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Analyzing Student's Perceptions and Learning Outcomes of Wooflash application in Undergraduate Cell and Developmental Biology Courses

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Abstract

The article evaluated the integration and effectiveness of Wooflash, an online learning platform, and JoVE Science Education Library videos in undergraduate cell and developmental biology courses. Surveys of second- and third-year students assessed how these tools impacted learning strategies, course comprehension, and exam preparation. Both resources were well-received, helping students identify weaknesses and reinforce concepts. However, most students used them only shortly before exams, limiting their potential for deep learning. Barriers included lack of time and unfamiliarity. Despite these challenges, Wooflash users showed modestly higher exam scores (6.7/15 vs. 5.4/15), and 66% of students found JoVE videos helpful for understanding course content. The study highlights the benefits of integrating digital tools in education while emphasizing the need for earlier adoption and better guidance to enhance consistent engagement. ***Keywords: wooflash,*** *flashcards, evaluation, quiz, pedagogical alignment*

1. Introduction

Teachers, and students alike, are constantly seeking innovative tools and methods to enhance the learning experience. There is a growing body of literature on potential effective strategies for supporting multimedia learning (Mayer, 2009; Henderson et al., 2015). Among these strategies, quizzing promote self-regulation processes and reinforce learning performances (Yang et al., 2021). To this extend, we have been experimenting tools that have gained significant consideration in recent years, namely, quizzes, flashcards and supplementary video resources.

Flashcards have undergone a digital transformation. At their core, flashcards are simple yet powerful devices that leverage key principles of cognitive psychology to facilitate learning and retention. These systems are based on two fundamental concepts: active recall and spaced repetition. Active recall involves actively stimulating memory during the learning process, forcing learners to retrieve information from memory and thereby strengthening neural connections. Spaced repetition, on the other hand, involves spreading out learning sessions over time, which has been proven to improve long-term retention (Kang, 2016). Benefits of flashcards are numerous, offering flexibility, allowing students to study anytime and anywhere. They promote active learning, helping students quickly identify knowledge gaps. Many digital flashcard applications incorporate gamification elements, which can increase student motivation. Furthermore, flashcards have been shown to improve concentration, accelerate learning speed, and enrich vocabulary, the latter being of high interest in discipline where memorization of glossaries is crucial. However, one shall recall that flashcards are not without limitations. There is a risk of encouraging superficial learning, if not designed to promote deeper understanding. Their effectiveness is heavily dependent on the quality of their design and the user's discipline in regular usage. Additionally, creating effective flashcards requires skill and time investment from both educators and students.

Wooflash is an online learning platform, provided by Wooclap (www.wooclap.com). Wooflash is an innovative educational revision platform, accessible via computer, tablet, and smartphone. This application offers the possibility to provide students with varied content and diverse questions. This platform was chosen because was currently being tested in our institution, where our colleagues are already using Wooclap quite intensively. The teachers of the University of Lille who use Wooclap were satisfied with the interface and the features offered by the platform.

Complementing flashcards, video resources have become common and efficient tools in education (Brame, 2016). The Journal of Visualized Experiments (JoVE) is a peer- reviewed scientific journal that publishes experimental methods in video format. The JoVE Science Education Library is a comprehensive video resource dedicated to teaching scientific experiments through engaging visual demonstrations. The library covers a wide range of disciplines, including Advanced Biology, Basic Biology, Chemistry, Clinical Skills, Engineering, Environmental Sciences, Physics, and Psychology. Such video-based approach offers several advantages like (i) enhanced understanding through visual learning (ii) accessibility to standardized experimental techniques demonstrated by experts, (iii) accessibility to complex scientific concepts for students at various levels, (iv) potential supplementary material for traditional lectures and textbooks, and (v) opportunity for students to review procedures multiple times at their own pace.

This article evaluates the integration and effectiveness of Wooflash and JoVE videos in undergraduate biology courses, examining their impact on student learning strategies, comprehension, and exam preparation. Therefore, the resources' objectives were to develop

students' understanding and reasoning in the fields of developmental biology and transgenesis methods. Mastering the glossary of terms in developmental biology, for example, is a recurrent difficulty encountered by students. Thus, it was tested whether these resources could affect the students' learning experience and could influence preparation for assessments. Results of questionnaire and recommendations for effective integration of such resources into curricula are provided.

