EdBi Educatio Biologiae Extended summary

Received 30.1.2023.
Accepted 15.2.2023.
Published 28.2.2023.

Peer teaching as support for the use of concept maps in independent online learning

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ABSTRACT

With the goal of cognitively active involvement of students in the teaching process, students who are at the beginning of higher education were provided with peer support in acquiring subject-specific knowledge using a concept map. The research was conducted in the academic years 2021/2022 and 2022/2023 with a total of fifty students of the Undergraduate University Study of Biology at the Department of Biology, University of Osijek. During the first phase of the research, students (future teachers of Nature, Biology, and Chemistry) who were in the role of those who teach designed and conducted a lesson in which different student activities alternated. At the same time supported the observation and separation of key concepts and connections between them, which is necessary for reaching knowledge at higher cognitive levels. Next, they programmed the same lesson and adapted it to online learning. In the second phase of the research, an initial written test of knowledge was conducted. Afterwards, the students were directed to independent online learning, which was followed by a final written test. By comparing the initial and final written tests, the effectiveness of peer support during independent online learning was determined. The results show that the students achieved a better score in the questions of all tested cognitive levels in the final written test of knowledge compared to the initial one.

Key words: *secondary school teacher; programmed teaching, students, effective learning, elementary school teachers*

INTRODUCTION

A concept map is a graphical tool for organizing and presenting knowledge (Novak & Cañas, 2006). It complements various learning procedures, methods, and strategies, whether the teaching is face-to-face or online. Many teachers[1] and students[2] are often surprised by the positive impact of the concept map and its profound effect on meaningful learning, long-term knowledge retention, and the application of that knowledge in a variety of contexts (Kinchin, 2014). The use of a concept map in teaching/learning facilitates understanding and recognition of relationships and connections between concepts, phenomena and processes, encourages students to acquire knowledge at higher cognitive levels, and improves problem-solving processes (Golubić et al., 2019). Concept maps can be used as a medium for constructive and collaborative learning activities in an online environment (Cicognani, 2000) and as a communication aid during teaching, learning, and (self-)assessment. The number and selection of concepts, the connecting lines, and the presence of cross-connections provide immediate insight into students' knowledge. Thus, concept maps can be used in formative assessment to modify learning and teaching.

Although the rules for creating a concept map are straightforward, the success of learning with the help of the map depends on students' readiness to use it to gain knowledge at higher cognitive levels. Readiness should be considered at two levels: (1) the level of independent use of the map in the learning process and (2) the level of academic achievement, which stipulates the ability to relate new concepts to familiar concepts meaningfully and at a higher cognitive level. In the process of

[1] The term "teacher" in this paper includes both males and females and refers to teachers working in secondary schools.
[2] The term "student" also refers to students in the context of those who learn.

URL DOI: https://doi.org/10.32633/eb.9.2

establishing independent learning and using a concept map, introducing peer teaching can be a useful support method. According to Topping and Ehly (1998), peer teaching is teaching in which students of a similar age help each other learn. In this research, peer teaching was organized in the following way: student teachers (future teachers of science, biology, and chemistry) organized and conducted classes with younger students who had no experience learning with a concept map. For teachers, a part of digital literacy is knowing how to adapt teaching to the online environment. Planning and modifying activities to students' needs remain unchanged whether the teaching is face-to-face or in an online environment. Therefore, the aim of this paper is to present face-to-face and online classes in which students are actively engaged cognitively in the teaching process through the systematic extraction of key concepts and the creation of a concept map and to determine the extent to which such peer support contributes to effective student learning.

METHODS

The study is divided into two stages. In the first stage, second-year graduate students (future teachers) designed and conducted a peer lesson that took place in person during the exercises of the course titled Anatomy of Plants. The structure of the lesson included an alternation of independent microscopy and solving tasks guided by the student-teachers while observing, extracting key concepts, summarizing, and creating a concept map (see the Results chapter for a more detailed description). This stage served as a roadmap for organizing the online learning that took place in the second stage of the research. The success of teaching was tested using the Teaching Observation Form (TOF (Bezinović et al., 2012)), which was completed by all students, both those who were taught and those who were teaching. The (self-)assessment of the lesson using the TOF form was followed by the planning of the same lesson adapted to independent online learning. For this purpose, the lesson was organized as an activity in Merlin.

In the second stage of the study, the students (40 of them) were subjected to an initial knowledge assessment test that included questions of different cognitive levels (determined according to Anderson's revised Bloom's taxonomy (Mainali, 2012). After that, students independently studied three lessons online and took the final assessment test. In online learning, peer support in actively extracting key concepts and creating a concept map was evident in the sequence and logic of planning the lesson, which was arranged in the same order as peer teaching in the classroom in the first stage.

