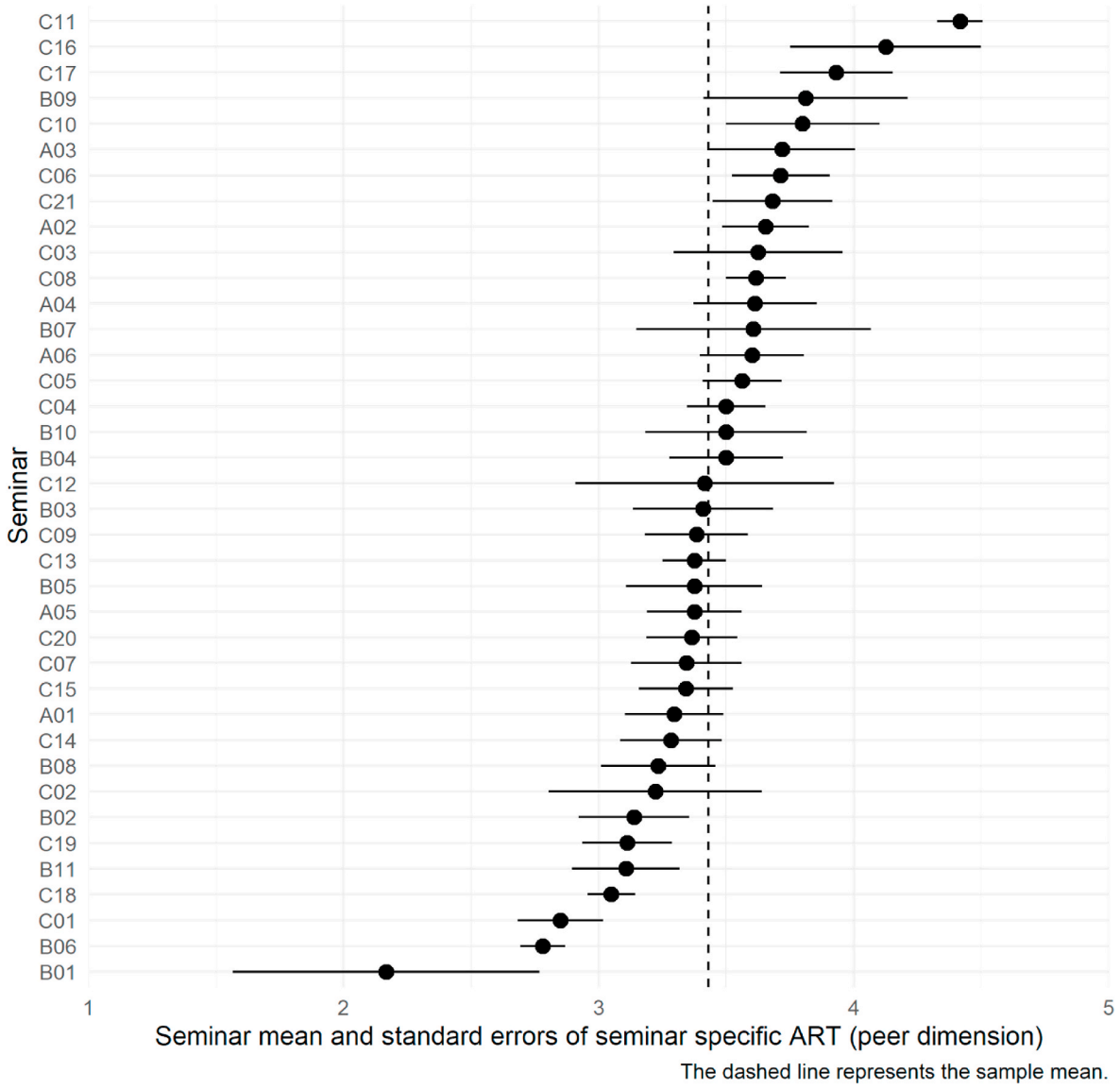

Fig. 4. Visualization of seminar means and standard errors of ART in ascending order (peer dimension).

