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Using online flipped classroom in problem-based learning medical curriculum: A mixed method study

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ABSTRACT

The coronavirus disease (COVID-19) pandemic has changed the education system, including problem-based learning (PBL), which is the main curriculum model in medical education. Social interaction and acquisition of knowledge and skills are one of the challenges in online learning during a pandemic. This study evaluated the use of the flipped classroom in the PBL curriculum of medical education. This study used mixed-methods design with a concurrent approach. The data collection technique was secondary data collection in the form of data from the block learning evaluation form. The evaluation form contains statements regarding the quality of the learning process, in the form of Likert scales. At the end of the form, there was a fill-in/essay question for more in-depth exploration. The quantitative data were analysed using descriptive univariate analysis, meanwhile, the qualitative data were analysed using thematic analysis techniques. Unbalanced learning load on the block, block learning management, and knowledge retention in block learning were considered lacking in flipped classroom block implementation. The management of time delays, a stage for students to be ready, a step to lessen psychological stress, and the use of media to generate different learning experiences are particular areas that need improvement.

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1. INTRODUCTION

The coronavirus disease (COVID-19) was first reported in Wuhan, China, in December 2019, then gradually spread to various countries until it was designated a global pandemic by the World Health Organization or WHO in March 2020 [1]. As a result of its very sudden and rapid spread, COVID-19 has caused significant changes in the worldwide healthcare system that have an impact on various aspects of human life. COVID-19 has affected all levels of the education system, from primary schools to higher education [2], [3]. Different countries have implemented various policies, such as the closure of educational facilities nationally. This has resulted in multiple changes in teaching and learning activities that move from academic institutions to online homes, including block learning in the faculty of medicine [4], [5].

Medical undergraduate studies in Indonesia mostly use the philosophy and method of problem-based learning (PBL). The implementation of PBL uses the smallest unit of learning in the form of blocks. The block focuses on case-based education, with the main activities being small group discussions, field activities, and skills training [6]. Lectures and practicum are PBL-supporting activities [7]. The PBL process requires learning by linking knowledge and cases with contextual/experience-based learning [8]. Knowledge retention arises from the constructive process of communication and interpersonal relationships in social interaction [9]. Social interaction in the form of face-to-face interaction has a different dimension from

interaction in the form of online learning. The process of social interaction using telecommunication technology intermediaries in the form of social media, face-to-face applications, and online learning (e-learning) [10]. This raises questions regarding effectiveness in facilitating interactions between the dimensions of teaching, learning, and learning design [11]. An exploratory study of learning experiences during a block pandemic can provide objective clues—instructions related to opportunities and challenges in preparing instructions in conditions that do not allow face-to-face.

The implementation of block learning that applies minimal face-to-face activities has problems. PBL learning techniques in conventional blocks have higher discussion performance rates in face-to-face tutorials than in online tutorials. Performance problems lie in the dimensions of participation, preparation for learning, and group discussion skills. Online learning during a pandemic allows for wider and immediate access to information, but on the other hand, the opportunity for fraud also increases during the assessment process. The variety of problems related to student satisfaction related to access and learning services and their influence on perceptions of achievement of learning objectives is one of the recommendations for further studies [10]–[12]. These problems, opportunities, and recommendations are considered to be explored from phenomena based on the background of the medical undergraduate education system in Indonesia, namely PBL. This research focuses on case studies to provide important points, especially developing block learning instructional designs. Therefore, this study aims to examine the important issues of lessons learned that emerged in implementing online flipped classroom block learning designs during the pandemic.

2. RESEARCH METHOD

This research is a mixed-methods study with a concurrent approach, i.e., quantitative research is carried out together with qualitative research. Quantitative analysis employed descriptive observational approach, while qualitative research was with a phenomenographic approach. The data collection technique in this study was secondary data collection in the form of data from the block learning evaluation form developed by the head of the medical study program. At the end of each block learning, students filled out a block learning evaluation form.

