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The role of students' epistemic beliefs for their argumentation performance in higher education

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ABSTRACT

Students' argumentation performance can be influenced by their epistemic beliefs, however, in the context of argumentative essay writing and argumentative peer feedback in online setting this has not been clearly investigated. This study explores relationship between students' epistemic beliefs and argumentation performance regarding essay writing and peer feedback. In total, 101 undergraduate students filled out the epistemic beliefs survey and wrote an argumentative essay. Then, they provided two sets of feedback on the essays of their peers and finally submitted their revised essays. Students' beliefs about the Internet-specific justification of knowledge did not play a significant role in their argumentation performance in essay writing, while it was related to their constructive peer feedback performance. Students' beliefs about the nature of scientific knowledge were significantly related to their argumentative essay writing and peer feedback performance. In terms of uptake of peer feedback, no significant role was found for epistemic beliefs.

Introduction

Argumentation is an integral part of knowledge-based reasoning in higher education (Baytelman et al., 2020). Argumentation plays a critical role when students deal with scientific controversial issues (Toulmin, 1958). Students as academic arguers, not only should be critical with providing evidence, but also they should acknowledge multiplicity to be able to change and adapt their minds (Ferretti & Graham, 2019). Prior studies have shown that students can expand their way of thinking and improve their critical thinking skills through argumentation practices (Clark et al., 2003). A good argumentation includes defending the claims of one's own position, evaluating and responding to the counter-arguments of the opponents, and making a conclusion (Noroozi et al., 2016a; Toulmin, 1958; Valero Haro et al., 2022). Higher education students, usually, practice argumentation skills through different learning activities in which writing argumentative essays and engaging in argumentative peer feedback processes are the two important learning activities to improve argumentation competence (Latifi et al., 2020, 2021).

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Argumentative essay writing is one of the common writing genres within higher education context that contributes to students' learning (Latifi & Noroozi, 2021; Liunokas, 2020). In the argumentative essay writing process, students practice argumentation skills by writing an introduction on the controversial topic, claiming a position, writing arguments in favour of the taken position, providing scientific facts to support their arguments, considering possible counter-arguments, and making a conclusion on the topic (Noroozi et al., 2016a; Toulmin, 1958). Such writing requires students to get through a high-level of cognitive processing where they should recall their prior knowledge on the scientific controversial topic, investigate the topic, take a position, and use higher-order thinking skills such as analysis, elaboration, justification, evaluation, and critical reasoning to conclude the argumentative topic (Noroozi et al., 2016a).

Peer feedback is another effective learning strategy that can be used for students' argumentation-based learning especially in classes with a large cohort of students where educators cannot effectively support students' argumentation with feedback due to high workload (Huisman et al., 2018; Latifi et al., 2021; Noroozi & Hatami, 2019). Peer feedback is defined as a learning activity where students are asked to critically review their peers' work, assess the quality, identify gaps and problems, think about possible solutions to fill the gaps and solve problems, and finally provide their peers with all those information in an emotionally friendly atmosphere (Carless & Boud, 2018; Topping, 2009). Engaging in such high-level learning activity requires students to have high-level cognitive and critical thinking skills (E. Z. F. Liu & Lin, 2007), and those skills are critical to performing high-quality argumentative peer feedback (Latifi & Noroozi, 2021; Panadero & Alqassab, 2019).

Scientific literature suggests that students' argumentation performance in essay writing and peer feedback can be affected by their epistemic beliefs and how they perceive knowledge (Noroozi et al., 2016b). Epistemic beliefs generally refer to one's beliefs about the nature and structure of knowledge (Hofer & Pintrich, 1997). In the context of education, epistemic beliefs explain how students approach education and learning (Muis et al., 2006). Epistemic beliefs entail different dimensions and differ from one person to another (Hofer & Pintrich, 1997; Kuhn et al., 2000). Kuhn et al. (2000) suggested three dimensions for epistemic beliefs including absolutist, multiplist, and evaluativist. Students with absolutist beliefs conceive knowledge as an absolute fact, while students with multiplist beliefs are sceptical about the certainty of knowledge and believe that different opinions can be equally valid. Similarly, evaluativists deny absoluteness of knowledge, however, acknowledge criteria for judging which perception is better than the other one (Kuhn et al., 2000; Noroozi, 2018). Hofer and Pintrich (1997) categorise the nature of knowledge into two dimensions including simplicity (ranging from simple facts to highly complex concepts) and certainty (ranging from unchanging nature of knowledge to evolving nature of knowledge).

