Improving Students' Knowledge and Engagement in Immunology Course Using Video-Based Learning and Concept Mapping in Modified E-tivities

Asih Triastuti [a,*], Arba Pramundita Ramadani [b]

[a, b] *Department of Pharmacy, Universitas Islam Indonesia, Yogyakarta, Indonesia*

* Corresponding author: asih.triastuti@uii.ac.id (ORCID: 0000-0001-8909-1452)

ABSTRACT: E-tivities were implemented in the online class of Immunology at the Department of Pharmacy UII using video-based learning (VBL) and concept mapping exercises to enhance student motivation and knowledge. The class measurement method was used by comparing the previous academic year's lecture evaluation and outcomes (the 2021 semester without video and concept mapping) and the 2022 semester (with e-tivities using VBL and concept mapping). According to the evaluation results, the combination of learning methods with learning video and concept mapping increased the student's interest and enthusiasm for learning. Furthermore, the student's mastery of the material increased from 8% to 41%, resulting in an increase in the student's final grade. The combination of video-based learning and concept mapping increased student motivation and knowledge

Keywords: E-tivities, Immunology, Engagement, Video based-learning; Concept mapping

INTRODUCTION

The rapid spread of COVID-19 has highlighted the importance of preparing for various diseases and technological changes. Pandemics provide an opportunity to remind ourselves of modern-day skills such as critical thinking, problem-solving, and adaptability. Resilience must be built into our education system to increase student competitiveness. Covid-19 transformed learning and transitioned to e-learning [1–3]. There are two different ways to learn: self-directed learning and guided learning [4]. Students in the self-directed learning model are allowed to move around and choose their sources of information and knowledge. Students are allowed to adjust their own learning pace and decide on their learning models. Online education providers are not required to schedule, manage, or track classes or enrollees. Learning materials are developed with an outline of learning objectives and are distributed using electronic devices, such as computers, laptops, and tablets. The assessment generally takes the form of a quiz. The interaction between students and instructors is minimal [5].

In a facilitated e-learning course model, students learn by collaborating with a facilitator and sharing knowledge with other students. The curriculum is designed and developed by incorporating several elements such as learning objectives, study materials, assessments, and evaluations that are arranged into a series of schedules. This model is devoted to active learning process in which students are given the opportunities to search for, analyze, and construct their own knowledge. Course instructors employ communication tools that enable students to collaborate via email, discussion boards, or meetings. Student competencies are evaluated at the end of the lesson, to ensure that each student has mastered their subject [4].

Immunology is a diverse field that deals with all manner of infectious diseases from vaccinations to the management and treatment of chronic diseases like allergies and cancer. Immunology is also the foundation for the advancement of the pharmaceutical industry, including modern antibody therapy, cell therapy, vaccines, and immunotherapy [6]. Immunology classes supplement a pharmacist's knowledge of biomedical science. In the case of the current Covid-19 pandemic, the immunological perspective is the foundation for disease prevention and control, as well as efforts to develop a Covid-19 vaccine [7]. Immunology is a difficult subject to teach for both students and lecturers. The main challenge is that

students must learn new vocabulary quickly, apply it to build knowledge quickly, answer complex questions logically and coherently, and think logically and coherently about the physiological system of the anatomical part of the cell (immunity). Immunology teaching is difficult for the lecturer because it requires students to integrate knowledge ideally derived from previous introductory courses in a variety of fields such as cell biology, biochemistry, anatomy, molecular biology, and pharmacology [8].

The e-tivities model was used in the immunology course with modification. E-tivities are frameworks for facilitating active learning using digital media tools It is significant because it is founded on principles of effective instructional design and adapts to the technologies used. E-tivities focus on learners (students) because they are contributors who seek, work on, interpret, and combine information. E-activities are based on the idea that peer-to-peer learning restructures societies [9]. Many students struggle with motivation and retention in immunology classes. It was caused by an inability to understand the complex and multidisciplinary field of immunology at the cellular level. It is difficult to translate the physiological aspects of the disease into the clinical consequences of the illness.

A combination of video-based learning and concept mapping exercises will be used to implement the student-centered learning concept [10,11]. Concept maps are visual representations of how we organize our knowledge and connect concepts in our minds to form a network of nodes and connecting links [11]. Recently, educational videos have been widely employed as an extra teaching tool, particularly in blended learning and MOOCs (Massive Open Online Courses) [12]. Videos allow teachers to monitor students as they solve issues, explain their thought processes, and share problem-solving approaches, while teachers encourage and extend students' ideas and create explicit linkages between images, concepts, and procedures [13]. Concept maps support higher order thinking better than many other teaching modalities. Creating a concept map requires understanding how ideas are related, a cognitive talent that can't be learned through memory or heuristics [14]. Assigning students the job of building a concept map–alone or in groups–can prompt them to consider what they've learnt metacognitively [15]. In our class, video-based learning will help the students to find and acquire the information along with the reading materials. Furthermore, concept mapping will facilitate the student to construct the information into knowledge. This self-reflective activity boosts learning and retention.