Students are for example more attentive during class (Lietaert et al., 2015) or participate more during class discussions (Wang & Eccles, 2013). We suspect high structure to encourage students to engage when they are reasonably certain about their contribution. Such an interaction between students and instructor would take comparatively little time and would not interfere with the instructor's timing and intended content load. For ART, Dachner et al. (2017), and Üztemur (2020) provide conflicting results, as less autonomy given by the instructor predicts less ART in students. When displaying ART, students risk making errors, which must be corrected and discussed. As this process is time-consuming, students may perceive ART to be a disruptive factor and avoid taking academic risks in highly structured seminars. Likewise, a high degree of structure can also mean that learning materials are provided in a more organized form, which may prevent cognitive misconceptions from the outset and thus lead to a higher perceived certainty in knowledge, rendering ART unnecessary. Consequently, the opportunities given by the instructor to show ART might be considerably lower in highly structured seminars.

High performance pressure positively relates to higher levels of ART in front of peers within the between-level regression models. This result is in line with prior findings by Dachner et al. (2017) and also with previous results within school contexts (Lee et al., 2021), which report higher levels of peer support in high pressure classrooms compared to low pressure classrooms. To fulfill the high performance expectations, students may turn to their peers in situations of uncertainty and discuss concepts and materials to create new knowledge. In this sense, students navigate their zone of proximal development (Vygotsky, 1978) when displaying ART by using scaffolding techniques in cooperation with their peers. Nevertheless, these two regression coefficients do not remain significant when introducing students' goal orientation to the model on the individual level. This change might be explained by a certain selectivity of students into specific seminars in accordance with their goal orientation (model endogeneity). Therefore, interpretation of findings of models without within-level predictors should not contain any causality.

Then, our results show that students display less ART in seminars with higher reproduction orientation. This may be because tasks that require reproduction have a precise concept of right and wrong, making it easier to spot errors. Hübner and Pfost (2022) found that students who tend to anticipate negative affect after making errors display less ART. It is therefore conceivable that students who are unsure about the correctness of their contribution may avoid trying to solve

Table 3
Results of the two-level baseline structural equation model.

	ART (group dimension)			ART (peer dimension)		
	UC	SC	SE	UC	SC	SE
Within-level factor loadings						
Item 1	1.00	0.65				
Item 2	1.01**	0.61	0.11			
Item 3	1.05**	0.59	0.13			
Item 4	1.07**	0.62	0.12			
Item 5	0.84**	0.53	0.11			
Item 6	0.90**	0.57	0.11			
Item 7				1.00	0.45	
Item 8				1.21**	0.59	0.22
Item 9				1.19**	0.57	0.21
Item 10				0.86**	0.54	0.17
Between-level factor loadings						
Items 1-6	1.00	0.94				
Items 7-10				1.00	0.81	
Covariances between the two ART factors						
	UC		SC		SE	
Within-level	0.14**		0.39		0.03	
Between-level	0.01		0.17		0.02	

Note. UC, unstandardized coefficient; SC, standardized coefficient; SE, standard error of the unstandardized coefficient. '*' $p \leq 0.05$; '**' $p \leq 0.01$.

Table 4
Results of the two-level structural equation model with regressions predicting between-level ART.