What can be understood here is that not all students have the same understanding and justification of knowledge. Students with different perceptions of knowledge respond differently to argumentative issues in scientific disciplines (Cheng et al., 2021). For example, it might be an intellectual question for a student

with the the absolutist perspective that 'Is there a point to argue?' (Baytelman et al., 2020, p. 1201) since there is only one certain fact. Over the years, a growing body of research has focused on the relationship between epistemic beliefs and argumentation (Baytelman et al., 2020; Noroozi, 2018; Nussbaum et al., 2008). Studies have found that students with more sophisticated epistemic beliefs generate arguments of higher quality than students with less sophisticated epistemic beliefs (Baytelman et al., 2020). Nussbaum et al. (2008) found that students with multiplist epistemic beliefs are less critical in their argumentation, while students with evaluativist epistemic beliefs are more critical and produce more different arguments.

Most of the previous works in this area of research have focused on the relationship between epistemic beliefs and students' level of argumentation during collaborative learning activities (Baytelman et al., 2020; Nussbaum et al., 2008). Little work has been done so far to explore the role of epistemic beliefs in students' argumentation performance in essay writing and peer feedback within the online learning context in higher education (Noroozi & Hatami, 2019). As a consequence, it has remained an open question how students' epistemic beliefs influence their argumentation performance in essay writing and peer feedback. It is not clearly known yet in the literature how similarly or differently students perform with relativist beliefs (Quine & Sugden, 1984) compared to students with absolutist beliefs (Quine & Sugden, 1984) regarding their argumentative essay writing and peer feedback. For example, in the case of peer feedback uptake, students with absolutist beliefs may not be open to accepting the comments from peers and revising their work since they persist in their own arguments as one true fact (Noroozi & Hatami, 2019). While for being a good arguer it is necessary to be fluid, flexible in adapting mind, and acknowledging the multiplicity (Ferretti & Graham, 2019). This has become more crucial to study as its implementation takes place in the context of online learning where there is an opportunity for anonymous argumentation performance where students could provide argumentative peer feedback without being identified. Such differences of epistemic beliefs can influence students' level of criticism and also avoid emotional responses from the feedback receiver (Aghaee & Hansson, 2013; Coté, 2014).

In addition, today, the use of the Internet for education in different disciplines is increasing to a large extent (Bråten et al., 2019). The Internet gives access to a huge amount of data and information with different levels of qualities from different types of sources (Lu & Yuan, 2011). This variation of knowledge on the Internet can lead to a different understanding of the subject (Y. C. Liu & Huang, 2017). Studies have shown that there are different preferences in terms of using the Internet as a source of knowledge. For example, while some prefer using relational information (more organised and structured), some others prefer using non-relational information (Lu & Yuan, 2011). Now, students use the Internet as a source of knowledge to generate arguments and counter-arguments for essay writing and also for providing feedback (Cheng et al., 2021). This raises a need for considering students' beliefs about the justification of knowledge received from the Internet as well (Bråten et al., 2019; Cheng et al., 2021). There is a lack of research regarding the effects of students' epistemic beliefs about the Internet-specific justification of knowledge on argumentative essay writing and argumentative peer feedback. Inspired by this, this study attempts to

address the role of students' epistemic beliefs for their argumentative essay writing and argumentative peer feedback performance and uptake. Following research questions are formulated to guide this study.

RQ1: To what extent do students' epistemic beliefs impact their argumentative essay writing performance?

RQ2: To what extent do students' epistemic beliefs impact their argumentative peer feedback performance?

RQ3: To what extent do students' epistemic beliefs impact their uptake of argumentative peer feedback in the revised essay?

