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Gender differences in students' argumentative essay writing, peer review performance and uptake in online learning environments

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ABSTRACT

This study adopted a pre-test-post-test design to explore gender differences in argumentative essay writing and peer review performance and uptake within a higher education context. To do this, as part of a bigger project, 101 students were asked to individually write an argumentative essay, engage in peer review activities and revise their original essay based on the received reviews from peers. The findings showed that female students perform better than male students in argumentative essay writing in terms of taking a position on the topic. Gender differences were also found in peer review performance, where females provided better justifications for identified problems in peer review, more constructive reviews and higher quality peer review than males. The findings also revealed that although there was no gender difference in overall peer review uptake, females uptake of peer review resulted in improvement of their arguments against the position in the revised essay. These findings suggest that gender plays a significant role in argumentative essay writing, peer review performance and uptake of the received reviews from peers. Recommendations for future research along with how to deal with these gender differences in educational practice in online settings are provided based on the findings.

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Argumentative essay writing; peer review uptake; gender; higher education; online learning; peer review performance

Introduction

Argumentation is a critical competence for success in higher education (Prata et al., 2019). Higher education students need to have argumentation skills to argue about their positions regarding complex and controversial issues within their specific domain of expertise (Fan & Chen, 2021; Glassner, 2017; Lazarou et al., 2016). Argumentation skills empower students with high-cognitive and higher-order thinking skills to critically and logically argue, elaborate and integrate different perspectives on knowledge and reach a conclusion (Valero Haro et al., 2020). Even after higher education, argumentation skills still play a key role to enable fruitful participation and engagement in professional and societal debates (Heitmann et al., 2014).

Most higher education students practice their argumentation skills by writing argumentative texts (Latifi et al., 2020) which is the most common type of academic writing (Liunokas, 2020). Prior studies showed that argumentative essay writing contributes to learning more than other genres of writing (e.g. Klein & Boscolo, 2016). This could be due to the nature of argumentation which requires high-cognitive processing and higher-order thinking skills (Barak & Dori, 2009; Kuhn, 1992; Mokhtar et al., 2020). Writing a good argumentative essay involves students' highlevel cognitive processing (Medimorec & Risko, 2017; Mohsen, 2021). This means that to write an argumentative essay, students need to recall their prior knowledge regarding the topic, need to investigate for the new knowledge, need to elaborate and justify on the topic not only from his/ her own point of view but also as an opponent and finally analyze and evaluate the elaborated knowledge to formulate a conclusion or decision (Liunokas, 2020; Noroozi et al., 2016). This whole process can be seen as a complete and high-level learning process. According to the literature, a high-quality argumentative essay normally starts with an introduction on a topic, followed by standing a clear position on that topic and supporting the position with arguments and evidence. Then, counter-arguments with evidence to the original position and responses to the counter-arguments are presented. Finally, a good argumentative essay warps up with a conclusion and implications (Latifi, Noroozi, Hatami et al., 2021; Noroozi et al., 2016; Toulmin, 1958).

Engaging in high-quality peer review activities, as an effective instructional strategy, also depends on the argumentation skills of students especially in classes with a large cohort of students where teachers are facing with a high workload in providing feedback on each student' essay (Er et al., 2021; Latifi et al., 2021, 2020; Noroozi et al., 2016). Peer review is defined as an educational activity that helps students to assess the quality of learning partners' work (Xiong & Schunn, 2021). Prior studies showed that high-quality peer review requires solid argumentation and deep cognitive processing skills (King, 2002; Latifi, Noroozi, and Talaee, 2021). In peer review, it is expected from students to carefully read their peers' essay, critically review it, see and pay attention to the gaps in order to identify problems, reason why this is a problem to convince his/her peers and finally innovatively offer suggestions and solutions for further improvements (see Latifi, Noroozi, & Talaee, 2021; Lizzio & Wilson, 2008). This high-level educational activity cannot be done properly without deep argumentative skills and cognitive processing skills. That is to say that argumentation skills are one of crucial and integral element of successful peer review (Latifi, Noroozi, Hatami et al., 2021; Noroozi et al., 2013).

