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The Impact of Epistemological Beliefs and Achievement Motivation on Learning Outcomes and Academic Self-Efficacy in Education

Xinlei Sun
Corresponding author, Chair of Educational Science, University of Passau, Passau, Germany, *xinlei.sun@uni-passau.de*

Maximilian Sailer
Chair of Educational Science, University of Passau, Passau, Germany, *maximilian.sailer@uni-passau.de*

Ruben Schlag
Chair of Educational Science, University of Passau, Passau, Germany, *ruben.schlag@uni-passau.de*

Recent advances in educational technology have prompted significant shifts in instructional practices. Among these, the flipped classroom model has gained attention for promoting student engagement and autonomy. When combined with the 5E instructional framework, it has attracted growing interest from educational researchers. This study investigates the effectiveness and feasibility of a 5E-based flipped classroom through a 10-week intervention involving 113 social science majors enrolled in the "Research Methods in Social Science" course at the University of Passau. Based on survey data, we examined the relationships among students' epistemological beliefs, achievement motivation, learning performance, and academic self-efficacy in this instructional context. The results indicated that epistemological beliefs significantly predicted both learning performance and academic self-efficacy. Furthermore, the fear-of-failure dimension of achievement motivation was a significant negative predictor of academic self-efficacy.

Keywords: 5E instructional model, flipped classroom, epistemological beliefs, achievement motivation, learning performance, academic self-efficacy

INTRODUCTION

Technological advancements have significantly transformed educational practices, with the flipped classroom emerging as a widely adopted model that integrates digital tools into traditional instruction. In this approach, students typically engage with instructional videos or readings before class, while in-class time is reserved for interactive activities facilitated by the instructor (Love et al., 2014). Compared to conventional teaching methods, flipped classrooms provide increased flexibility and enable more personalized, student-centered learning. Recent systematic reviews indicate that flipped classrooms

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can also serve as catalysts for curriculum innovation, offering diverse pathways for integrating active learning strategies into higher education contexts (Lencastre et al., 2020). As the model has evolved, researchers have explored its integration with other pedagogical frameworks, such as inquiry-based flipped learning (Schallert et al., 2022), collaborative flipped classrooms (Foldnes, 2016), and project-based group work (Béres & Kis, 2018), all aimed at further improving learning performance and student satisfaction.

Among the instructional models compatible with flipped classrooms, the 5E instructional model - comprising Engagement, Exploration, Explanation, Elaboration, and Evaluation phases (Bybee et al., 2009) - has gained increasing attention. Rooted in constructivism learning theory, the 5E model encourages student curiosity and promotes independent knowledge construction, aligning well with the principles of flipped learning. Moreover, the 5E framework provides a structured pedagogical foundation, addressing the common criticism that flipped classrooms often lack theoretical coherence (Lo et al., 2018). Although previous studies have demonstrated positive effects of 5E-based flipped classrooms on students' self-efficacy and academic outcomes (Hew et al., 2020), the underlying mechanisms driving these effects remain insufficiently explored.

Two critical psychological factors, epistemological beliefs and achievement motivation, are known to influence learning processes and outcomes. Epistemological beliefs, or students' conceptions about the nature of knowledge and learning, are strongly associated with cognitive engagement and academic performance (Fischer et al., 2014). Recent research shows that professional and epistemological beliefs significantly shape instructional behaviors and educational outcomes (Luján, 2021). In inquiry-oriented learning environments such as 5E-based flipped classrooms, specific dimensions of epistemological beliefs, namely, justification by authority and justification by multiple sources, become crucial. These beliefs govern how students engage with the autonomy demanded by the flipped classroom and participate in the Exploration phase of the 5E model, ultimately shaping their confidence in tackling learning challenges (self-efficacy) and their success in mastering complex tasks (achievement). Similarly, achievement motivation has been linked to both academic self-efficacy and actual performance. The present study focuses on the Exploration phase of the 5E model within a flipped classroom, aiming to investigate how students' epistemological beliefs and achievement motivation interact to shape their learning performance and academic self-efficacy.