Materials and methods

Participants

This exploratory study took place at Wageningen University and Research, the Netherlands. As a part of a bigger project, 101 undergraduate students (Female = 70, 69%, Male = 31, 31%) the Environmental Sciences domain participated in this study. To comply with ethical considerations, students received information about the research set-up of the study. Students were informed that their data will be collected, de-identified and their confidentiality will be maintained during the research and publication of the results. Also, an ethical approval from the Social Sciences Ethics Committee at Wageningen University and Research has been received.

Context and procedure

In this study, we designed an online module called 'Argumentative Essay Writing' and embedded that through the FeedbackFruits tool within the Brightspace platform for the regulation of argumentative activities. The module was composed of three main tasks followed in three consecutive weeks. In week one, instructions about the online module including information about the structure of the module, details on the required tasks, important deadlines, notes, and information about the research set-up of the module were provided for students. In addition, students also filled out the epistemic beliefs survey and wrote an argumentative essay on one of the provided topics including (a) the long-term impacts of Covid-19 on the environment, (b) the role of private actors in funding local and global biodiversity, and (c) bans on the use of single-use plastics. In week two, students provided two sets of feedback on their peers' essays based on the rubric provided for students in FeedbackFruits (see, Table 1). In week three, students revised their original essay based on the feedback received from peers. The length for argumentative essay writing was 600 to 800 words excluding references. For argumentative peer feedback, it was 30 to 50 words for each section of the argumentative essay writing. These number of words have been suggested through panel of experts and also teachers of the respected courses.

Table 1. Online argumentative peer feedback rubric.

Argumentative essay elements	Argumentative essay checker question prompt
Introduction on the topic	To what extent did your peer present a clear introduction on the topic in terms of motivation, importance, and the societal aspect of the issue at hand? What are your suggestions? Please explain.
Taking a position on the topic	To what extent did your peer present a clear position on the topic in favour or against the topic? What are your suggestions? Please explain.
Arguments for the position	To what extent did your peer provide arguments in favour of her/his own position on the topic? What are your suggestions? Please explain.
Justifications for arguments for the position	To what extent did your peer provide justifications (facts, evidence, examples, figures, experiences, etc.) for arguments in favour of her/his position? What are your suggestions? Please explain.
Arguments against the position (counter-arguments)	To what extent did your peer provide arguments against her/his position (counter-arguments) on the topic? What are your suggestions? Please explain.
Justifications for arguments against the position	To what extent did your peer provide justifications (facts, evidence, examples, figures, experiences, etc.) for arguments against her/his own position? What are your suggestions? Please explain.
Response to counter-arguments	To what extent did your peer respond (using justified arguments) to various counter-arguments against her/his position? What are your suggestions? Please explain.
Conclusion and implications	To what extent did your peer come to a conclusion (restating her/his position) followed by a clear implication (suggestion and/or plan of action) for the position? What are your suggestions? Please explain.

Measurements

Students' epistemic beliefs

Students' epistemic beliefs were assessed through Cheng et al. (2021) questionnaire. This questionnaire is an adjusted version of epistemic beliefs about the Internet-specific justification of knowledge questionnaire (Bråten et al., 2019) and the nature of scientific knowledge questionnaire (Conley et al., 2004). The Internet-specific justification of knowledge means how a person perceives knowledge received from the Internet (e.g. web-pages, blogs, and wikis) as a source of knowledge (Bråten et al., 2019). Students' Internet-specific justification of knowledge was measured in three categories including (a) personal justification (4 items), (b) justification by authority (4 items), and (c) justification by multiple sources (4 items). Personal justification means that one relies on his/her own personal views, opinions, and cognitive sources (i.e. knowledge and reasoning) when he/she uses the Internet as the source of knowledge. The justification by authority means that one believes that the received knowledge from the Internet needs to be authorised by an expert or a competent user. Students with justification by multiple sources' beliefs imply that they prefer to receive knowledge from the Internet from different sources in order to use it (Cheng et al., 2021). The higher score for each dimension is an indication of one's belief about the Internet-specific justification of knowledge. Students' beliefs about the nature of scientific knowledge include two dimensions (a) certainty of knowledge (6 items) and (b) development of knowledge (6 items). Certainty of knowledge indicates that one believes that knowledge is a certain, true, and absolute fact that there is only one answer for scientific questions. While one with development of knowledge beliefs state that knowledge has an evolving nature, there is no certain and absolute answer for scientific questions, and our perception of knowledge can evolve and differ as time goes by (Conley et al., 2004). The higher score for each dimension is an indication of one's belief about the nature of scientific knowledge (Cheng et al., 2021). All items of this

questionnaire were rated on a five-point Likert scale ranging from strongly disagree (1) to strongly disagree (5). This questionnaire has been used and validated by some prior studies (Bråten et al., 2019; Kammerer et al., 2021).