METHOD

The video-based learning and concept mapping exercise was implemented for 177 students of immunology A, B, C, and D of student's class 2019 (academic year 2022). The learning process was designed as displayed in Figure 1.
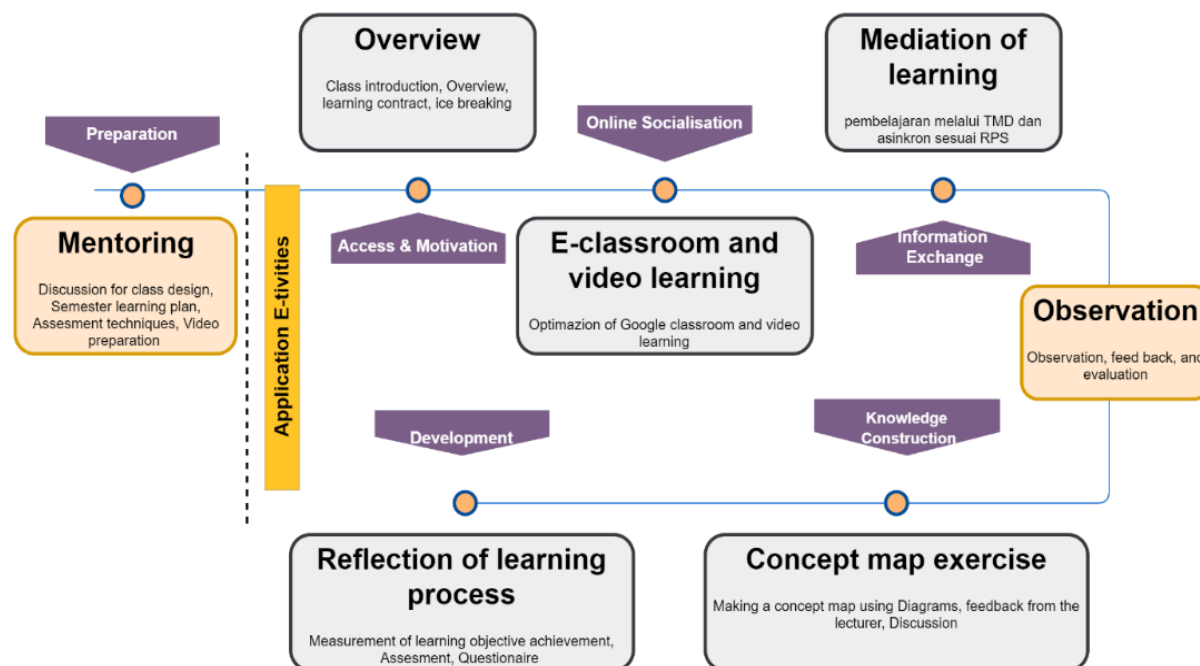
FIGURE 1: Utilization of e-activities in an online Immunology course. Mentoring and observation steps were added to the e-activities. Mentoring enabled the instructor to prepare all the materials (hand out, video, and semester learning plan). Observation was the monitoring of the learning process, which included providing students with feedback and evaluating their work.

(i) Preparation

The pre-class preparation process is required to determine how well students understand the topics to be covered. The semester learning plan was created by the team lecturers to ensure that there is little variation in students' understanding of the course. The semester learning plan was shared and explained to students as part of the course preparation process.

There are two learning outcomes (LO) in Immunology course. The first is PEF2: Graduates understand the theory, methods, concepts, and applications of basic biomedical sciences that support the development of pharmaceutical science and practice, as well as the second LO, SIF3: Graduates can apply responsibility, dedication, and discipline based on sincerity, honesty, and integrity thoroughly in their fields. These two LOs were broken down into five-course learning outcomes (CLO) based on the course materials and APTFI's (Association of Indonesian Pharmacy Universities) requirements for mastery the biomedical science.

(ii) Access and motivation

At this point, the lecturer ensured that the student had access to the online learning design process. The main challenge for UII Pharmacy students is the limited internet network, especially for students who live outside of Java. To overcome this barrier, the lecturer provided an online platform that would be used at the start of the meeting so that students could prepare to access it (or download the application), which was required in addition to the planning of asynchronous activities at several lecture meetings. The lecturer distributed the Semester Learning Plan (SLP), which included the 1-semester learning process and material and explained the introductions to the lectures as well as the rules relating to the lectures, including the assessment rules, at the first meeting. The file has been uploaded to Google Classroom (GC).