It has been argued that performing a solid argumentation in scientific essay writing and peer review performance is a challenging learning activity for most higher education students (Fan & Chen, 2021; Noroozi et al., 2013; 2020). Prior studies reported that the quality of students' argumentative essays and peer review is not highly satisfactory and most students struggle to argue with solid argumentation in their essays (e.g. Latifi, Noroozi, Hatami et al., 2021; Noroozi & Hatami, 2019; Valero Haro et al., 2020) and peer review (e.g. Latifi et al., 2020; Misiejuk et al., 2021; Wingate, 2012; Xiong & Schunn, 2021).

Scholars have identified different reasons as to why students perform a poor level of argumentation in their essays and peer review. First, students fail to argue solidly in essays due to the lack of knowledge on argumentation (Bacha, 2010; Latifi, Noroozi, Hatami et al., 2021). Second, students perform poorly in argumentative texts because writing a high-quality argumentative text requires complex cognitive skills to translate argumentation knowledge into an application (Noroozi et al., 2013, 2016). Third, students' limited domain-specific knowledge could also result in their failure in good essay writing (Valero Haro et al., 2020). For peer review, similarly, students' poor level of performance could be addressed by their limited domain-specific knowledge, lack of knowledge and experiences on how to provide an effective and high-quality peer review, validity and reliability issues about peer's competence in review and psychological and emotional issues which may occur when students deal with critical reviews for and from peers (Er et al., 2021; Gielen & De Wever, 2015; Latifi, Noroozi, Hatami et al., 2021; Li & Li, 2017; Noroozi et al., 2016; Tseng & Tsai, 2007).

Scientific evidence suggests that to address these issues, support should be provided for students (e.g. Chen, 2016; Latifi, Noroozi, Hatami et al., 2021, 2021; Law & Baer, 2020; Zhao, 2014). Such support

can be offered through online learning environments which allow students to engage in a desirable type of reviews from peers (Latifi et al., 2020; Noroozi et al., 2020). With specific elaborative and argumentative questions embedded in the online learning environments, we can quire students to provide arguments and also justifications for their peer review activities which in turn reduces shallow and surface types of reviews from peers on each others' works (see Noroozi et al., 2016). Prior studies revealed that such support is positively correlated with students' performance in peer review and argumentative writing (e.g. Latifi et al., 2021, 2020; Li et al., 2010; Noroozi et al., 2016, 2020).

Scientific evidence also confirms that students' argumentation and peer review performance could be influenced by their gender (Bastarrica & Simmonds, 2019; Nasri et al., 2018; Noroozi et al., 2020). Gender affect the way students think, argue and reflect (Asterhan et al., 2012; Tsemach & Zohar, 2021). The literature review surprisingly showed that findings are not consistent in terms of gender's effects on students' argumentation performance in essay writing and peer review (Asterhan, 2018; Bastarrica & Simmonds, 2019; Tsemach & Zohar, 2021). Asterhan et al. (2012) pointed out that gender differences matter in online argumentation, where female students are more collaborative in their argumentation and they are scored higher in their argumentation quality compared to male students. A study by Jeong and Davidson-Shivers (2006) showed that in a computer supported learning environment, females posted fewer rebuttals to the disagreements and challenges of females and males posted more rebuttals to the challenges of females. In another study, based on the data collected from the National Assessment of Educational Progress (NAEP), Reilly et al. (2019) stated that females perform better than males in writing performance in all grades. Similarly, Zhang et al. (2019) reported that female students outperformed male students in essay writing in online peer-assessment process. In the case of peer review, another study showed that female students are more willing to implement feedback than male students in an online peer review process (Wu & Schunn, 2020a). Bastarrica and Simmonds (2019) found that argumentative peer review does not differ significantly between male and female students in face-to-face education. In line with the previous study, Asterhan (2018) found that in-person classes, there are no consistent gender differences with respect to peer argumentation. While on the contrary, Erkens and Janssen (2008) found that in a computer supported learning environment, females communicate differently than males do: they use more affiliative language (responsive and argumentative dialoque acts), whereas males use more assertive language (informative and imperative dialogue acts). Likewise, Tsemach and Zohar (2021) found that female and male students differ in their in-person argumentation patterns. Findings from Noroozi et al. (2020) revealed that in online learning settings, female students provide deeper argumentative feedback compared to male students, while in argumentative essay writing, significant gender differences are not found. In contrast, Hamer et al. (2015) found that male students tend to give more specific and in-depth feedback than female students in face-to-face education. Further, Nasri et al. (2018) stated that in face-to-face education, female and male students make differential use of stance and engagement features in their argumentative written discourse. While female students used more hedges (e.g. possible, may, could), male students used more boosters (e.g. definitely, sure, absolutely). In another study, Yurdabakan (2011) also reported that female and male students differ in terms of their peer review for cooperative learning groups in which female students outperformed male students in face-to-face learning settings. Wu and Schunn (2020a) based on their findings suggested that males should get more support than females to better perform in peer feedback activities. In reverse, the findings of Langan et al. (2006) did not show any significant effects of gender on peer review in face-to-face education.