Students' argumentative essay writing performance

For measuring students' argumentative essay writing performance, an adjusted coding scheme based on Noroozi et al. (2016a) study was used. This coding scheme contains eight elements including (1) introduction on the topic, (2) taking a position on the topic, (3) arguments for the position, (4) justifications for arguments for the position, (5) arguments against the position (counter-arguments), (6) justifications for arguments against the position, (7) response to counter-arguments, and (8) Conclusion and implications. Each element was scored from 0 points (not mentioned at all) to 3 points (mentioned with the highest quality). All points are summed up together for one's argumentative essay writing performance. Differences between the quality of the argumentative essay in the original draft and the revised draft determined the progress students made in argumentative essay writing. Two coders coded the data and the Cohen's kappa coefficient analysis was used to measure the inter-rater reliability between the coders. There was a reliable agreement between the coders (*Kappa = 0.70, p < 0.01*).

Students' argumentative peer feedback performance

For measuring students' argumentative peer feedback performance, a coding scheme was designed by the authors based on the literature mainly Nelson and Schunn (2009), Patchan et al. (2016), and Wu and Schunn (2020). This coding scheme entailed three main categories including affective (emotional responses and critical-emotional responses), cognitive (description, identification, and justification), and constructive dimensions (improvement and feedback-feedforward type). The coding scheme was scored from 0 points (poor) to 2 points (good) for each category. All points were summed up together and determined the quality of argumentative peer feedback performance (see, Table 1). Since, each student provided and received two sets of peer feedback, the mean score of both peer feedback was identified as the quality of argumentative peer feedback performance for each student. For coding analysis, the same two coders participated and the Cohen's kappa coefficient results for inter-rater reliability among coders was significant (*Kappa = 0.60, p < 0.01*).

Analysis

As the purpose of this study was to explore the relationship between epistemic beliefs and argumentation performance and to see to what extent do students' epistemic beliefs predict their argumentation performance in online learning contexts, Pearson's correlation, and multiple regression tests were used. The multiple regression method was used to measure the effect of several independent variables on a dependent variable. Performing such regression analysis allowed for determining independent variables that have greater impact on the dependent variables, and predicting the influential factors more accurately. But before performing multiple regression analysis, the assumptions of using this test were examined to ensure the eligibility of the analysis. The assumptions of a linear relationship between the

outcome variables and the independent variables were supported using the scatterplots. The normality of residuals was supported by the Kolmogorov-Smirnov test. Also, VIF values were 2.01 for predictors, which was much lower than the cut-off score (i.e. 10), indicating that there is no multicollinearity problem.

Results

RQ1: To what extent do students' epistemic beliefs impact their argumentative essay writing performance?

Students' justification by authority for the knowledge received from the Internet was positively correlated to their overall argumentative essay performance ($r = 0.243$, $p < 0.05$). For the nature of scientific knowledge, the certainty of knowledge beliefs was negatively correlated to students' justification for arguments against the position ($r = -0.282$, $p < 0.05$) and their overall argumentative essay performance ($r = -0.239$, $p < 0.05$). The development of knowledge beliefs was positively correlated to students' overall argumentative essay performance ($r = 0.268$, $p < 0.05$; Table 2). Also, the results of multiple linear regression showed that students' epistemic beliefs about the nature of scientific knowledge could predict their overall argumentation performance in essay writing ($F(3,74 = 3.49$, $p < 0.05$).

RQ2: To what extent do students' epistemic beliefs impact their argumentative peer feedback performance?