Motivation is an essential element that helps students "enjoy" online lectures to encourage student participation and an active role in the learning process. It is critical to remember that learning activities must provide students with value/use/benefit for them to succeed in the course. The lecturer's first steps were to increase students' understanding of the importance of lectures (immunology), explain the course's contribution to the pharmacist profession, why the learning model was chosen, and what students should do to actively participate in the learning process. The lecturer also discussed the rewards for students who actively participate and perform well. One of the lecturer's motivations was to provide a video on Covid-19 to bring students closer to real-world immunology applications and the development of Covid-19 vaccines.

(iii) Online socialization

The course design was explained at this stage, including the introduction of learning platforms such as Google forms, Panopto, and Diagrams. The aim of this online socialization step was for the students to well prepared for lectures, such as installing the necessary software or devices. The students were provided with an explanation of how to use the application gradually, according to the activity agenda that uses the application (at least 1 week before the application is used). Lecturers helped students who are not familiar with the platform being used. For each meeting covering both synchronous and asynchronous, the lecturer introduces the day-to-day material and the platform to be used. In addition to explaining how to use the application, the online socialization stage was used to get to know each other personally and to understand each student's intentions, hopes, and even dreams. When taking online classes, lecturers facilitate this process by, for example, creating small discussion forums between lectures with Padlets or Flipgrids where students write down their expectations.

(iv) Information exchange

This stage is at the heart of the learning process, where there is an exchange of information between lecturers-students, and vice versa. The learning process is carried out by promoting the student-centered learning (SCL) method, where students are guided to find information from the sources shown/provided by the lecturer, to discuss the material and to conclude the results of the discussion as information/knowledge. At this stage, various applications have been used as previously socialized to the students. The lecturer prepared structured content for the learning material and sent it to students through the GC. This content is in the form of reference books, reading materials (newspapers/infographics), links to other websites for information, and learning videos uploaded no later than 3 days before the start of the lecture. Lecturer prepared video supplements are categorized into two, namely those made by lecturers and videos accessed from online platforms [16] . Some of the videos accessed from the online platform include:

a. Nature immunology: https://www.youtube.com/channel/UC7c8mE90qCtu11z47U0KErg
b. iBiology:https://www.ibiology.org/educators-resources/flipped-courses/immunology-flipped-course/
c. Khanacademy:https://www.khanacademy.org/science/biology/human-biology/immunology/v/role-of-phagocytes-in-innate-or-nonspecific-immunity
d. Walter + Eliza Hall: https://www.wehi.edu.au/wehi-tv/animation
e. Janeway Immunology [17]

(v). Knowledge construction

Students at this stage learn to control their knowledge and then build in new ways. Students watch videos from references and lecturers to help visualize the immune response and understand it better. After watching the instructional video, the student must create an immunological concept map that corresponds to each topic of discussion. Individual concept maps are an attempt to integrate some of the information that they have learned. At this point, in addition to students learning how to create student folders, several online applications have been introduced to make creating digital concept maps easier (soft skills improvement).

(vi). Development

In this stage, both lecturers and students were reflecting on the learning process that has been carried out. For students, it is necessary to continue this reflection at the next stage of the lecture process. While for lecturers, learning evaluation is very important in building creativity to develop teaching materials and methods.

RESULT AND DISCUSSION

One week before the first course, all the materials for one semester, including the e-book, video, and application, were set up in GC. The course team leader ensured that all the materials for four classes were properly set up in GC.

The initial assessment revealed that 75% of students were prepared and ready to take online lectures, while the remaining 25% were not. Students at UII Pharmacy typically have access to a limited internet network, particularly if they live outside of Java (Figure 2). The lecturer then adjusted the learning process based on the data. The lecturer distributed a semester learning plan that included the process and learning materials for one semester, explained the introduction to lectures, and the rules related to lectures, including assessment rules, at the first meeting. Google Classroom received the document (GC). Figure 3 depicts students' reception to the SLP explanation and implementation over the course of one semester.
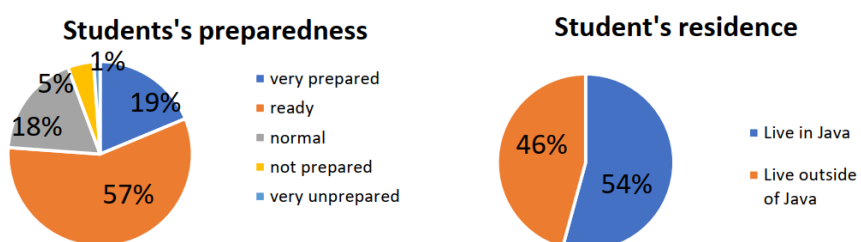