While existing research has examined the effects of the 5E model and flipped classrooms independently, empirical studies combining both approaches, especially within the field of social sciences in higher education, remain limited. To fill this gap, the present study advances the proposition that epistemological beliefs shape motivational dispositions, which in turn influence students' confidence and performance in active, inquiry-based pedagogies such as the 5E-based flipped classroom. On this basis, the study addresses the following research questions:

(1) To what extent do students' learning performance and academic self-efficacy change in a 5E-based flipped classroom?

(2) How do students' epistemological beliefs influence their academic self-efficacy and learning performance in a 5E-based flipped classroom?

(3) How does students' achievement motivation influence their academic self-efficacy and learning performance in a 5E-based flipped classroom?

Theoretical Framework

To explore the psychological mechanisms underlying student learning in a 5E-based flipped classroom, this study systematically delineates the theoretical foundations relevant to this instructional approach.

5E-based flipped classroom

The 5E-based flipped classroom constitutes a hybrid instructional model that merges the structured, inquiry-driven design of the 5E learning cycle with the time-flexible, learner-centered features of flipped learning. Rooted in constructivist theory, the 5E model organizes instruction into five sequential phases - Engagement, Exploration, Explanation, Elaboration, and Evaluation - each strategically designed to promote cognitive activation, conceptual growth, and meaningful understanding (Bybee et al., 2006). Empirical evidence suggests that the 5E learning cycle can significantly enhance student achievement when systematically embedded in subject-specific instruction, highlighting its potential to structure flipped classroom activities effectively (Suwito & Budijanto, 2020).

Flipped learning environments provide optimal conditions for implementing each phase of the 5E model. In the Engagement phase, learners' prior knowledge is activated, and epistemic curiosity is stimulated through pre-class materials such as instructional videos or targeted readings. These preparatory resources function as cognitive scaffolds, enabling students to arrive in class with a foundational understanding conducive to inquiry-based exploration.

The reallocation of direct instruction to pre-class contexts allows in-class sessions to focus on Exploration and Explanation. During the Exploration phase, students work individually or collaboratively on hands-on or problem-based tasks, fostering independent reasoning, hypothesis generation, and experiential learning. This is followed by the Explanation phase, where students begin to consolidate their understanding through guided discussions, peer interaction, and teacher feedback.

The Elaboration phase deepens learning by encouraging students to apply and extend their conceptual knowledge through contextualized inquiry, collaborative discourse, and real-world problem-solving. Finally, the Evaluation phase integrates both formative and summative assessments such as reflective discussions, peer assessments, or post-class assignments, to measure conceptual mastery and inform future learning trajectories (Bybee et al., 2006).

In summary, the integration of the 5E instructional model within a flipped classroom yields a synergistic pedagogical environment that fosters active engagement, sustained motivation, and enhanced academic performance. This blended model aligns not only with the epistemological assumptions of constructivism but also with sociocultural theories of learning that emphasize interaction, mediation, and scaffolding as central to cognitive development.

Guided by this framework, the present study examines learners' cognitive and motivational variables, such as epistemological beliefs, achievement motivation, and academic self-efficacy, within a 5E-based flipped classroom context. This integrative approach is particularly well-suited to capturing the complex interplay between individual cognition, peer collaboration, and instructional support, thereby satisfying the core tenets of both constructivism and sociocultural learning theories.

Epistemological beliefs

Epistemological beliefs, defined as individuals' conceptions about the nature of knowledge and knowing, play a critical role in how learners interpret information and engage with content (Kampa et al., 2016). Prior research has demonstrated significant associations between epistemological beliefs and various academic variables, including motivation, cognitive strategy use, conceptual understanding, and overall achievement (Greene et al., 2010). In this study, we adopt the multidimensional framework of Greene et al. (2010), which distinguishes three core dimensions: (1) Personal Justification: refers to the extent to which individuals believe that scientific knowledge is grounded in the subjective viewpoints or interpretations of scientists, and encompasses the tendency to regard scientists' opinions as definitive scientific facts. (2) Justification by Authority: reflects the degree of trust placed in authoritative sources, such as textbooks or recognized experts, as valid conveyors of knowledge, and represents a propensity to accept claims based solely on their endorsement by scientific authorities. (3) Justification by Multiple Sources: embodies the belief that knowledge claims (e.g., scientific theories) should be corroborated by multiple, independent sources, signifying an evaluative stance that values cross-validation from diverse perspectives.