These complex and contradictory findings raise the need for further research and exploration on the role of gender in argumentative essay writing and peer review. There is also unclarity, regarding differences in male and female students when they uptake and implement the received reviews from learning peers (Wu & Schunn, 2020a). That is to say that although prior studies indicate that providing a supported online peer review tool helps with providing high-quality reviews (e.g. Latifi, Noroozi, Hatami et al., 2021, 2021; Law & Baer, 2020; Zhao, 2014), it does not say much about the extent to which male and female students differently or similarly uptake these reviews and feedback. Do

male and female students implement and uptake the received reviews in their revised essays in the same way or differently? In prior studies, influencing factors on uptake of the peer review have been investigated, such as the role of the design and nature of the peer review (Mercader et al., 2020; Nelson & Schunn, 2009), students feedback literacy (Carless & Boud, 2018) and students perception of peer review (Huisman et al., 2018; Wu & Schunn, 2020b), however, gender impacts on uptake of the peer review has not been explicitly considered in the literature (Wu & Schunn, 2020a). Furthermore, most prior studies on gender and argumentation have been related to argumentative discourse rather than argumentative essay writing (e.g. Asterhan, 2018; Asterhan et al., 2012; Erkens & Janssen, 2008; Jeong & Davidson-Shivers, 2006). More studies are required to further explore gender effects on students' argumentation, peer review performance and uptake of peer feedback in written contexts within online learning settings as our review revealed that most of the prior studies have been conducted in face-to-face learning settings (e.g. Asterhan, 2018; Hamer et al., 2015; Langan et al., 2006; Nasri et al., 2018; Yurdabakan, 2011). Studies have shown that there are differences in male and female students' adoption of online learning, motivation and satisfaction (Cuadrado-García et al., 2010). Female students compared to male students showed better self-monitoring and concentration in online learning settings (Marimuthu et al., 2013). In addition, in online learning settings there is an opportunity to argue and deliver peer review anonymously in which male and female students can perform without fear of embarrassment, shame, or emotional responses (Aghaee & Hansson, 2013; Coté, 2014). Also using active online tools can help male and female students to freely engage in a desirable argumentative peer review process at anytime and anyplace (Du et al., 2022; Noroozi et al., 2016). It is needed to explore gender differences in argumentative essay writing and peer review performance in online learning settings as it has not been adequately examined before. Therefore, this study was conducted to explore and address these issue by answering the following research questions and providing possible explanations for gender differences in the final section.

- RQ1. To what extent gender affects students' argumentative essay writing performance?
- RQ2. To what extent gender affects students' argumentative peer review performance?
- RQ3. To what extent gender affects students' uptake of peer review in argumentative essay writing performance?