Students' personal justification of the knowledge received from the Internet and justification by multiple sources were positively correlated to their constructive argumentative peer feedback performance ($r = 0.250$, $p < 0.05$; $r = 0.227$, $p < 0.05$). In contrast, the constructive argumentative per feedback performance of students was negatively correlated with their certainty beliefs about the nature of knowledge ($r = -0.284$, $p < 0.05$). Students' beliefs in the development nature of knowledge were positively correlated to their argumentative peer feedback performance in the identification of the problem ($r = -0.318$, $p < 0.01$; Table 3). Results also showed that students' epistemic beliefs about the nature of scientific knowledge could predict their argumentative peer feedback performance in identification of the problems in peers' essays ($F(2,73) = 4.56$, $p < 0.05$) and in providing constructive feedback for peers ($F(2,73) = 3.52$, $p < 0.05$)

RQ3: To what extent do students' epistemic beliefs impact their uptake of argumentative peer feedback in the revised essay?

Table 2. The correlations between students' epistemic beliefs and argumentative essay writing performance.

	Intro.	Posit.	Argu fav.	Just fav.	Argu agai.	Just agai.	Res argue agai,	Conc.	Overall
Personal	−0.012	0.005	−0.043	−0.001	0.112	−0.001	0.018	0.125	0.108
Authority	−0.003	0.124	0.200	0.098	0.132	0.116	0.001	0.222	**0.243***
Multiple	−0.006	0.049	0.038	−0.160	0.155	0.072	0.088	0.034	0074
Certainty	0.015	−0.020	−0.086	−0.137	−0.180	**−0.282***	−0.059	−0.042	**−0.239***
Develop.	0.004	0.113	0.180	0.180	0.145	0.208	0.018	0.071	**0.268***

($P < 0.01$)**, ($P < 0.05$)*

Table 3. The correlations between students' epistemic beliefs and argumentative peer feedback performance.

	Affective	Description	Identification	Justification	Constructive
Personal	0.135	0.063	−0.101	−0.041	**0.250***
Authority	−0.060	−0.113	0.013	0.002	−0.019
Multiple	−0.089	−0.090	0.137	−0.005	**0.227***
Certainty	−0.012	−0.020	−0.082	−0.018	**−0.284***
Development	−0.092	−0.189	**0.318****	−0.029	0.221

$(P < 0.01)$**, $(P < 0.05)$*

Table 4. The correlations between students' epistemic beliefs and uptake of argumentative peer feedback in the revised essay.

	Intro. Upt	Posit. Upt	Argu fav. Upt	Just fav. Upt	Argu agai. Upt	Just agai. Upt	Res argue agai. Upt	Con. Upt	Overall Upt
Personal	−0.045	−0.018	0.091	−0.002	−0.024	0.072	−0.129	0.098	0.008
Authority	0.036	0.004	−0.097	0.029	0.107	**0.236***	−0.048	−0.004	0.078
Multiple	0.001	0.153	−0.124	0.023	−0.182	0.026	−0.131	0.094	−0.008
Certainty	−0.067	−0.119	−0.010	0.078	−0.015	0.068	0.094	0.019	0.006
Develop.	0.156	0.071	−0.172	−0.149	−0.001	0.066	−0.155	0.030	−0.039

$(P < 0.01)$**, $(P < 0.05)$*

The results did not show any overall significant correlations between students' epistemic beliefs and their uptake of argumentative peer feedback in the revised essay. However, a positive correlation was reported between justification by authority and argumentative peer feedback uptake when they justified arguments against the position ($r = 0.236$, $p < 0.05$; Table 4). Furthermore, the results showed no significant role of students' epistemic beliefs about Internet-specific justification of knowledge and the nature of scientific knowledge in predicting the uptake of peer feedback in argumentative essay writing performance ($F(3,73) = 0.17$, $p = 0.91$; $F(2,74) = 0.06$, $p = 0.93$).