Taken together, these dimensions afford a nuanced understanding of how students assess the credibility, origin, and validity of knowledge claims, processes that, in turn, profoundly influence their engagement, learning strategies, and academic success.

Academic self-efficacy

Academic self-efficacy, originating from Bandura's (1977) social cognitive theory, refers to learners' conviction in their ability to succeed in academic tasks. This conviction is grounded in their perceived competence and past experiences. Importantly, academic self-efficacy becomes critical when students encounter novel tasks for which previous experience offers little guidance. A substantial body of research indicates that higher academic self-efficacy enhances goal setting, increases effort, and promotes perseverance in the face of setbacks, making it a robust predictor of academic achievement (Honicke & Broadbent, 2016). Moreover, academic self-

efficacy is central to self-regulated learning: it influences the level of challenge students choose, directs their selection of learning activities, and shapes how they interpret and respond to discrepancies between goals and outcomes.

Learning performance

Learning performance refers to the measurable outcomes of students' cognitive engagement with academic content, typically assessed through evaluations of declarative knowledge, conceptual understanding, and the ability to apply knowledge in novel contexts (Nilsen & Gustafsson, 2016). It serves as a key indicator of instructional effectiveness and functions as a core variable in educational research. Furthermore, contemporary learning theories posit that learning performance is shaped not only by students' prior knowledge and cognitive abilities but also by their motivational, affective, and metacognitive processes (Pintrich & De Groot, 1990).

METHOD

Research design

We employed a course-level pre-test/post-test design at a single German university to examine the psychological mechanisms underpinning learning in a 5E-based flipped classroom. Implementing the intervention within a tightly controlled course, using standardized instructor training, materials, and procedures, ensured consistency while prioritizing internal validity over broad generalizability. The pre-test/post-test framework enabled within-subject comparisons to detect changes over time. Pre-post changes in learning performance and academic self-efficacy were analyzed using repeated-measures ANOVA, and predictive relationships among key psychological variables were examined via multiple regression, including the effects of self-efficacy and achievement motivation on subsequent performance, as well as the antecedents of academic self-efficacy.

Sample

This study draws on data from Schlag and Sailer (2025), who investigated the effects of in-class modality on affective and cognitive learning outcomes in a higher education flipped classroom context. The participants were 113 undergraduate students enrolled in the "Research Methods in Social Science" course at the University of Passau. Throughout five instructional sessions, students completed a series of self-report questionnaires before and after class to assess key psychological constructs. In addition, knowledge assessments were administered during and immediately following each session to evaluate cognitive learning outcomes. All procedures were conducted in accordance with institutional ethical standards: participation was voluntary, informed consent was obtained from all participants, and data were collected anonymously and used solely for research purposes.

Instruments

Scales

Epistemological beliefs were assessed using the scale developed by Klopp et al. (2023), which includes three subscales: Personal Justification (PJ), Justification by Multiple Sources (JS), and Justification by Authority (JA). Internal consistency, as measured by Cronbach's alpha, was acceptable to good across subscales (PJ = 0.697, JS = 0.782, JA = 0.726).

Achievement motivation was measured using the Achievement Motive Scale (AMS) developed by Rheinberg (2004) and Engeser (2005), comprising two subscales: Hope for Success (HS) and Fear of Failure (FF). Both subscales demonstrated good internal consistency (HS = 0.737, FF = 0.796).

Academic self-efficacy was assessed using a scale adapted from Greene et al. (2004), with items rated on a 4-point Likert scale. Higher scores indicated stronger perceived self-efficacy. The scale showed very good internal reliability (Cronbach's $\alpha = 0.860$).

Learning performance tests

To measure learning performance, we used two types of assessments. First, a mid-session Kahoot quiz was administered in each of the five sessions to assess students' declarative knowledge. Second, an application-focused post-session quiz was conducted at the end of each session to evaluate students' ability to apply learned concepts.

Statistical analysis

All statistical analyses were conducted using SPSS 27.0.1.0. Of the initial 113 participants, 30 were excluded due to extensive missing data, yielding a final sample of 83 students. Subsequently, correlation analyses and multiple linear regressions were performed to examine the relationships among epistemological beliefs, achievement motivation, learning performance, and academic self-efficacy within the 5E-based flipped classroom context.