	ART (group dimension)			ART (peer dimension)		
	USC	SC	SE	USC	SC	SE
Within-level factor loadings						
Item 1	1.00	0.63				
Item 2	1.06**	0.62	0.13			
Item 3	1.08**	0.58	0.14			
Item 4	1.09**	0.60	0.14			
Item 5	0.89**	0.54	0.12			
Item 6	0.91**	0.55	0.12			
Item 7				1.00	0.44	
Item 8				1.25**	0.63	0.23
Item 9				1.12**	0.54	0.21
Item 10				0.86**	0.55	0.17
Between-level factor loadings						
Items 1-6	1.00	0.94				
Items 7-10				1.00	0.79	
Between-level regressions						
Structure	**−0.15**†	0.35	0.09	0.01	0.04	0.07
Rapport with instructors	0.15	0.21	0.18	0.12	0.28	0.14
Rapport with fellow students	0.03	0.06	0.12	0.16	0.42	0.10
Pressure to perform	0.06	0.16	0.07	0.10†	0.48	0.06
Knowledge construction	0.07	0.12	0.18	0.08	0.21	0.15
Knowledge transmission	0.02	0.07	0.06	0.07	0.37	0.05
Meaning orientation	0.02	0.04	0.14	0.15	0.41	0.12
Reproduction orientation	0.24*	0.41	0.11	0.06	0.16	0.09
Covariances between the two ART factors						
	UC		SC		SE	
Within-level	0.14**		0.41		0.04	
Between-level	0.01		0.38		0.02	

Note. UC, unstandardized coefficient; SC, standardized coefficient; SE, standard error of the unstandardized coefficient. '†' $p \leq 0.10$; '*' $p \leq 0.05$; '**' $p \leq 0.01$.

reproduction-oriented tasks and thus avoid making visible errors and experiencing negative affect. Another explanation considers ART not only as a type of engagement but also as a learning strategy. According

Table 5
Results of the two-level structural equation model with regressions predicting within-level ART.

	ART (group dimension)			ART (peer dimension)		
	USC	SC	SE	USC	SC	SE
Within-level factor loadings						
Item 1	1.00	0.67				
Item 2	0.97**	0.62	0.10			
Item 3	1.00**	0.59	0.11			
Item 4	1.00**	0.60	0.11			
Item 5	0.79**	0.53	0.10			
Item 6	0.87**	0.58	0.10			
Item 7				1.00	0.43	
Item 8				1.37**	0.64	0.24
Item 9				1.10**	0.50	0.20
Item 10				0.94**	0.56	0.17
Within-level regressions						
Mastery	0.13	0.09	0.08	0.51**	0.44	0.10
Performance-approach	0.27**	0.33	0.05	0.03	0.05	0.04
Performance-avoidant	0.49**	0.65	0.05	0.09*	0.14	0.05
Between-level factor loadings						
Items 1-6	1.00	0.93				
Items 7-10				1.00	0.82	
Covariances between the two ART factors						
	UC		SC		SE	
Within-level	0.08**		0.34		0.03	
Between-level	0.01		0.27		0.02	

Note. UC, unstandardized coefficient; SC, standardized coefficient; SE, standard error of the unstandardized coefficient. '*' $p \leq 0.05$; '**' $p \leq 0.01$.

to models of self-regulated learning, the choice of learning strategies follows the clarification of the goal and the identification of situational patterns (Perels et al., 2020; Schmitz & Wiese, 2006). Our results thus are coherent with a perspective that students adjust their learning behavior according to the challenges of the learning context. ART may be a good strategy when it comes to a deep understanding of the content (Krochmal & Roth, 2017), but not necessarily within seminars that aim to memorize and reproduce knowledge. Instead, superficial learning strategies may be relevant. However, this is just a first idea and further research that also takes the direction of the effect into account is necessary.

Though we observe significant differences in students' ART between seminars, roughly between 80% and 90% of variance in students' ART are attributable to differences on an individual level. Previous theory and research suggest students' goal orientation to be a key factor for their behavioral and educational decisions (Middleton & Midgley, 1997; Stasielowicz, 2019). Our research supports this assumption, albeit only partially confirming our hypotheses. As expected, performance-avoidant goal orientation predicts ART negatively on both dimensions. As students with performance-avoidant goal orientation wish to conceal their potential lack of skills to others, it is not surprising that those students would avoid taking academic risks not only within seminars, but also in front of their peers. However, the assumption of mastery goal orientation being beneficial for ART only holds for the peer dimension of ART. These students strive to elucidate uncertainties (Park et al., 2007), so it seems peculiar that they would only use selected peers as a resource for their goal attainment, considering that the association between mastery goal orientation and students' ART in front of the seminar group has been found before (Hübner & Pfost, 2022). One possible explanation may be that mastery goal oriented students believe that they learn best by listening and concentrating during the seminar and then actively discussing challenging content with their peers afterwards. Additional to the hypothesized associations, we find performance-approach goal orientation to predict ART on the seminar group dimension positively. These students aim to demonstrate their skills in front of others (Elliot &

