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CAN A DIGITAL GUIDED PEER FEEDBACK SYSTEM FOSTER LEARNING

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Abstract

Despite the fact that scientific literature highlights the importance of feedback for learning, there remains a challenge for students to construct good quality feedback in collaborative settings. This study designs, implements, and evaluates a digital learning module with an intensified peer feedback support. The goal is to explore whether a digital module with guided peer feedback which encourages challenges and motivation support students' domain specific knowledge gain. The extent to which the use of such a digital learning module is appreciated by students is studied as well.
Participants were 203 students who were randomly assigned to groups of three. students were asked to explore various perspectives, and the 'pros and cons' on the topic of 'Genetically Modified Organisms (GMOs)'. The findings show that the digital module fosters students' learning and satisfaction. The use of peer feedback support guided the students in appropriate ways to analyse learning partners arguments about the topic, express agreements/disagreements and when possible integrate various points of views in their own reflection report. This digital learning module provided a safe and respectful learning environment for students to also practice their argumentation and exercise critical discussion and reasoning skills without recourse to, or fear of, personal (ad hominum) statements, enhancing their awareness of the topic.

Keywords: *Attitudinal change, digital learning module, learning, peer feedback, student satisfaction.*

1. Introduction

With the advancement of educational technologies, digital modules are now being introduced in higher education in different countries (Noroozi, 2017; Van Seters et al., 2012). Different modalities and functionalities of such digital and online learning modules have shown to increase students' motivation, their understanding and retention of knowledge (Sweller, Van Merriënboer, & Paas, 1998), to facilitate the acquisition of domain-specific knowledge (Diederen et al., 2003). Embedding representational tools such as graphs, texts, diagrams, and pictures in digital learning modules to authenticate and visualize learning contexts and to acquire complex cognitive skills and perform deep learning (Mayer, 2003).

Despite investments on digital modules, the use of such learning modules are challenging especially in real educational settings. A promising approach to stimulate motivation for students to embrace such digital learning modules in their regular courses is to design and develop modules with peer feedback possibility that provide students with fun opportunities for learning. Receiving feedback from learning peers with the same motivational needs and also giving feedback to them in a reciprocal manner are important aspects of learning process (see Bayerlein, 2014; Crisp, 2007). Effective feedback can guide students to realize the gap between their own current and expected, and provide them with advice on what to improve and how to improve (De Nisi & Kluger, 2000).

Although scientific literature highlights the importance of feedback for learning as well as the features of high quality feedback (see Bayerlein, 2014; De Nisi & Kluger, 2000), there remains a challenge for students to construct good quality feedback in collaborative learning environments (see Noroozi et al, 2011, 2012a, 2012b, 2013a, 2013b, 2013c; 2016a, 2016b, 2017, 2018a, 2018b). For various reasons, some students may avoid giving critical feedback to the learning peers while some others may prefer not to receive critical feedback from their learning peers. These reasons include psychological, emotional, and social barriers for giving and receiving critical feedback such as fear of losing face or getting into a fight with learning partners (Andriessen, 2006), and perceiving critiques and counterarguments as personal attacks (Rourke & Kanuka, 2007). For example, there are students who would be reluctant to oppose and disagree with their learning peers, while others may not appreciate being challenged themselves (Nussbaum et al., 2004). Furthermore, less assertive students may avoid giving critical feedback just due to the (negative) competitive and disagreement aspects of the critiques (Nussbaum et al., 2008). As a result, the feedback typically remains at the surface level and lack well-founded arguments for promoting critical thinking, and deep and elaborative learning. This is a striking omission since deep processing, critical thinking and logical reasoning are essential objectives in education that positively associate with learning performance (see Noroozi et al., 2012b). Therefore, additional feedback support is needed if students are to willingly and with a high degree of motivation provide critical yet constructive feedback in such digital learning modules. This study provides such peer feedback support in a digital learning module to scaffold learning by guiding students on how to represent, structure, evaluate, and analyse their feedback for the learning partners.