Materials and methods

Participants and context

This experimental study is a part of a bigger project that took place at [University name omitted for review]. As a part of a bigger project, for this study, one course from Environmental Sciences domain was selected in which 135 undergraduate students participated. Among these students, 101 students have completed the module, and their data were considered for this study. About 69% of participants were female (N = 70) and 31% of participants were male (N = 31). To comply with ethical considerations, participants were informed about the research setup of the courses. All participants were notified that data will be collected for research purposes and will be used anonymously, and no one can link findings to any individual participants. Nonetheless, participants were given a choice to quit the study or request for immediate omitting of their collected data; however, none of the students declined participation. Furthermore, ethical approval from the Social Sciences Ethics Committee was obtained for this study.

Procedure

To run this study, a course module called "Argumentative Essay Writing" was designed and embedded in the course within the Brightspace platform. The module was followed by the students in three consecutive weeks and for each week they were asked to complete specified tasks. In the first week, students

were provided with introductory instructions on how to write an argumentative essay, they were asked to fill out an online survey about their demographic data and write an argumentative essay in English on one of the three 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. The topics were selected by the course teacher based on the given criteria including that the topic had to be controversial and rather new in the field of environmental economics and environmental policy. We considered the first draft of the essay as the pre-test. In the second week, students were asked to review two of their peers' argumentative essays and provide comments on them (30–50 words for each argumentation element – see next section) on peers' essay performance based on the given criteria embedded in the FeedbackFruits app within the Brightspace platform. In the third week, students were asked to revise their essays according to the two review sets they received from their learning peers and submit the revised version of the essay on the platform. We considered the second draft of the essay as the post-test. The design of the study is presented in Figure 1.

Materials and instruments

Brightspace was used as an online learning platform to run this study. This learning management system (LMS) allows teachers to dynamically manage and deliver online courses, create modules and online rubrics and assess students. For students, Brightspace offers varied options such as accessing the course content, peer collaboration and submitting the learning tasks from anywhere at anytime. FeedbackFruits is an external EdTech tool embedded in Brightspace to drive students' engagement through different peer collaboration strategies. This tool has many functionalities including peer review, assignment review, skill review, automated feedback, interactive video, interactive document, discussion assignments, interactive presentations, etc. For this study, we used the peer review tool which enables instructors to create assignments for students to provide feedback to their peers. The tool can be used to structure and streamline the process of students reviewing their peers' work. The teacher specifies the criteria by which students evaluate their peers' work. Learning groups are automatically synced from the LMS and each student is automatically assigned a submission to provide feedback on. Feedback can be provided on multiple types of deliverables such as videos, websites and documents

Students' argumentative essay performance

To measure the quality of students' argumentative essay performance, a coding scheme adjusted based on Noroozi et al.'s (2016) instrument was used. This coding scheme was developed based on a high-quality argumentative essay structure which comprised of 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, (6) justifications for arguments against the position, (7) response to counter–arguments and (8) conclusion and implications. Each element is scored from 0 points (not mentioned at all) to 3 points (mentioned with

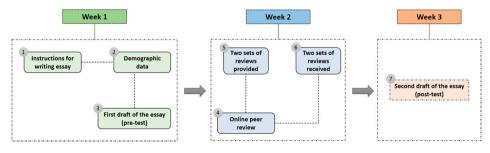


Figure 1. The design of the study

the highest quality). All given points for these elements are summed up together and indicate the student's total score for the quality of the written argumentative essay. This coding scheme was used in two phases. In the first phase, it was used to assess students' first draft of the essay and in the second phase, it was used to assess students' revised version of the essay. The quality of students' argumentative essays was assessed based on the differences in their performances in the first draft and revised draft of the essay. Two coders with education background have contributed to the coding of the quality of written argumentative essays. The Cohen's kappa coefficient analysis was used to measure the inter-rater reliability between the coders and the results showed that there is a reliable agreement between the coders (Kappa = 0.70, p < .01) (see appendices).