The evaluation form contains statements regarding the quality of the learning process, the suitability of the method with learning objectives, the suitability of online learning methods, the quality of lecturers' teaching. The evaluation dimension score is in the form of Likert scales ranging from 0 (very unsatisfactory) and 5 (very satisfactory). Meanwhile, the overall score ranges from 0-10. Research constructs the questionnaire validity with data triangulation—the triangulation considered from medical education peer discussion consisting of five members and item-based references construction. The result is calculated with the item validity test and proofread again. The reliability test was conducted among thirty students before they transferred into Google Form. The questionnaire is given to students via the Google Form link. Evaluation components that score less than 3.5 and an overall score of less than seven are considered not to meet the quality assurance standard. Qualitative research data in the form of answers/responses to essay questions on the Google Block learning evaluation form. The quantitative data were analysed using descriptive univariate analysis to examine the quality of the learning process, the suitability of the method with learning objectives, the suitability of online learning methods, the quality of teaching lecturers, and student perceptions regarding online block learning.

At the end of the form, there was a fill-in/essay question for more in-depth exploration. Responses from the fill-in/essay questions were taken as qualitative data. The data then were analysed using thematic analysis techniques to describe the block learning process during a pandemic, its strengths, benefits, constraints, and things that must be considered in online learning. This was done to analyze more deeply how ideally the instructional design in the online PBL system. Two researchers carried out open coding. The coding was started by identifying the codes, followed by categories and themes.

2.1. Setting

This study was conducted in a faculty of medicine in Indonesia, which conducting a problem-based learning curriculum since 2013. The PBL curriculum consists of a block and course system. The curriculum is divided into three themes, the first year of basic medical sciences, and the second and third years of clinical sciences. The main activities of the block are problem-based learning tutorials, clinical skills training, and field activities. Supporting activities are lectures and practicum. Students use Maastrich's seven-step PBL tutorial approach. Tutorial, practicum, and lecture activities produce summative scores with multiple choice question (MCQ). Clinical skills training and field activities are assessed using the objective structured clinical examination (OSCE) and portfolio. The course system is a non-block learning approach covering topics of research methodology, medical ethics and professionalism, and interprofessional education.

3. RESULTS AND DISCUSSION

3.1. Quantitative study

Table 1 shows the characteristics of respondents by gender in each evaluation block. It appears that most of the respondents are females. Response rate varies with the percentage between 62.4-93.6. The response rate is acceptable because there is no obligation for students to fill out the block evaluation questionnaire and there are no sanctions for those who do not fill out the questionnaire.

Table 1. Distribution of respondents for each block evaluation

Response	Male	Female	Total response	Response rate (%)
Basic genitouropoetica (year 1)	60	153	213	91.4
Basic cardiorespiration (year 1)	52	134	186	79.8
Basic neuroendocrine (year 1)	64	154	218	93.6
Immunohematology diseases (year 2)	61	127	188	79.3
Gastrohepatology diseases (year 2)	54	116	170	71.7
Cardiovascular diseases (year 2)	44	104	148	62.4
Reproduction and uropoetica diseases (year 3)	50	135	185	88.5
Special senses diseases (year 3)	42	109	151	72.2
Life cycle (year 3)	38	94	134	64.1

There are 10 dimensions of student feedback on the learning they experienced. The feedback can provide an understanding of the concepts and principles of science, which is the most that needs to be improved. The special senses diseases block got score of 6.93 (<7) as seen in Table 2, meanwhile, there are two blocks that receive an evaluation in the form of an unbalanced learning load on the block. In addition, two evaluation components are considered lacking, block learning management and knowledge retention in block learning. When the three evaluation dimension scores are lacking, the overall score also becomes less. This shows that these three components are very important in flipped classroom learning.