FINDINGS

To investigate the effects of the 5E-based flipped classroom on students' learning performance and academic self-efficacy over time, we conducted repeated measures ANOVA on academic self-efficacy scores collected during sessions 1, 3, and 5 (see Table 1).

Table 1
Repeated measures ANOVA results for academic self-efficacy across sessions 1, 3, and 5

SE	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9.002	2	4.501	14.913	0.000

The ANOVA results revealed a significant difference in students' academic self-efficacy across the three time points (Sum of Squares = 9.002, $p < 0.001$). Post hoc Bonferroni-corrected comparisons (see Table 2) further pinpointed the source of this

difference: no significant change was observed between sessions 1 and 3, whereas a significant decline occurred from session 3 to session 5. This decrease may be explained by students' growing awareness of the increasing difficulty and cumulative nature of the course content, which likely prompted a reassessment of their self-efficacy beliefs. This trend is consistent with Zimmerman and Schunk (2011) findings that academic self-efficacy fluctuates in response to perceived task complexity and self-appraisal of performance.

Table 2
Post hoc bonferroni-corrected comparisons of academic self-efficacy scores across sessions 1, 3, and 5

(I) Session	(J) Session	Mean Difference (I-J)	Sig.	95% Confidence Interval	
1	3	0.005	1.000	-0.200	0.211
	5	0.406*	0.000	0.200	0.612
3	1	-0.005	1.000	-0.211	0.200
	5	0.401*	0.000	0.195	0.606
5	1	-0.406*	0.000	-0.612	-0.200
	3	-0.401*	0.000	-0.606	-0.195

Note. * The mean difference is significant at the 0.05 level.

In addition, to assess whether students' learning performance significantly changed over the course of the 5E-based flipped classroom intervention, we conducted repeated measures ANOVAs on scores from the Kahoot quizzes (see Table 3) and the post-session quizzes (see Table 5) across Sessions 1 through 5 (Mean_KH_1 to Mean_KH_5; Mean_PT_1 to Mean_PT_5).

Table 3
Repeated measures ANOVA results for kahoot quiz scores across sessions 1 to 5

KH	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.652	4	0.413	9.957	0.000

The ANOVA results for Kahoot quiz scores across sessions 1 to 5 were statistically significant (Sum of Squares = 1.652, $p < 0.001$), indicating notable variation in students' learning performance over time. Post hoc Bonferroni-corrected comparisons (see Table 4) further revealed that scores were significantly higher in sessions 1 and 5, while performance in sessions 2, 3, and 4 was comparatively lower. This pattern may reflect differences in content complexity across sessions. In particular, sessions 2 to 4 may have introduced more abstract or unfamiliar material, leading to a temporary decline in performance before consolidation occurred in session 5.

Table 4
Post hoc bonferroni-corrected comparisons of kahoot quiz scores across sessions 1 to 5

(I) Group 2	(J) Group 2	Mean Difference (I-J)	Sig.	95% Confidence Interval	
1	2	0.160*	0.000	0.071	0.250
	3	0.157*	0.000	0.067	0.246
	4	0.130*	0.000	0.041	0.219
	5	0.054	0.899	-0.036	0.143
2	1	-0.160*	0.000	-0.250	-0.071
	3	-0.004	1.000	-0.093	0.085
	4	-0.030	1.000	-0.120	0.059
	5	-0.107*	0.008	-0.196	-0.018
3	1	-0.157*	0.000	-0.246	-0.067
	2	0.004	1.000	-0.085	0.093
	4	-0.026	1.000	-0.116	0.063
	5	-0.103*	0.012	-0.192	-0.014
4	1	-0.130*	0.000	-0.219	-0.041
	2	0.030	1.000	-0.059	0.120
	3	0.026	1.000	-0.063	0.116
	5	-0.076	0.161	-0.166	0.013
5	1	-0.054	0.899	-0.143	0.036
	2	0.107*	0.008	0.018	0.196
	3	0.103*	0.012	0.014	0.192
	4	0.076	0.161	-0.013	0.166

Note. * The mean difference is significant at the 0.05 level.