Students' online peer review performance

To measure the quality of students' online peer review performance, a coding scheme was designed by the authors based on the review of related previous studies mainly Nelson and Schunn (2009), Patchan et al. (2016), and Wu and Schunn (2020b). This coding scheme entails four main categories including affective, cognitive (description, identification and justification), constructive and feedback–feedforward type. The coding scheme was scored from 0 points (poor) to 2 points (good) for all the categories. All points were summed up and determined the quality of online peer review. Since each student provided two sets of peer reviews, the mean score of both peer reviews was identified as the quality of online peer review for each student. Similar to the argumentative essay analysis, the same two coders participated in the coding process for peer review analysis and the Cohen's kappa coefficient results for inter-rater reliability among coders were found to be significant (Kappa = 0.60, p < .01) (see appendices).

Analysis

Levene's test was used to check the variance equity between the groups. Since there was no difference in variance between the female and male groups (pre-test (F = 0.61, p = .43), posttest (F = 1.35, p = .24), peer feedback (F = 0.83, p = .36)), the unequal cell size of male and female students was not problematic (Schulte et al., 2003). MANOVA tests were conducted to compare differences between essay quality and peer review quality of male and female students. MANOVA for repeated measurement was used to investigate male and female uptake of peer review through comparing gender differences in essay quality improvements from pre-test to post-test.

Results

RQ1. To what extent gender affects students' argumentative essay writing performance?

The results showed that female and male students significantly differ in terms of mean quality scores of their argumentative essay quality in the pre-test: the overall argumentative essay writing score for female students was higher than for male students. This difference was mainly due to the quality scores of taking a position on the topic in which female students performed better than male students (Table 1).

RQ2. To what extent gender affects students' argumentative peer review performance?

The results showed that female and male students significantly differ in terms of mean quality scores of their provided peer review. Female students provided better justification of the identified problem, constructive feedback and feedback-feedforward type than male students (Table 2).

Table 1. Gender differences for argumentative essay writing performance in the pre-test.

Gender					
	Male		Female		Difference between essay quality of
Variables	Mean	SD	Mean	SD	males and females in the pre-test
Introduction on the topic	2.74	0.44	2.77	0.45	F (1, 99) = 0.09, p = .76
Taking a position on the topic	0.77	0.80	1.28	0.80	F (1, 99) = 8.73, $p < .01**, \eta 2 = 0.08$
Arguments for the position	2.74	0.51	2.71	0.66	F(1, 99) = 0.04, p = .83
Justifications for arguments for the position	2.25	1.03	2.54	0.82	F(1, 99) = 2.17, p = .14
Arguments against the position	1.48	0.96	1.20	0.86	F(1, 99) = 2.17, p = .14
Justifications for arguments against the position	0.90	0.83	0.84	0.87	F(1, 99) = 0.10, p = .74
Response to counter-arguments	0.90	0.74	0.72	0.65	F (1, 99) = 1.39, p = .24
Final conclusion and implications	1.80	0.79	1.97	0.56	F(1, 99) = 1.42, p = .23
Overall argumentative essay writing	13.61	2.33	14.05	2.85	F (8, 92) = 2.01, $p < .05^*$, $\eta 2 = 0.15$

p < .01**, p < .05*.

RQ3. To what extent gender affects students' uptake of peer review in argumentative essay writing performance?

The results showed that there was no significant difference between female and male students in terms of peer review uptake in argumentative essay writing performance. This means that no gender differences were found in the mean score of essay quality improvements from pre-test to post-test. However, female students showed higher feedback uptake in arguments against the position. This conveys that female students uptake of the feedback regarding presentation of arguments against the position was significantly better than male students (Table 3).

Discussions

In this study, we explored the gender differences among higher education students in three different phases, as it was represented in research questions, including augmentative essay writing performance, peer review performance and uptake of peer review to revise the argumentative essay writing. The findings for each phase are further discussed in the following sections.

Table 2. Gender differences for provided peer review performance.