Discussions

Our findings revealed that there was a positive relationship between students who believed that the received knowledge from the Internet should be authorised with their argumentative essay writing. This finding means that the more students justify the Internet-specific knowledge by authority, the more they are expected to perform better in their argumentative essay writing. A possible reason to explain such finding is that in the context of higher education when students are asked to write an argumentative essay, validity, and authority of the argumentations and counter-argumentations are the key factors since as academic person they are expected to provide scientifically valid evidence to justify their argumentations and counter-arguments (Cheng et al., 2021; Noroozi, 2018). Therefore, it is understandable why justification by authority can be positively correlated with argumentative essay writing. We also found that the more students believe that knowledge is certain, the less they were expected to perform high-quality argumentation performance in their essays, especially, in justification for counter-arguments. In contrast, the more students believe in the evolving nature of knowledge, the more they are expected to show a high level of performance in argumentative essays. Basically, a good argumentation requires students to accept that there is a point to argue

(Baytelman et al., 2020). If one believes that there is only one true answer, then this is unlikely to see the other side of the coin where one might speculate rebuttals for arguments. This means that to perform a high-quality argumentation, there should be an acknowledgement of different opinions (Kuhn et al., 2000). This finding can be supported by both theoretical and empirical findings (Baytelman et al., 2020; Cheng et al., 2021; Noroozi, 2018; Noroozi et al., 2016b; Nussbaum et al., 2008).

The findings also revealed students with more beliefs in the personal justification of the Internet-specific knowledge and justification of the Internet-specific knowledge by multiple sources, were expected to provide more constructive feedback. In terms of personal justification of knowledge, this finding did not align with our expectations and theoretical evidence, because, this is a scientific argumentation and we expected to see students with justification by authority beliefs provide more constructive feedback. However, prior studies support our findings for justification by multiple sources (Kuhn et al., 2000; Noroozi, 2018; Noroozi et al., 2016b). When students receive knowledge from different sources, they likely see knowledge from different points of view which helps them expand their way of thinking and possibly enables them to look at the controversial issue from different angles. This might result in providing more constructive comments. It was also found that the more one believes that knowledge is certain, the less she or he is expected to provide constructive feedback. This finding can also be justified by the argumentation theory and evidence as it was stated that to provide deeper argumentation it is necessary to accept the relativeness of the knowledge as it opens the door for discussion and seeing from different perspectives (Baytelman et al., 2020; Nussbaum et al., 2008). In such a situation, students are more able to suggest points for improvement.

Finally, the findings showed no role for epistemic beliefs in the uptake of argumentative peer feedback in the revised essay. This finding is not supported by the main body of literature (e.g. Noroozi, 2018; Noroozi & Hatami, 2019) as it was expected to see students' uptake of feedback is influenced by their epistemic beliefs. Because, for students who have absolutist beliefs there is only one true fact/right and it is expected that they are not very open to accepting different ideas (Baytelman et al., 2020; Kuhn et al., 2000; Quine & Sugden, 1984). A possible reason for this neutral finding could be related to the design and structure of the module and rubric of the argumentative peer feedback in this study. As students were provided with guidelines on how to provide argumentative feedback, this might cause an alleviation of the influence of students' epistemic beliefs on the uptake of feedback in the revised essay. This concern is also reported by some prior studies (Noroozi & Hatami, 2019).

Conclusion, limitations, and future studies

This study extends our understanding of how different epistemic beliefs can influence students' argumentation performance in essay writing and peer feedback. The findings of this study add value to educational practice. First, the more students use authorised knowledge on the Internet, the better performance is expected in their argumentative essay writing. Therefore, teachers should encourage students to pay attention to the source of used knowledge from the Internet whether it is authorised by an expert or not. This would imply that teachers can somehow give indications of grey and white sources to their students. Second, teachers should encourage students who believe in the

certainty of knowledge as an absolute fact to rethink or change their perceptions into a more developed nature of knowledge where knowledge is perceived as an evolving nature, in order to perform high-quality argumentative essay writing. Third, teachers can support students' argumentative peer feedback by providing multiple sources of knowledge as it was found that the knowledge that is justified from multiple sources is positively correlated to argumentative peer feedback performance. Finally, it was found that students are willing to uptake feedback which is perceived as authorised knowledge. Therefore, teachers should encourage students to provide authorisations such as references when they engage in peer feedback activities.

For future studies, as we speculated the alleviation role of the structure of argumentative peer feedback and textual guidelines in the impact of epistemic beliefs on argumentation performance, we suggest a follow-up study to explore to what extent this can impact students' argumentation performance. Due to such a small number of participants from one course, we cannot make any strong claim for higher education settings. We recommend conducting a follow-up study in different courses with a large number of participants to make more reliable and stronger claims.

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