To conclude, the importance of digital learning modules for learning is well researched, yet little empirical studies have addressed their combined effects on domain-specific knowledge gain, attitudinal change, and students' satisfaction. The picture is even more unclear when it comes to the features of these digital learning modules with regard to the peer feedback support. This study thus designs, implements, and evaluates a digital learning module with an intensified peer feedback support.

The goal of this study is to explore whether a digital learning module with guided peer feedback which encourages challenges and motivation support students' domain specific knowledge gain in the field of biotechnology and molecular life sciences. In addition, the extent to which the use of such a digital learning module is appreciated by students is studied as well. Furthermore, since interactions of students during peer feedback involve social process (O'Keefe, 1982) and facilitate consideration of alternative viewpoints (Nussbuam et al., 2008), it was examined whether the confrontation of viewpoints during peer feedback with learning partners leads to modification of students' conceptions and attitudinal change in a digital learning modules.

2. Method

The study took place at Wageningen University in the Netherlands. The topic for discussion was Genetically Modified Organisms (GMOs) with the focus on the use of "cultured meat manufacturing – insect cells". The three learning partners in each group were distributed over different locations of a classroom. A digital learning module was designed and used in this study. This digital learning module is a web-enabled platform that provides students with various modes of information presentation, such as texts, exercises, graphs, diagrams, and pictures with the feedback features to stimulate interactions between members of a group in an active learning environment by getting them thinking together about topics, media or material that is relevant to them. The feedback features in this digital learning module is designed in such a way as to guide the interaction style for both synchronous and synchronous interactions – promoting reasoning, critical discussion, and justified arguments –.

The main feature of this digital learning module is the use of guided peer feedback. This digital learning module provides the context and interaction style for reasoned and structured feedback, justified arguments and allowing the students to produce reusable content from their group experiences. This is done using a variety of input text boxes and sentence openers embedded in the platform for provoking and promoting students' reasoning, conceptual change, and argumentative feedback processes and practices. The structure of the guided peer feedback was designed on the basis of the characteristics for writing a complete and sound reflection report in the field of Molecular Life Sciences and Biotechnology. To do so, a series of meetings were held with the experts of the field and also the teachers of the course to define the elements of a complete and sound reflection report for students in the field of Molecular Life Sciences and Biotechnology. These meetings were resulted in a list of items that should be included in the reflection reports of students (see Table 1 for the list of these items).

The validity of these items was obtained through circulating them among the experts and the teachers of the course. We then designed our guided peer feedback on the basis of these items (see Table 1) and embedded them in the digital learning module using input text boxes and sentence openers.

Overall, the session took about 4 hours and consisted of four main phases. A pre-test post-test questionnaire was used to measure students' domain-specific knowledge gain. This questionnaire consisted of 17 multiple-choice questions. Specifically, both in the pre-test and post-test, each student was asked to answer these questions. A pre-test post-test questionnaire was used to measure students' attitudinal change on the GMOs topic. This questionnaire consisted of eight questions on a five-point Likert scale ranging from "strongly disagree", "disagree", "neutral", "agree" through to "strongly agree". Both in the pre-test and post-test, each student was asked to indicate the extent to which s/he agreed with the GMOs statements. A questionnaire was adapted to assess students' motivation and satisfaction with the learning experiences. This questionnaire consisted of four main sections and 36 items in total on a five-point Likert scale ranging from "almost never true", "rarely true", "occasionally true", "often true" through to "almost always true".

Table 1. Features of a good reflection report and guided peer feedback embedded in the digital module.

Number	***Features of a good reflection report by panel of experts and teachers***	***Guided peer feedback embedded in the digital module using input text boxes and sentence openers***
1	The intuitive opinion on the topic.	To what extent your learning partner present his/her intuitive opinion on the topic? Is that clear? Why or why not? (30 to 50 words).
2	The arguments in favour of the topic (pros).	To what extent your learning partner provide arguments in favour of the topic? To what extent your learning partner reflect the opinion of the advocates on the topic? (30 to 50 words).
3	The scientific facts in favour of the topic (pros).	To what extent your learning partner provide arguments against the topic? To what extent your learning partner reflect the opinion of the opponents on the topic? (30 to 50 words).
4	The arguments against the topic (cons).	To what extent your learning partner provide scientific facts in favour of the topic? (30 to 50 words).
5	The scientific facts against the topic (cons).	To what extent your learning partner provide scientific facts against the topic? (30 to 50 words).
6	The opinion on the topic taking into account various pros and cons.	To what extent your learning partner integrate various pros and cons of the topic? (30 to 50 words).
7	The arguments and scientific facts (evidence, examples, figures, facts etc.) to support opinion.	Does your learning partner come to a conclusion based on his/her arguments? What do you think about his/her conclusion? (30 to 50 words).
8	The final conclusion and statement on the topic.	What are your suggestions for improving the quality of the reflection report of your learning partner? (30 to 50 words).