		Gender	Peer revie	w quality	Difference between essay quality of males and females in the pre-test
Variables			Mean	SD	
Affective		Female	1.65	0.15	F (1, 94) = 2.24, p = .13
		Male	1.60	0.15	
		Total	1.63	0.15	
Cognitive	Description	Female	1.38	0.35	F(1, 94) = 3.42, p = .06
3	·	Male	1.24	0.31	
		Total	1.33	0.34	
	Identification	Female	0.69	0.32	F(1, 94) = 0.55, p = .45
		Male	0.75	0.39	
		Total	0.71	0.34	
	Justification	Female	0.05	0.06	F $(1, 94) = 6.95, p < .05*, \eta 2 = 0.06$
		Male	0.02	0.04	
		Total	0.04	0.06	
Constructive		Female	0.84	0.40	F $(1, 94) = 4.29, p < .05*, \eta 2 = 0.04$
		Male	0.66	0.40	
		Total	0.78	0.41	
Feedback-feedforward type		Female	1.49	0.24	F $(1, 94) = 5.89, p < .01**, \eta 2 = 0.06$
	,,	Male	1.37	0.20	7,
		Total	1.45	0.23	

p < .01**, p < .05*.

Table 3. Gender differences for argumentative essay writing performance improvements from pre-test to post-test.

		Gender				Difference between a constitution
	Test	Male		Female		Difference between essay quality improvements of males and females
Variables		Mean	SD	Mean	SD	from pre-test to post-test
Introduction on the topic	Pre-test	2.76	0.43	2.76	0.45	F (1, 97) = 0.24, p = .62
	Post-test	2.86	0.34	2.82	0.38	
Taking a position on the topic	Pre-test	0.76	0.81	1.26	0.77	F (1, 97) = 1.86, p = .17
	Post-test	1.46	0.89	1.73	0.77	
Arguments for the position	Pre-test	2.73	0.52	2.71	0.66	F (1, 97) = 0.84, p = .36
•	Post-test	2.73	0.52	2.78	0.56	·
Justifications for arguments	Pre-test	2.33	0.95	2.53	0.83	F(1, 97) = 0.62, p = .43
for the position	Post-test	2.60	0.62	2.70	0.70	•
Arguments against the position	Pre-test	1.46	0.97	1.18	0.86	F $(1, 97) = 6.24, p < .05*, \eta 2 = 0.06$
	Post-test	1.56	0.89	1.56	0.80	
Justifications for arguments	Pre-test	0.90	0.84	0.82	0.87	F (1, 97) = 0.94, p = .33
against the position	Post-test	1.20	0.76	1.24	0.84	•
Response to counter–arguments	Pre-test	0.86	0.73	0.71	0.64	F(1, 97) = 0.52, p = .46,
	Post-test	1.06	0.78	1.00	0.72	•
Final conclusion and implications	Pre-test	1.83	0.79	1.97	0.56	F (1, 97) = 0.99, p = .58
•	Post-test	2.16	0.74	2.23	0.45	·
Overall argumentative essay writing	Pre-test	13.66	2.35	13.97	2.78	F (7, 91) = 1.27, p = .27
, ,	Post-test	15.66	1.76	16.08	2.32	·

p < .01**, p < .05*.

Discussions for findings of the RQ1

Our findings revealed female students significantly outperformed male students in overall argumentative essay writing performance. This difference was mostly related to taking a position on the topic. These findings imply that female students were more thoughtful than male students to clearly inform their readers about their positions whether they are against or in favour of the topic of the essay. These findings, in general, are in line with the literature that found gender differences in students' argumentation (e.g. Asterhan et al., 2012; Jeong and Davidson-Shivers, 2006; Nasri et al., 2018; Tsemach & Zohar, 2021), and in specific, support the previous studies that report better performance for female versus male in writing performance (e.g. Reilly et al., 2019; Reynolds et al., 2015; Zhang et al., 2019). The better female performance in essay writing might possibly be related to orderliness (Zhang et al., 2019) that resulted in a desire of female students to write their argumentative essays in a more orderable way. Another potential reason for this difference can be due to female's and male's different personalities (Weisberg et al., 2011). Females are somewhat better than males in the case of conscientiousness, such as order, dutifulness and discipline (Costa et al., 2001). This conveys an implication why female students follow the order of highquality argumentative essays better than male students. In addition, from theoretical point of view, taking a position in an argumentative essay refers to students' claim and the side that they take in an argumentation (Noroozi et al., 2016, 2018; Toulmin, 1958). In this case, prior studies indicate that females are more straightforward than males (Grosch & Rau, 2017). This can mean that females prefer to put their claims in a more clear way than males, which corresponds with our findings of outperformance of female students over their male counterparts. In general, these findings suggest that, male students need more support than female students in their argumentative essay writing to reach the same quality. This support can be provided by giving additional specific guidance to male students. In online learning settings, additional guidance can be provided either by the system itself using intelligent online tools such as Automated Feedback function in Feedback-Fruits or through teachers and peers to male students in terms of guiding them how to clearly indicate their position in favour or against the topic.