Table 5
Repeated measures ANOVA results for post-session quiz scores across sessions 1 to 5

PT	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.305	4	1.076	34.845	0.000

The ANOVA results for post-session quiz scores across sessions 1 to 5 revealed a significant effect (Sum of Squares = 4.305, $p < 0.001$), indicating substantial variation in students' learning performance over time. Post hoc Bonferroni-corrected comparisons (see Table 6) showed that scores in Sessions 1, 2, and 5 were statistically comparable. Notably, performance in Session 3 increased significantly compared to the previous session, while scores in Session 4 were significantly lower than those at all other time points.

This fluctuation in performance can be attributed to the concept of cognitive disequilibrium (Posner & Strike, 1992), a mechanism in cognitive development theory. According to this theory, when learners encounter new, challenging content or phenomena that cannot be readily explained by their existing knowledge structures, they often experience discomfort, confusion, and a temporary decline in performance. However, such dissonance can serve as a catalyst for cognitive restructuring and deeper learning. The observed performance fluctuations across the five sessions may thus reflect this process, suggesting that students eventually integrated the newly acquired knowledge following a period of conceptual reorganization.

Table 6
Post hoc bonferroni-corrected comparisons of post-session quiz scores across sessions 1 to 5

(I) Group 2	(J) Group 2	Mean Difference (I-J)	Sig.	95% Confidence Interval	
1	2	0.054	0.495	-0.023	0.131
	3	-0.149*	0.000	-0.226	-0.072
	4	0.156*	0.000	0.079	0.233
	5	-0.052	0.594	-0.129	0.025
2	1	-0.054	0.495	-0.131	0.023
	3	-0.202*	0.000	-0.279	-0.125
	4	0.102*	0.002	0.025	0.179
	5	-0.105*	0.001	-0.182	-0.028
3	1	0.149*	0.000	0.072	0.226
	2	0.202*	0.000	0.125	0.279
	4	0.304*	0.000	0.227	0.381
	5	0.097*	0.004	0.020	0.174
4	1	-0.156*	0.000	-0.233	-0.079
	2	-0.102*	0.002	-0.179	-0.025
	3	-0.304*	0.000	-0.381	-0.227
	5	-0.207*	0.000	-0.284	-0.130
5	1	0.052	0.594	-0.025	0.129
	2	0.105*	0.001	0.028	0.182
	3	-0.097*	0.004	-0.174	-0.020
	4	0.207*	0.000	0.130	0.284

Note. * The mean difference is significant at the 0.05 level

To investigate potential predictors of students' learning performance and academic self-efficacy, we conducted correlation and regression analyses. The results of the correlation analysis among all variables are presented in Table 7.

Table 7
Correlation matrix of all variables

Correlations	EB_PJ	EB_JS	EB_JA	AM_HS	AM_FF	SE	KH	PT
EB_PJ	1							
EB_JS	-0.088	1						
EB_JA	-0.112	0	1					
AM_HS	-0.082	0.155	-0.113	1				
AM_FF	0.17	-0.107	0.119	-0.256*	1			
SE	-0.026	0.264*	-0.014	0.208	-0.310**	1		
KH	-0.061	-0.133	-0.18	0.092	-0.041	0.146	1	
PT	-0.103	0.049	-0.029	0.252*	-0.212	0.214	0.482**	1

Note. The full name of each variable and the explanation for p (* $p < 0.05$, ** $p < 0.01$):

EB_PJ, Pre-Test - Epistemological beliefs (Personal justification); EB_JS, Pre-Test - Epistemological beliefs (Justification by multiple sources); EB_JA, Pre-Test - Epistemological beliefs (Justification by authority); AM_HS, Pre-Test - Achievement motivation - Hope for success; AM_FF, Pre-Test - Achievement motivation - Fear of failure; SE, Academic self-efficacy over all sessions; KH, Average performance in

Kahoot quiz (declarative knowledge) over all sessions; PT, Average performance in post-session quiz (application-oriented knowledge) over all sessions.