3. Results

ANOVA test for repeated measurement showed that the domain-specific knowledge of students improved significantly from pre-test to post-test, $F(1, 200) = 287.50$, $p < .01$, $\eta^2 = .59$. This indicates the positive effects of the digital learning module on the domain-specific knowledge gain of students. Students' mean quality scores for domain-specific knowledge was 9.37 ($SD = 1.89$) for the pre-test and 12.22 ($SD = 1.76$) for the post-test. So, in average, the gain of knowledge for every student was 2.85 which is significant.

Students' motivation and satisfaction with the learning experiences appeared to be sufficiently high (around four on a five-point Likert scale) for all students. Specifically, the average score of students for 'perceived effects of the domain-specific learning outcomes ' was 3.82 on a five-point Likert scale higher (SD = .73). The average score of students for 'perceived effects of the domain-general learning outcomes' was 3.26 (SD = .76). The average score of students for 'the ease of use of the module' was 4.23 (SD = .63). The average score of students for 'appreciation of the module' was 3.44 (SD = .62). During the plenary discussion sessions, students appreciated the module with regard to its dynamic nature, user-friendliness, and variation of the sentence openers. Furthermore, they said that the module was useful with respect to practicing, provoking and promoting their critical reasoning and argumentation skills.

This section presents the findings for the effects of the digital learning module with guided peer feedback on students' attitudinal change. A check was performed on students' attitudinal change on the GMOs from pre-test to post-test.

MANOVA test for repeated measurement showed that students significantly shifted their attitude towards GMOs from pre-test to post-test, *Wilks'* $\lambda = .24$, $F(1, 202) = 74.43$, $p < .01$, $\eta^2 = .76$. This was the case with all the eight questions with regard to students' positions on the GMOs. There is an indication that the digital learning module with guided peer feedback affected students' attitude to the GMOs. While students in the pre-test were almost fully in favour of GMOs, the digital learning module and also the peer feedback from their learning partners shifted students' attitude towards being neutral. The results showed that students GMOs' attitude can be shifted through argumentation and engagement in critical thinking and reasoning through engaging with the digital learning module supported with peer feedback.

4. Discussions and conclusions

With implementation of a dialogue learning module, students were able to gain domain-specific knowledge as demonstrated in their post-test compared with pre-test. This study used a digital learning module that also supported peer feedback process to engage students in an intensified processes of learning and writing about a controversial topic. The module was designed in such a way as to provoke students for exchanging and directing diverse and multiple conflicting opinions towards deeper reasoning. While various information presentation of the digital learning module such as textual and graphical information e.g. texts, exercises, graphs, diagrams, pictures etc. fostered domain-specific knowledge of the students, the use of peer feedback support promoted and scaffolded argumentation and critical reasoning enabling the students to provide constructive and critical feedback for their peers. The use of peer feedback support guided the students in appropriate ways to analyse learning partners arguments about the topic, express agreements/disagreements and when possible integrate various points of views in their own reflection report. This digital learning module provided a safe and respectful learning environment for students to also practice their argumentation and exercise critical discussion and reasoning skills without recourse to, or fear of, personal (ad hominum) statements, enhancing their awareness of the topic. Exchanging diverse and multiple conflicting opinions, analysing one another arguments, and expressing agreements/disagreements supported with scientific facts, arguments, logical evidence and examples were then reflected in the attitudinal change of students towards the controversial topic of the GMOs from pre-test to post-test.

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