FIGURE 2. Student preparedness and student residence during the online course. More than seventy-five percent of students indicated that they were prepared for the course despite living outside of Java, typically with a poor internet connection.
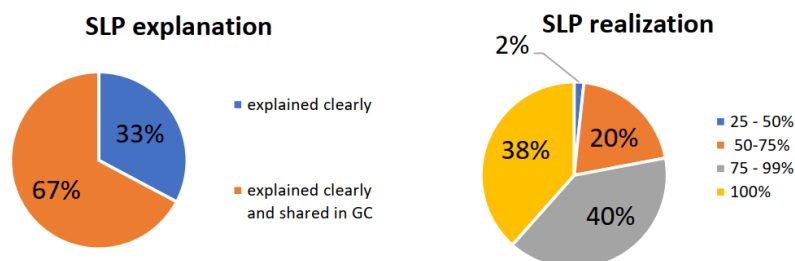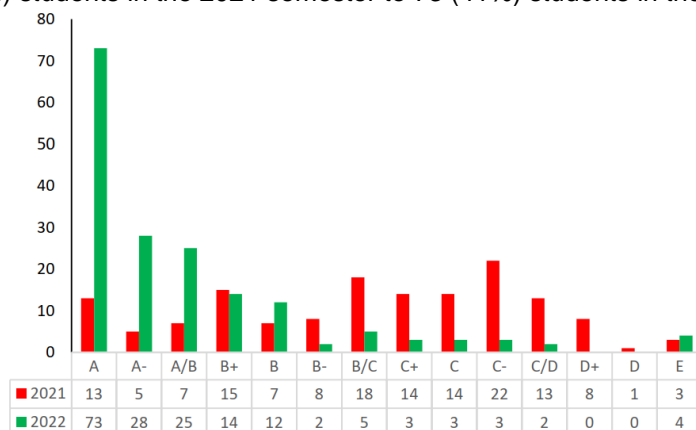

FIGURE 3. Students' perspective on semester learning plan (SLP) delivery explanation and realization during one semester. All students stated the SLP was well delivered and 78% stated well realized during the course.

One of the issues with online learning is student motivation and retention. During the immunology course, students reported being very excited and motivated (82%). Furthermore, the course assignments are stated to be able to improve student understanding (Figure 4).
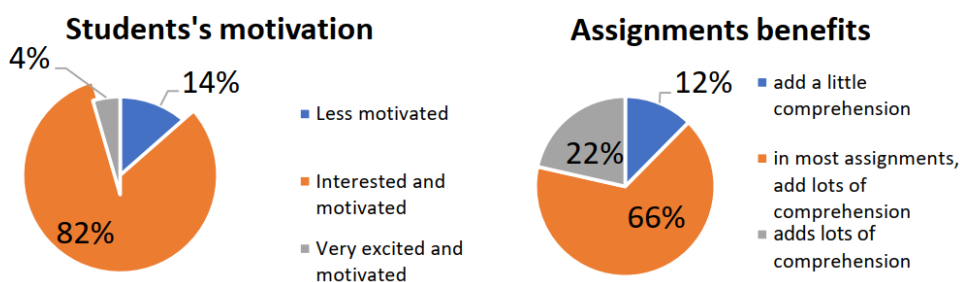
FIGURE 4. shows how students' motivation has increased throughout the course and how they view the advantages of the assignment. 86% of students reported that the course increased their motivation. They added that the assignments were not a burden but rather helped them understand the material.

Figure 5 shows that the e-tivities learning model increased the number of students who received grade A from 13 (8%) students in the 2021 semester to 73 (41%) students in the 2022 semester.

	A	A-	A/B	B+	B	B-	B/C	C+	C	C-	C/D	D+	D	E
2021	13	5	7	15	7	8	18	14	14	22	13	8	1	3
2022	73	28	25	14	12	2	5	3	3	3	2	0	0	4

FIGURE 5. Student's grade comparison between two academic years. E-tivities increased students' comprehension hence increase students' final grade.

Meanwhile, the percentage of students receiving the minimum grade of B also increased from 31.8 per cent (2021) to 87.4 per cent (2022), which corresponds to the increasing number of students passing the Immunology course. Based on the average, the final mark for this semester was 76.29 ± 10.74, an increase of 16.39 per cent compared to the previous semester.