The success of peer-supported online learning was tested by comparing the results of the initial assessment test with the results of the final assessment test using the paired-samples t-test at the $\alpha = 0.05$ significance level (Statistics 12, Quest Software Inc, Aliso Viejo, CA, USA).

RESULTS

Peer support in the effective creation of a concept map in teaching face-to-face

During the face-to-face lesson, the teaching included the alternation of microscopy and the creation of a portfolio. Each exercise started with microscopy, which demonstrated the presence of cellulose in the cell walls. Students then drew the changes they observed in their portfolio and, with assistance, named the key concepts. They were constantly cognitively active because of answering numerous thought-provoking questions. At the end of the exercises, students worked in groups to join the selected concepts into a concept map. All concept maps were presented at the end of the lesson using the gallery method for formative assessment. Based on the analysis of the maps and the TOF form, the teaching was assessed as successful because all the features of the teaching important for actively engaging students in the teaching process were present.

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Effectiveness of peer support in online learning

The average score achieved for first-level questions was 0.5, 3 points for second-level questions, and 4 points for third-level questions (Figure 1). The range of points achieved for second-level questions is from 1 to a maximum score of 5, while for third-level questions it is from 0 to a maximum score of 9.

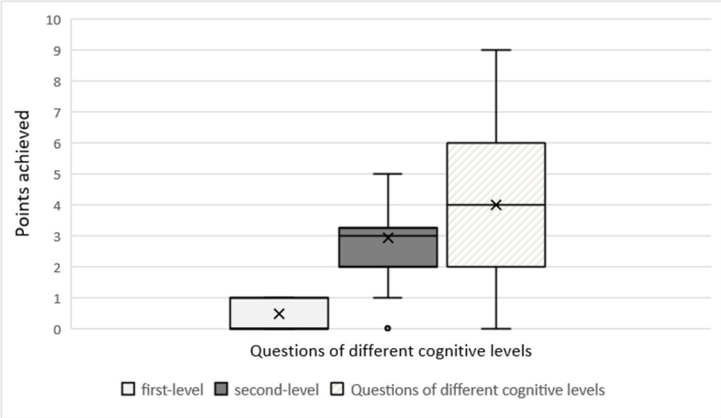

Figure 1 The results of the initial knowledge assessment test

The online learning included the independent completion of three lessons. The lessons began with the activation of prior knowledge and included an introductory section on plant cell structure and cell walls. Each lesson had a protocol for each exercise and associated video material. Instead of looking at the microscope, students had to answer guided questions, watch video recordings of the exercises, and then, already interactively engaged in the work, highlight key concepts related to the exercises they had seen. This was followed by a final written assessment test, the results of which are shown in Figure 2.

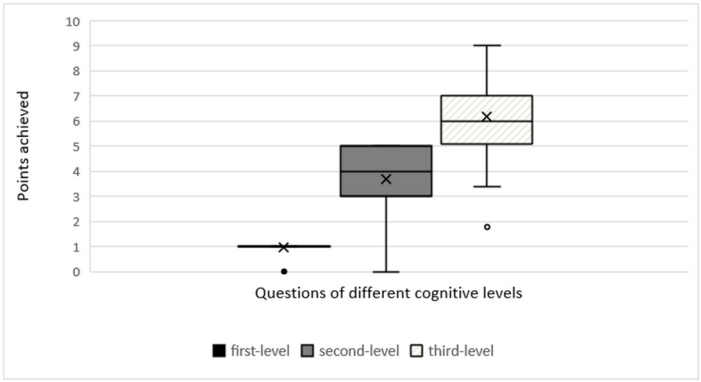

Figure 2 The results of the final knowledge assessment test

The comparison of Figure 1 and Figure 2 indicates that students achieved a higher average score on questions at all levels on the final assessment test than on the initial assessment test. For third-level questions, they achieved a higher minimum score on the final assessment test than on the initial assessment test.

DISCUSSION

The transition from high school to university involves moving from a close circle of peers/friends to a much larger number of students/colleagues (Lombard, 2020). Various social and emotional changes are associated with this transition, which may be related to feelings of self-esteem, self-efficacy, and motivation for learning and studying in general. In our study, the concept map was offered to students

URL DOI: https://doi.org/10.32633/eb.9.2

as a technique to complement their learning methods. Since these were students who had no experience learning with a concept map, it was necessary to provide them with peer support.

The students who took on the role of teachers first stated the objective of the lesson so that at the end the students-learners could self-assess whether they had achieved the planned objective based on the concept map they had created. Learners were also supported in independent online learning through the sharing of video materials and questions aimed at focusing attention on key concepts and identifying important connections between them. The completed concept maps, as well as the results of the final assessment test that followed the independent online learning, show that the lesson designed in this way produced positive changes in learning.