For the other elements of high-quality argumentative essay writing, it was found that female and male students did not meaningfully differ in terms of introduction on the topic, arguments, counter–arguments, justifications for arguments and counter–arguments, response to counter–arguments and

concluding. However, by looking at the mean scores of these elements, it can be found that female students' mean scores tended to be higher in the introduction on the topic, justifications for arguments and counter—arguments and conclusion elements. This means that regardless of the null results for these elements, females students tended to provide a better introduction on the topic in their essays, and they supported their arguments and counter—arguments with scientific facts, evidence, figures and examples. While male students were more considerate in giving better arguments and counter—arguments in their essays alongside a response to the counter—arguments. These findings, although not statistically significant, might provide practical implications on how to differently guide and support female and male students in argumentative essay writing performance. For example, one suggestion could be supporting females students for paying more attention to the arguments either against or in favour of the topic in their essays and supporting male students to draw their attention on providing facts, evidence, and examples to better justify their arguments and counter—arguments.

In general, although review of the literature about gender effects on argumentative essay writing stated conflicting results, in a broad perspective, results are more lean towards females' better performance than males' and the findings of the current study confirmed this result. These findings are in line with the gender characteristics that we discussed for females and males.

Discussions for findings of the RQ2

Our findings showed that overall, gender plays an effective role in peer review performance. Female students justified their critical comments more than male students. This means that females have used more convincing language in their peer reviews to explain why they believe that the recognised problem in the reviewed essay should be fixed. This is in line with Erkens and Janssen's (2008) study where they found that female students use more argumentative language than males. Also, this finding is supported by prior studies that have reported better performance of peer review for females (e.g. Noroozi et al., 2020; Wu & Schunn, 2020a). For example, Noroozi et al. (2020) found that female students' peer review entails more solid argumentation than male students'. A reason why female students showed better peer review performance in justification of the identified problem elements might be due to the cognitive differences between males and females (Ardila et al., 2011; Weber et al., 2014). It was found that females have better verbal abilities (Ardila et al., 2011). Then, it might be related to females' verbal ability to present a well-structured of their peer review to justify and convince others.

In addition, our findings revealed that female students outperformed male students in providing a high-quality constructive review and feedback-feedforward type. This finding implies that female students compared to male students suggested more points for improvements and they provided a clear action plan on how to implement the suggested recommendations. In addition, the quality of the type of review provided by female students was better than by male students. This shows that female students not only gave more feedback but also they provided more feedforwards than male students. This might indicate that in general, the quality of the peer review provided by female students was better than by male students. These findings are supported by prior studies (e.g. Noroozi et al., 2020; Wu & Schunn, 2020a; Yurdabakan, 2011). One of the reasons that might explain females' better performance in peer review could go back to gender preferences in which females tend to be more specific than males (Croson & Gneezy, 2009). Therefore, when it comes to review a work, females might tend to read more carefully and be more particular than males. Another reason might be the online nature of the learning environment. Studies have shown that there is a gender difference in online learning preferences (Yu, 2021). Female students tend to engage more in learning activities than male students in online learning environments (Richardson & Woodley, 2003). In addition, female students showed higher self-regulation in online learning environments compared to male students (Alghamdi et al., 2020). These gender differences in online learning contexts might somewhat explain why females' performance in peer review was better than male students.