The course learning outcomes (CLOs) were also measured based on the assessment of student assignments, and mid and final examinations to evaluate the student knowledge. CLO achievement is presented in Figure 6.
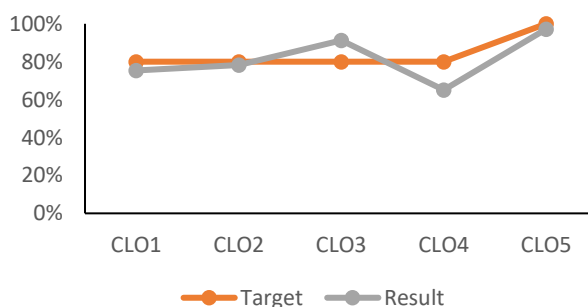
FIGURE 6. Course learning outcome accomplishment. All the learning objectives were achieved during the course.

Teaching immunology is difficult for both students and instructors. Students must grasp the new language and rapidly use it to establish a knowledge base and provide answers to complicated queries, as well as figure out how to think logically and coherently about the physiological systems of the anatomical (immune) portion of the cell. Immunology is a difficult subject for lecturers to teach since it demands students combine knowledge from basic courses in cell biology, biochemistry, anatomy, molecular biology, and pharmacology, among others [8]. Before taking immunology course, students should master molecular biology and pharmacology because these two courses give the basic understanding of cellular mechanism. For instance, the study of antigen recognition by immune cells relies on receptors and ligands that should have been learned in pharmacology classes. In addition, students lack the fundamentals of molecular biologyy, such as a grasp of DNA replication and gene switching, which underpin studies on the activation of T cells and B cells (antibodies). This complicates the learning process for both lecturers and students. From the perspective of the lecturer, they must construct a learning model that encourages students to read/master a theory they do not possess and ensures that students comprehend the subject. On the student's side, there is a need to study other material that they have not independently acquired with limited understanding so that a "bias" or conception of the mastery of a vast subject can be formed.

According to the students' perspectives, the SLP was explained clearly, indicating the preparation and socialization steps in e-tivities were successfully delivered. Furthermore, the SLP realization was also well realized during one semester with good receptions >78%. Information exchange was facilitated through GC and Zoom. All reading and materials were free to access to students. The lecturers also produced self-made learning videos and post tio GC and YouTube channels (Memes Asih Lectures).

Motivating the student to study in the online classroom is an important factor in successful SLP implementation as well as curriculum employment, especially during the Covid-19 pandemic [18]. There are several ways to augment the student's motivation including the use of learning media. Students, such as the Z generation, tend to like joyful studying methods. Video-based learning and concept map making are proven to enhance students' motivation and retention hence utilized in this immunology course [19,20]. The concept mapping task allowed the student to be active and express their thought. Furthermore, for the kinesthetic learner, constructing a concept map supports the habit that they need to "moving" while studying [21,22]. In this course, the lecturers facilitated students to make an appropriate and correct concept mapping by developing a guided-concept mapping. The lecturers gave the keywords of concepts and asked the students to elaborate and develop them into a concept map. For video-based learning, the student becomes passive since they are ordered to watch the video. After watching the movie, students were given projects to create resumes, followed by group discussions, to improve student involvement. Students claimed (86%) that videos and concept maps improve their motivation and retention. These techniques helped most students by helping them to better understand the assignments (Figure 3). Students stated video and concept mapping enhance their motivation and retention (86%). Most of the students benefited from these methods in terms of increasing their comprehension through the assignments (Figure 3).

The last step of e-tivities −the development step involved lecturers' and students' elaboration to review the learning process. Students' grades increased compared to the previous academic year (Figure 4). Students' final grades in immunology courses have been found to improve when the assessment process includes not only the midterm and final tests, but also detailed activities and assignments. This is also reinforced by the remediation policy in each Course Learning Outcome (CLO) evaluation conducted independently by the lecturer, which reduces the strain on students if they are required to repeat all CLO after the lectures. The CLO also exceeded the target, demonstrating the student's CLO achievement throughout the course (Figure 5). The grades of the students and their achievement of CLOs revealed the benefits of video-based learning and concept mapping in the learning process.

CONCLUSION

This research demonstrated the synergistic benefit of video-based learning and idea mapping in an immunology course. For future studies, lecturers may advise students on the construction of concept maps for classes with high degrees of complexity. This strategy could enhance students' cognitive abilities and position them to achieve better academically. This research paradigm can be utilized to study the use of video and conceptual mapping to improve student achievement in other forms of higher education.

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