Based on the results, only a few significant correlations were observed among the variables. The correlation between EB_JS and SE was 0.264, indicating a weak positive relationship between students' epistemological beliefs (justification by multiple sources) and their academic self-efficacy prior to the sessions. A stronger and statistically significant negative correlation was found between AM_FF and SE (r = -0.310), suggesting that students with a higher fear of failure tend to report lower academic self-efficacy. Additionally, the correlation between KH and PT was 0.482, reflecting a moderate and highly significant positive association between students' mastery of declarative knowledge and application-oriented knowledge.

Subsequently, we conducted a series of multiple linear regression analyses with epistemological beliefs and achievement motivation as independent variables, and academic self-efficacy and learning performance as dependent variables. The results are summarized as follows.

In Model 1 (Epistemological Beliefs → Academic Self-Efficacy), $R^2 = 0.073$, indicating that epistemological beliefs accounted for 7.3% of the variance in academic self-efficacy (See Table 8). The Durbin-Watson statistic was 2.087, suggesting no autocorrelation in the residuals. All predictor variables had VIF values close to 1.0 (VIF < 5), indicating the absence of multicollinearity. The standardized regression coefficients were: B-EB_PJ = 0.002, B-EB_JS = 0.176, and B-EB_JA = 0.029. Among these, only B-EB_JS was statistically significant (p = 0.016), suggesting that epistemological beliefs (justification by multiple sources) have a positive and significant effect on academic self-efficacy.

Table 8
Multiple linear regression results for model 1: Epistemological beliefs predicting academic self-efficacy

Model 1	Standardized Coefficients			Collinearity Statistics	
Predictors	B	t	p	Tolerance	VIF
(Constant)	1.664	3.007	0.004		
EB_PJ	0.002	0.042	0.967	0.973	1.028
EB_JS	0.176	2.468	0.016	0.925	1.081
EB_JA	0.029	0.488	0.627	0.920	1.087

Note. Dependent Variable: SE. Predictors: (Constant), EB_PJ, EB_JS, EB_JA.

In Model 2 (Epistemological Beliefs → Average Kahoot Quiz Performance [Declarative Knowledge]), $R^2 = 0.077$, indicating that epistemological beliefs explained 7.7% of the variance in students' average Kahoot quiz scores (See Table 9). The Durbin-Watson statistic was 2.291, suggesting no autocorrelation in the residuals. VIF values were all close to 1.0 (VIF < 5), confirming the absence of multicollinearity. The standardized coefficients were: B-EB_PJ = -0.017, B-EB_JS = -0.040, and B-EB_JA = -0.040, with only B-EB_JA reaching statistical significance (p = 0.035), indicating that

epistemological beliefs (justification by authority) have a significant negative effect on students' declarative knowledge performance.

Table 9
Multiple linear regression results for model 2: Epistemological beliefs predicting average kahoot quiz performance

Model 2	Standardized Coefficients			Collinearity Statistics	
Predictors	B	t	p	Tolerance	VIF
(Constant)	0.989	5.79	0.000		
EB_PJ	-0.017	-0.964	0.338	0.973	1.028
EB_JS	-0.040	-1.805	0.075	0.925	1.081
EB_JA	-0.040	-2.151	0.035	0.920	1.087

Note. Dependent Variable: KH. Predictors: (Constant), EB_PJ, EB_JS, EB_JA.

In Model 3 (Achievement Motivation → Academic Self-Efficacy), $R^2 = 0.114$, showing that achievement motivation explained 11.4% of the variance in academic self-efficacy (See Table 10). The Durbin-Watson statistic was 2.235, suggesting no autocorrelation in the residuals. All VIF values were around 1.0, confirming the absence of multicollinearity among predictors. The standardized coefficients were: B-AM_HS = 0.133 and B-AM_FF = -0.199, with only B-AM_FF reaching statistical significance (p = 0.014), suggesting that achievement motivation (fear of failure) negatively and significantly impacts students' academic self-efficacy.

Table 10
Multiple linear regression results for model 3: Achievement motivation predicting academic self-efficacy

Model 3	Standardized Coefficients			Collinearity Statistics	
Predictors	B	t	p	Tolerance	VIF
(Constant)	2.870	7.239	0.000		
AM_FF	-0.199	-2.52	0.014	0.934	1.070
AM_HS	0.133	1.269	0.208	0.934	1.070

Note. Dependent Variable: SE. Predictors: (Constant), AM_FF, AM_HS.