These findings suggest that male students need more support than female students to provide a high-quality peer review, which is in line with a previous study, in which Wu and Schunn (2020a) highlighted that males should get more support than females to better perform in peer feedback. In general, these findings are in line with previous studies that pointed out gender differences in peer review performance (e.g. Erkens & Janssen, 2008; Yurdabakan, 2011), and, in particular, support the literature that indicates higher performance for females vs. males in peer review performance (e.g. Noroozi et al., 2020; Wu & Schunn, 2020a).

Discussions for findings of the RQ3

In terms of peer review uptake in the revised essay, no gender differences were found. This means that male and female students did not differ in overall improvement from pre-test to post-test. However, an improvement was found from pre-test to post-test for female students regarding arguments against the position. This denotes that for female students, engaging in the peer review activity was helpful to know what was the problem in their counter-arguments and how they can improve it in their revised essays. These findings indicate female students were more willing to uptake received feedback on their counter-arguments and implement it in their revised essay. This finding is in line with the literature that suggests female students are more willing to uptake and implement feedback than male students (e.g. Wu & Schunn, 2020a). Also, in a broad scope, this finding is consistent with the prior studies where they report gender differences in students' peer review performance (e.g. Hamer et al., 2015; Noroozi et al., 2020; Yurdabakan, 2011). For the other elements of the essay, although gender differences were not significant from pre-test to post-test, a slight improvement can be found in all elements for male and female students from pre-test to post-test. This finding implies that regardless of the role of gender, peer review activity was slightly helpful to improve students' argumentative essay writing performance. This finding can support the literature that reported the effectiveness of supported peer feedback tools on improving students' argumentative writing (e.g. Latifi, Noroozi, Hatami et al., 2021, 2021; Noroozi et al., 2016).

Limitations and future research

There are some limitations to this study that require further research. The literature suggests that argumentative writing can be affected by students' epistemic beliefs and the culture from which students are coming (Kuhn et al., 2013; Noroozi & Hatami, 2019; Tsemach & Zohar, 2021; Uysal, 2008). This means that epistemological beliefs and cultural background play a role in shaping students' thoughts and arguments. By saying this, although this current study was conducted in an internationally respected higher education institution, we did not consider students' cultural backgrounds and epistemic beliefs in our study. Future research should investigate how students' culture and epistemic beliefs might affect students' argumentative essay writing and peer review performance. In other words, we suggest a multifaceted intervention study that takes different individual characteristics such as gender, cultural background and epistemic beliefs into account.

We explored the role of gender in argumentative essay writing and peer review as an individual performance where students individually write an argumentative essay and provided two sets of peer reviews, while some studies suggest that male and female students' argumentative performance can differ in groups working (e.g. Jeong & Davidson-Shivers, 2006; Yurdabakan, 2011). It would be interesting to explore the role of gender in heterogeneous and homogeneous groups working for argumentative essay writing and peer review in future studies.

In this study, we did not specify students' argumentative essay writing and peer review performance with regards to their course domains while it could be an influential variable associated with students' performance in argumentative essay writing and peer review (e.g. Latifi, Noroozi, Hatami et al., 2021; Noroozi et al., 2020; Valero Haro et al., 2019). We did not explore how differently male and female students perform in the courses and how the difficulty of the task and variety of the topics given in each course and their prior knowledge about the provided topics might differently affect their performance. Therefore, our findings should be cautiously interpreted. Further studies might be useful in providing a better understanding of the role of course domain and students' prior knowledge in argumentative essay writing and peer review performance, and scaling up the findings to other courses.

Conclusion

Overall, this study provides insights into the role of gender in argumentative essay writing, peer review performance and peer review uptake within a higher education context. The findings of this study extend the existing knowledge and evidence about higher education male and female students' differences in the process of argumentation for essay writing and peer review in online learning contexts. The results of this study supported the evidence that confirms the significant role of gender in argumentative essay writing and peer review performance. Future studies should involve larger student samples considering their cultural background, prior knowledge, epistemic beliefs and learning content. This can help to get a conclusive picture of the effects of gender on argumentation performance in essay writing and peer review with respect to the role of other potentially influential variables.

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