Table 6
Results of the two-level structural equation model with regressions predicting within-level ART, and between-level ART.

	ART (group dimension)			ART (peer dimension)		
	USC	SC	SE	USC	SC	SE
Within-level factor loadings						
Item 1	1.00	0.66				
Item 2	1.02**	0.63	0.11			
Item 3	1.04**	0.59	0.12			
Item 4	1.01**	0.59	0.12			
Item 5	0.83**	0.53	0.11			
Item 6	0.88**	0.56	0.10			
Item 7				1.00	0.41	
Item 8				1.43**	0.67	0.26
Item 9				1.07**	0.48	0.21
Item 10				0.96**	0.57	0.19
Within-level regressions						
Mastery	0.11	0.07	0.08	0.48**	0.41	0.10
Performance-approach	0.29**	0.36	0.05	0.05	0.07	0.04
Performance-avoidant	0.48**	0.67	0.05	0.11**	0.18	0.05
Between-level factor loadings						
Items 1-6	1.00	0.93				
Items 7-10				1.00	0.82	
Between-level regressions						
Structure	0.13	0.32	0.08	0.03	0.06	0.07
Rapport with instructors	0.08	0.13	0.16	0.18	0.82	0.15
Rapport with fellow students	0.08	0.14	0.11	0.15	0.76	0.10
Pressure to perform	0.05	0.15	0.06	**0.09**	0.50	0.06
Knowledge construction	0.08	0.15	0.16	0.00	0.20	0.15
Knowledge transmission	0.01	0.02	0.06	0.07	0.36	0.05
Meaning orientation	0.01	0.02	0.13	0.17	0.73	0.12
Reproduction orientation	0.24*	0.45	0.10	0.09	0.33	0.09
Covariances between the two ART factors						
	UC		SC		SE	
Within-level	0.08**		0.37		0.03	
Between-level	0.01		0.43		0.01	

Note. UC, unstandardized coefficient; SC, standardized coefficient; SE, standard error of the unstandardized coefficient. '†' $p \leq 0.10$; '*' $p \leq 0.05$; '**' $p \leq 0.01$.

Harackiewicz, 1996) and may achieve this goal by accepting the risk inherent to ART of making an error for the chance of being correct. However, they may also define "demonstrating skills" not exclusively as "being correct" but also as "being engaged and critical". Therefore, taking academic risks in itself would fulfill their objective.

4.2. Limitations and implications for future research

Research on ART within higher educational contexts is still in its infancy. Although first findings have shown relations of ART, for example with beliefs about errors (Hübner & Pfost, 2022) or goal orientation (Abercrombie et al., 2022), there is still much research potential, especially regarding the role of the learning environment. With our work, we provide one of the first studies conjointly observing ART in relation to teaching quality in higher education contexts, and to individual student characteristics. There are, however, some limitations to our design, which should be discussed critically.

First, two perspectives on the same seminar do not necessarily coincide. In our dataset, the instructors assess the teaching quality of their own seminars. However, the students attending the seminar may have a different impression and consequently may adjust their behavior, distorting our results. To illustrate using the example of the rapport with fellow students scale, consider the fact that instructors primarily see their students during seminars and may perceive them to be supportive of each other in this setting. However, the students are also able to consider interactions outside the seminar which, depending on the quality of these interactions, may create a discrepancy to the instructor's assessment.