A large number of students can also be a disruptive factor for the teacher, which is why he or she cannot provide equally good and constructive feedback to all students. In such moments, peer support can complement student-teacher interaction. In addition, peer teaching activates intrinsic motivation by allowing students to take charge of their learning and set their own goals. The very act of setting a goal triggers metacognitive skills (Lončarić, 2014). All of this can be realized very successfully through the creation and use of a concept map, either during learning or afterward (Rukavina, 2017). The concept map provides deep insight into learning, promotes critical thinking, and requires a connection with other knowledge to ultimately reach certain conclusions. Incorporating the map into teaching allows for a shift away from memorization to long-term knowledge where ideas are organized and new relationships between concepts are established, facilitating meaningful learning in a new environment.

The online environment facilitates the learning process because it can occur anywhere, anytime. However, it is important to ensure active learning. The problem of undirected attention is common in the online environment, and it is also often organized around the principle of knowledge transfer from teacher to student. The teacher is still expected to create situations in which he or she successfully implements curriculum objectives, regardless of whether students are learning face-to-face or online (Radanović et al., 2018). Sometimes it is difficult to provide students with a foundation for developing knowledge at higher cognitive levels because linear viewing of video materials generally leads to poor long-term learning outcomes (Chou et al., 2022). Video-based teaching should be interactive and encourage active linking of different concepts. Therefore, it is necessary to encourage students to learn with concept maps because when creating concept maps, students independently build on concepts they have already mastered, think critically, and draw certain conclusions, which is a prerequisite for long-term knowledge (Aydoğdu & Güyer, 2019).

CONCULSION AND METODOLOGICAL SIGNIFICANCE

A concept map is not the only technique that helps activate students in online learning. Regardless of the strategies/methods/procedures and techniques used, and regardless of whether students are learning face-to-face or online, the fundamental task of the teacher is to identify students' difficulties and provide them with the support that will lead to effective learning.

REFERENCES

Aydoğdu, Ş., & Güyer, T. (2019). The Effect of Digital Concept Maps in Online Learning Environments on Students' Success and Disorientation. *Malaysian Online Journal of Educational Technology*, *7*(1), 75–92. https://doi.org/10.17220/mojet.2019.01.006

Bezinović, P., Marušić, I., & Ristić Dedić, Z. (2012). *Opažanje i unapređivanje školske nastave*. https://www.bib.irb.hr/601226

Chou, Y.-Y., Wu, P.-F., Huang, C.-Y., Chang, S.-H., Huang, H.-S., Lin, W.-M., & Lin, M.-L. (2022). Effect of Digital Learning Using Augmented Reality with Multidimensional Concept Map in Elementary Science Course. *The Asia-Pacific Education Researcher*, *31*(4), 383–393. https://doi.org/10.1007/s40299-021-00580-y

URL DOI: https://doi.org/10.32633/eb.9.2

Cicognani, A. (2000). Concept Mapping as a Collaborative Tool for Enhanced Online Learning. *Journal of Educational Technology & Society*, *3*(3), 150–158.

Golubić, M., Begić, V., & Radanović, I. (2019). Analiza konceptualnih mapa uz udžbenike u svrhu utvrđivanja mogućih konceptualnih poveznica za olakšano razumijevanje procesa razmnožavanja. *Educatio biologiae : časopis edukacije biologije*, *5.*, 48–66. https://doi.org/10.32633/eb.5.4

Kinchin, I. (2014). Concept Mapping as a Learning Tool in Higher Education: A Critical Analysis of Recent Reviews. *The Journal of Continuing Higher Education*, *62*, 39–49. https://doi.org/10.1080/07377363.2014.872011

Lombard, P. (2020). Factors that influence transition from high school to higher education: A case of the JuniorTukkie programme. *African Journal of Career Development*, *2*. https://doi.org/10.4102/ajcd.v2i1.5

Lončarić, D. (2014). *Motivacija i strategije samoregulacije učenja: Teorija, mjerenje i primjena*. https://www.bib.irb.hr/767560

Mainali, B. P. (2012). Higher Order Thinking in Education. *Academic Voices: A Multidisciplinary Journal*, *2*, 5–10. https://doi.org/10.3126/av.v2i1.8277

Novak, J., & Cañas, A. (2006). *The Theory Underlying Concept Maps and How to Construct Them*.

Radanović, I., Luksa, Z., Garašić, D., Sertić Perić, M., Gavrić, B., Begić, V., & Novoselic, D. (2018). *The effect of learning experiences using expert concept maps on understanding cell division processes*.

Rukavina, M. (2017). Tranzicija adolescenata u srednju školu i studij. *Školski vjesnik : časopis za pedagogijsku teoriju i praksu*, *66*(1), 107–122.

Topping, K., & Ehly, S. (Eds.). (1998). *Peer-assisted Learning*. Routledge. https://doi.org/10.4324/9781410603678