2. Methods

2.1. Participants

The use of the Wooflash application was tested with two groups of students, in the second (L2) and third (L3) years of the Bachelor's program in Cellular Biology and Physiology (LBCP). L2 students have taken developmental biology courses. Two types of teaching are carried out: lectures in amphitheaters on the major stages of development (fertilization, cleavage, gastrulation, neurulation, sea urchin development, human development), and small group teachings (<30 students; amphibian development, bird development, experimental embryology). The course entitled 'Animal Transgenesis' is mandatory for all third-year undergraduate students (L3) majoring in Cellular Biology and Physiology (BCP). This course is only taught in large classes (amphitheater). It covers gene transfer methods, theoretical and practical approaches to transgenesis, with analysis of application cases of genetic modifications in animals. This lecture is placed within the regulatory and ethical framework of animal experimentation.

2.2. Wooflash

The courses / quizzes created are available online. The educational content was presented in a linear format, with the slides in a predetermined order. When appropriate, feedback was provided automatically by the Wooflash platform. The platform offers the possibility to easily create educational content using Artificial Intelligence. Questions can include video, slide, or PDF content. Among the 17 question types offered by the tool, the multiple-choice questions (MCQ), short answer questions, and flashcards options were used.

For the L2 students, 3 courses were created, respectively addressing the principles of developmental biology (41 questions, code : 7AA829R0), bird development (60 questions, code : N791TSXR), and human development (23 questions, code : 419KQ4E7). For the L3 students, a course including 85 questions was created and subdivided in 3 sections : ethical aspects of animal experimentation, gene transfer methodologies, course comprehension questions. Quizzes are available using the code AESL8CZ6.

2.3. Survey

At least three weeks after sessions ended, a global online questionnaire with 19 questions was administered. The questionnaire was made with socrative (www.socrative.com, Showbie Inc.) and directly sent to students by e-mail. Responses were totally anonymous, as mentioned in the e-mail sent to the students. It was indicated that the questionnaire is part of the evaluation of teaching by students, with the aim of improving teaching practices. 13 questions used a scale from 1 to 5 to measure students' perception (Do you find that Wooflash adds value to teaching? Do you find that the Jove capsules, underlining key concepts, bring added value to teaching? Do you think Wooflash helped you prepare for your exams? Do you think Wooflash helped you better understand any points in the course? Do you think Wooflash helped you to identify your weaknesses? Do you think Wooflash has helped you memorize more easily? Do you think Wooflash has improved your relationship with the teacher? Do you think Wooflash is an easy app to use? Do you think the questions offered on Wooflash are appropriate? The questions in the JoVE capsules helped you prepare for your exams?? Do you think that the JoVE video clips have helped you better understand course points? Do you think that the JoVE videos have helped you memorize concepts more easily? Do you think the JoVE video clips are suitable?). Four questions were proposed, and two open-ended questions closed the survey : What other resources/applications would you like? (open-ended), free comments.

No statistical comparison was made of the results of the questionnaires of L2 and L3 students since multiple variables may be taken into account. The relevance of such an analysis would be questionable.

3. Results and discussion

The questionnaire exhibited that overall, the resources were perceived positively by students, both at the L2 and L3 levels (Figure 1). Open-ended responses of the survey highlighted the suitability and advantages of Wooflash and its utility : (1) "We can better understand and identify our weak points », (2) « I was able to notice some of my confusions and other errors in my course without having to send a question message (to the teacher). I wish I had organized my time better to take advantage of Wooflash in advance » and (3) « It allows me to confirm my knowledge and to learn and revise in a fun way ». A L2 student stressed that "you have to use it correctly (...) you shouldn't rely solely on Wooflash to succeed ».

Did the students feel that the proposed resources were enough? To the question "Which applications would you like?", the majority of students respond that they did not want additional resources. A few students mentioned applications like Gizmo (1), Anky (1), and Quizlet (4). Given that these applications are similar to Wooflash, it is reasonable to think that these students have not fully adopted and used the proposed application.