Second, as we are working with 38 seminars to explain 16.3% of variance on the seminar group factor, and 11.0% of variance on the peer factor, test power may just be sufficient to detect strong relations. To clarify this issue, the evaluation of ART within large-scale longitudinal surveys would be desirable. This would also permit more complex research questions to be addressed. For example, with our design, we cannot say with certainty that students adjust their academic risk taking behavior according to the requirements and opportunities of a specific seminar or if the opposite is the case. Students usually have an idea of instructors' teaching styles and the complexity and demands of a seminar before registering for it. Therefore, students may adjust the selection of their seminars to their willingness to take academic risks rather than the other way around. One potential research question therefore concerns the existence of a person-specific ART baseline in the sense of a trait component and possible deviations in the sense of a state component (Fredricks et al., 2004). Observing longitudinal processes of change by evaluating the same students within different seminars and/or across different phases of their studies would be especially interesting. Another research focus might be the question of academic success. Students who take academic risks in school, generally benefit from this behavior inasmuch as they achieve higher GPAs (Bal-İncebacak et al., 2019; Varışoğlu & Ekinci Çelikpazu, 2019) and pursue higher academic tracks (Clifford, 1991; Clifford & Chou, 1991). Only sparse evidence exists for university students in that respect (Hübner & Pfost, in press; Krochmal & Roth, 2017). Therefore, it should be established, whether academic risk taking leads to higher academic outcomes in university students and whether the association of academic success and ART is moderated by specific learning goal criteria (Adams, 2015).

Third, we raise the question of whether the SSCO model captures all key quality dimensions for teaching with respect to ART. While the model is quite rich, it does not explicitly cover, for example instructors' reactions to errors or their feedback policies. However, these aspects may play an important role, as students who fear receiving negative feedback tend to take less academic risks (Çetin et al., 2014; Üztemur, 2020). For future research endeavors, we therefore propose supplementing the SSCO model with a support component that focuses on the instructors' feedback practices regarding feedback type (summative vs. formative) and feedback frequency. Additionally, the observed negative relationship between ART and structure should be examined in more detail. While previous research suggests that students engage more in ART when they find themselves in a structured environment (Lietaert et al., 2015; Wang & Eccles, 2013) strict rule setting and a high perceived certainty of knowledge may encourage risk-aversion and conformity. Including instrumentation which differentiates more aspects of structure such as the formal structure (e.g., educational material provided), the content structure (e.g., explicit formulation of learning goal criteria), and the social structure (e.g., rules within the seminar) may better illuminate this relationship.

Fourth, and concerning the gender distribution present in our sample, the high number of female students may limit the generalizability of our results. As Byrnes et al. (1999) found that women tend to take more academic risks, this may lead to an overestimation of the prevalence of ART.

5. Conclusion

In conclusion, our research provides a first insight into the multidimensional dynamics between student characteristics, student behavior, and teaching quality. Although students' individual characteristics seem to play a major role in terms of predicting their ART within seminars,

neither researchers nor practitioners should forget or neglect the role of teaching decisions made by the instructors, though future research is warranted.

In terms of recommendations for practitioners, we would like to exercise restraint as our results still leave many questions unanswered. However, if instructors perceive ART to be a desirable trait within their learning environment, our results offer possible approaches to create opportunities deliberately and consciously for their students to engage in ART. According to our results, a strong focus on reproduction orientation is rather a hindering factor for ART. This should be considered by instructors in higher education. Reproduction orientation typically manifests in the formulation of corresponding goal criteria and then is also apparent during the seminar in which the goal criteria should be fulfilled. Consequently, instructors who wish to encourage their students to take academic risks might also define learning objectives that require higher levels of cognitive processing and are of increasing complexity, rather than criteria that only require reproduction and focus on facts (Adams, 2015).

Declarations of interest

None.

CRediT authorship contribution statement

Vanessa Hübner: Conceptualization, Methodology, Formal analysis, Data curation, Writing – original draft. **Maximilian Pfost:** Conceptualization, Methodology, Writing – review & editing.

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