DISSCUSSION AND CONCLUSION

This study demonstrated that epistemological beliefs significantly influence students' academic self-efficacy and, to a lesser extent, their learning performance in a 5E-based flipped classroom. Among achievement motivation factors, fear of failure emerged as a significant negative predictor of academic self-efficacy. Students who held more sophisticated epistemological beliefs generally reported higher self-efficacy, suggesting that such beliefs may foster greater confidence in managing academic tasks. However, the relationship between epistemological beliefs and learning performance proved more complex. Notably, the belief in justification by authority negatively predicted performance on Kahoot quizzes, implying that deference to authority may hinder the acquisition of declarative knowledge.

This finding aligns with Bråten et al. (2014), who argued that justification beliefs influence academic performance indirectly via self-efficacy. Nevertheless, the observed negative association between justification by authority and post-session quiz scores presents a paradox. One plausible explanation is that overreliance on authority figures may impede the development of independent reasoning skills. Prior research has indicated that strong adherence to justification by authority can undermine students' use of scientific thinking (Klopp et al., 2023). Moreover, the generally weak correlations between epistemological beliefs and performance suggest that learning outcomes are shaped by a broader constellation of factors. For example, Muis et al. (2006) highlighted the dynamic interplay between cognitive and motivational variables, while Greene et al. (2010) emphasized the moderating roles of self-regulation and perceptions of the learning environment. These findings support the interpretation that justification by authority may inhibit deep learning by discouraging critical engagement with knowledge (Bråten & Strømsø, 2010).

Given these insights, future research should explore how epistemological beliefs interact with factors such as motivation and self-regulation to influence academic outcomes. Such work could yield a more nuanced understanding of how students' beliefs about knowledge shape their engagement and performance in learning environments.

In terms of achievement motivation, fear of failure significantly and negatively impacted academic self-efficacy. Furthermore, this result echoes prior findings linking fear of failure with lower academic satisfaction, diminished self-esteem, and reduced overall well-being (Giel et al., 2020). The negative impact of fear of failure on academic self-efficacy may stem from cognitive avoidance behaviors such as reduced risk-taking or an unwillingness to engage in challenging tasks. Such behaviors are particularly detrimental in inquiry-driven settings, like a 5E-based flipped classroom. In addition, the absence of a direct link to learning performance may stem from constrained generalizability due to sample size (n = 83) and sample homogeneity (all students from the same institution and majoring in social sciences).

Overall, this study highlights the relevance of epistemological beliefs and achievement motivation in shaping students' learning performance and academic self-efficacy in a 5E-based flipped classroom. By focusing on a social science context, it extends existing research predominantly centered on STEM fields, demonstrating the broader applicability of the 5E instructional model. Future studies should replicate these findings with larger, more diverse samples across disciplines to improve generalizability. Taken together, the results provide valuable insights for both educational research and pedagogical practice in flipped classroom settings.

LIMITATIONS

Several limitations of the present study warrant consideration. First, the sample size was relatively small (n = 83) and drawn from a single university in Germany within the social sciences, which limits the generalizability of the findings across broader populations, different cultural contexts, and other academic disciplines. Second, the

intervention spanned a relatively short duration (10 weeks) and focused on a single course, constraining the study's ability to capture the long-term effects of a 5E-based flipped classroom on students' learning trajectories. Finally, although the statistical analyses revealed significant associations among key variables, the correlational nature of the design precludes causal inferences.

Based on these findings, we offer several recommendations for practice and future research. First, instructors designing flipped classrooms should employ structured frameworks, such as the 5E model, to ensure implementation fidelity and enhance students' academic self-efficacy and achievement motivation. Second, professional development programs should explicitly target teachers' epistemological beliefs, as these beliefs shape how educators enact digital and inquiry-based pedagogies in the classroom. Third, for future research, scholars should recruit larger and more diverse samples, adopt longitudinal designs, and integrate mixed-method approaches to examine the long-term impacts of 5E-based flipped instruction and clarify the mechanisms linking epistemological beliefs, motivation, and learning outcomes.

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