It was observed that students only connected lately to the tools, in the days preceding the final evaluations: the attendance rate doubled in the 72 hours preceding the terminal exams (data not shown). The number of students who quickly and regularly adopted the tool remained modest. The majority of students estimated that they used the tool between 5 and 10 times (Figure 1A). The fact that students did not make "intensive" use of the tool and that this use occurred quite lately in their learning strategy did not facilitate a deep learning. A low and late frequency of tool use did not allow students to benefit from the advantages of this tool in terms of memorizing terminology or understanding key points. The main barriers to using these tools are lack of time and unfamiliarity with the tool (Figure 1B). The lack of time was highlighted by a student in the open-ended responses of the survey : "the resources are a very good idea but unfortunately complicated to look at in addition to other courses and other subjects". Beyond the intrinsic qualities of the tool, acknowledged by the students (figure 1C&D), teachers must consider how they have integrated the tool into their teaching approach (scenario), and the time available for students to appropriate these tools/resources. These factors can limit the performance induced by the tools. As mentioned previously, usability of these tools requires minimal investment on the part of students. Technical problems were very rare (only one student mentioned that «JOVE videos cannot be opened on all devices »). The user-friendliness and ease of use of the application are highlighted by students (1C, 1D). The questionnaire also highlighted that use of the tool did not increase interactions with teachers; in fact, as student autonomy is encouraged, interactions with teachers tend to decrease (1C, 1D). While our survey identified lack of time and unfamiliarity as primary barriers (Figure 1B), other factors likely contributed to this pattern of late adoption. This behavior could be tied to students' existing study habits and beliefs about effective learning strategies, where last-minute review and cramming are often prioritized over distributed practice. Furthermore, the perceived 'stakes' of using the tools might have been low early in the semester. Since Wooflash and JoVE were presented as supplementary resources, students may not have fully appreciated their value until the pressure of the impending exam motivated them to seek additional support. The concentrated use of Wooflash prior to exams suggests that students primarily leveraged these tools for knowledge retrieval and reinforcement rather than for initial learning and conceptual understanding. Spaced repetition, a key principle behind effective flashcard use (Kang, 2016), is undermined when learning is compressed into a short period. Additionally, the limited timeframe may have prevented students from engaging with the resources in a more exploratory or self-directed manner, such as identifying knowledge gaps early on and seeking clarification from the instructor.

Was there a positive effect on student results? Students who used Wooflash showed an average score of 6.7/15 (+/-2), while students who did not use Wooflash exhibited an average score of 5.4/15 (+/-2). An average increase of one point was observed; the distribution of grades exhibited better results for wooflash users in final exams, in contrast to non users (data not

shown). This result seemed modest and needs to be confirmed by further experiences using this tool in the coming years.

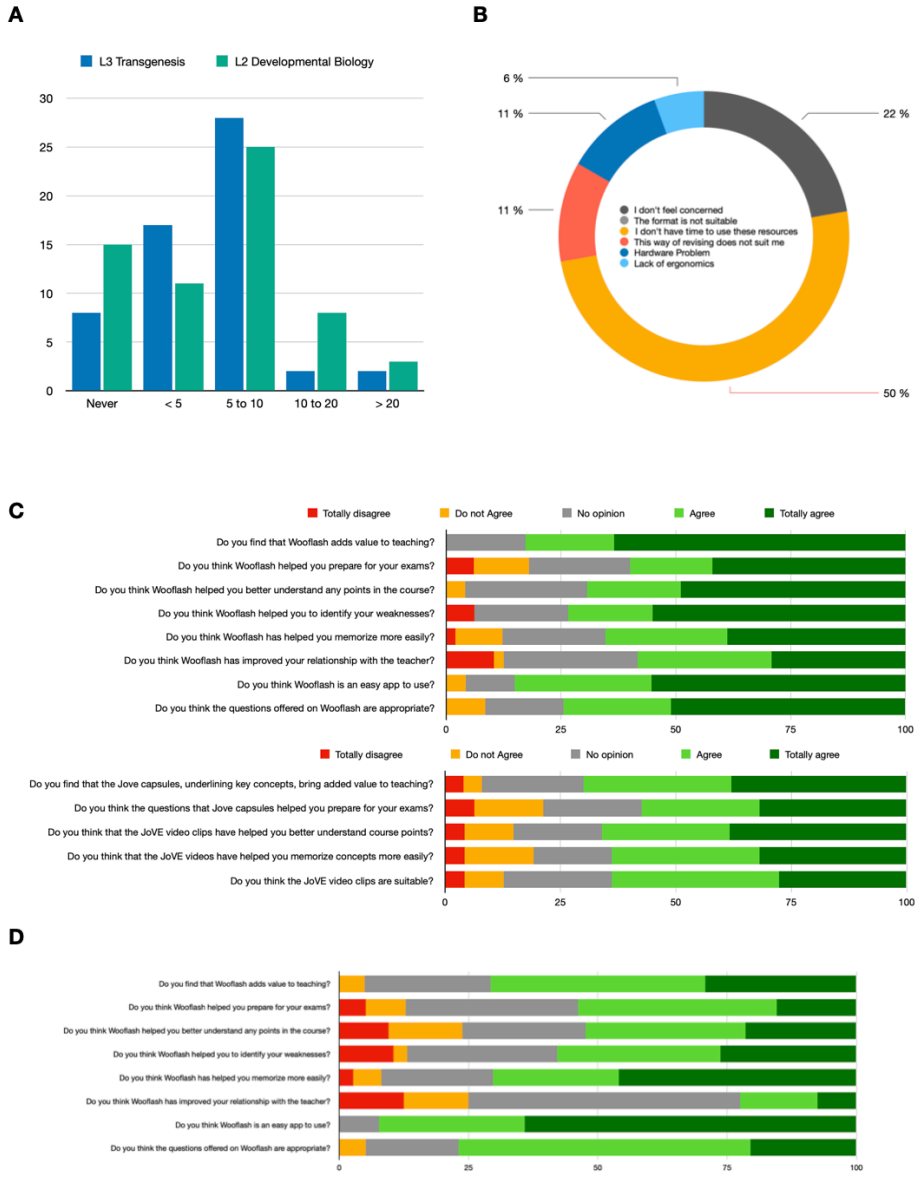

Figure 1. Student survey ; A : Comparison of the frequency of use of Wooflash among L2 (n=62) and L3 participants (n=57) . B : Reasons evoked by L3 participants not to use the tools or resources ; student survey among participants in developmental biology courses (L2) or transgenesis (L3

The advantages of providing supplementary video content are manifold. Videos allow for the visualization of complex concepts and the demonstration of practical techniques, offering an alternative to traditional learning methods. Videos also allow students to review material at their own pace, reinforcing understanding and retention. Use of video resources also presents challenges (Ramachandran et al., 2019). The production of high-quality educational videos can be costly and time-consuming. There is also a risk that students may become passive in their learning if they rely too heavily on videos at the expense of other forms of engagement with course material. The JoVE Science Education Library was only used in the context of the lessons in L3. The main advantage of this platform is to provide turnkey, clear, relevant and short videos. Seven videos were proposed, illustrating key concepts : transgenic organisms, genetic engineering, CRISPR, reproductive cloning, embryonic stem cells, induced-pluripotent stem cells, gene therapy. These resources are received very positively by students, who consider them "suitable", "clear" and "very good ». 66% of the students agreed that the videos helped to understand course points and 64% considered that it helped them to memorize key concepts (Figure 1C). Efficiency of the use of JoVE videos in chemistry lessons was elsewhere observed and documented (Ramachandran et al., 2019). Feedback encourages the use of new videos, which will be used in other courses, like developmental biology and bioethics.

At last, two points should be highlighted, regarding the teacher teaching-experiment. First, the existence of a dashboard within the Wooflash application allows teachers to follow students' responses in real time. This feature enables teachers to identify students who have difficulty answering questionnaires or memorizing terms, and to identify questions or key points where students encounter difficulties, and to be able to re-explain them in class, or to suggest alternative resources. Second, the teacher must ensure, in his syllabus, or during his course, to explain the contributions of the application. These explanations could have a positive impact on the 1 in 5 students who do not feel concerned by the tool (1B). The demonstration can be done in front of the students, or offered in the format of a short video, explaining for example how wooflash can help the student in their learning experience.

4. Conclusion

The article addressed the use of Wooflash and JoVE video resources in undergraduate cell and developmental biology courses. The survey suggested that these tools are generally well-received by students and can potentially enhance their learning experience. Indeed, students perceived Wooflash and JoVE videos positively, finding them useful for identifying weaknesses and reinforcing key concepts. JoVE videos were particularly well-received for their clarity and relevance. A modest improvement in exam scores was observed for Wooflash users, though further research is needed to confirm this effect. One shall remained aware of the biases and possible variables in these observations : bias of complacency in the questionnaire, inter-individual variability in the appetite for digital tools, motivation, etc. A comparative analysis of

the wooflash, anki and quizlet tools could be conducted in order to determine the advantages and limitations of the practices enabled by these tools.

However, several challenges were identified, including late adoption by students and limited impact on exam performance : late and infrequent use of the tools may limit their effectiveness in promoting deep learning, and time constraints and unfamiliarity with the tools are primary barriers to adoption. Therefore, there is a need to determine the nature of the factors that lead students to procrastinate (Steel, 2017). Future implementations should focus on earlier integration of these tools into the curriculum and providing more guidance to students on their effective use.

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