Table 2. Respondent responses on item dimension evaluation of each block

Item dimension of evaluation	Clarity of learning objective	Learning activities support learning objective	Block management-support learning objective	Discussion drives self-regulated learning	Discussion supports the learning process	Balance of learning cognitive weight	Retention of knowledge	Subject and media attraction	Relevancy with the jobs need	Assesment reflects learning objective and outcome	Overall evaluation
Basic genitouropoetica (year 1)	4.75	4.68	4.49	4.69	4.67	4.65	4.55	4.58	4.73	4.67	9.07
Basic cardio respiration (year 1)	4.67	4.56	4.44	4.55	4.60	4.38	4.26	4.38	4.69	4.49	8.72
Basic neuroendocrine (year 1)	4.6	4.5	4.36	4.52	4.54	4.26	4.18	4.25	4.63	4.48	8.67
Immunohematology diseases (year 2)	4.54	4.49	4.28	4.46	4.43	4.26	4.26	4.38	4.57	4.35	8.70
Gastrohepatology diseases (year 2)	4.53	4.38	4.15	4.46	4.38	4.02	4.10	4.23	4.62	4.24	8.28
Cardiovascular diseases (year 2)	4.40	4.32	4.26	4.40	4.40	4.17	4.14	4.30	4.53	4.22	8.45
Reproduction and uropoetica diseases (year 3)	4.16	3.85	3.61	4.16	4.17	**3.45***	3.74	3.92	4.38	3.88	7.35
Special senses diseases (year 3)	3.76	3.5	**2.95***	3.85	3.81	**2.79***	**3.26***	3.58	4.13	3.52	**6.93***
Life cycle (year 3)	4.07	3.89	3.59	3.98	4.0	3.75	3.69	3.88	4.21	3.90	7.59

*) below the average of the student perception marks each dimension

The implementation of block learning that applies minimal face-to-face activities has problems. PBL learning techniques in conventional blocks have higher discussion performance rates than online tutorials. Performance problems lie in the dimensions of participation, preparation for learning, and group discussion skills. Online learning during a pandemic allows for wider and immediate access to information, but on the other hand, the opportunity for fraud also increases during the assessment process [1]–[3]. The

variety of problems related to student satisfaction related to access and learning services and their influence on perceptions of achievement of learning objectives is one of the recommendations for further studies [4], [5], [13]. These problems, opportunities, and recommendations are considered to be explored from phenomena based on the background of the medical undergraduate education system in Indonesia, namely PBL. The big question to be answered by paying attention to the problems above are the important points of wisdom that emerged in implementing block learning designs during a pandemic.

3.2. Qualitative study

Table 3 shows the results of qualitative thematic analysis. Four dominant themes emerged from the student's comments on stimulus questions in the Google Form. The themes show us the pattern among phenomena. Flipped classroom sensitivities towards time, suitable media, training among lectures students, and physiological resilience.

Table 3. Qualitative thematic analysis results

No	Themes	Quotation
1	The allocation of flipped classroom learning time is something sensitive	"*I also suggest to lecturers not to leave students and to use their time as effectively as possible because some new material that is foreign makes students not aware of it and cannot study independently*" (Y1) "*The schedule of block learning in this semester is too tight, changes are sudden, and out of sync*" (Y2) "*For the practicum schedule, it may be possible to separate the days between topics because if there is more than one topic in one day, sometimes the learning load is heavier*" (Y3)
2	The structure of the formulation of learning objectives in the flipped classroom learning design requires the support of activities and supporting media	"*….tutorial activities can be placed after students get the material/cases that will be discussed from lectures/lectures so that students find it easier to understand and apply the topic*" (Y1) "*Overall, all block activities have supported students to understand the material that suits the needs of the profession later*" (Y2) "*It is better to optimize the use of LMS, give enrolment key blocks, and update ppt before class time. Because it will be very useful for students to read and read first, so when studying, we can better understand what the lecturer is explaining*" (Y3)
3	Flipped classroom teaching requires different pedagogic training from conventional classes	"*It seems that to be more motivated to understand, lecturers can practice more interactively and creatively, a 'Kahoot' quiz can be held after lectures like what Ms*" (Y2) "*The longer the pandemic, the lecturer could conduct better online lectures, short lectures but with lots of interactions so that they are more interesting*" (Y1)
4	The burden arising from the flipped classroom learning experience raises a critical point between meaningful knowledge retention and psychological burn-out	"*Learning to be more adjusted between portions and the essence, especially for material that is applicable so that knowledge is obtained that is not too much (overloaded) but good in understanding*" (Y3) "*because if there is more than one online practicum in one day, sometimes the learning burden is heavier*" (Y1)

a. Theme 1: The allocation of flipped classroom learning time is something sensitive

The proportion of guided face-to-face time, independent assignments, and quiet periods needs to be considered when preparing a learning instructional design. Flipped classroom time feels more congested even though the total amount is no different from normal time. The maximum comfortable learning time per session is 1.5 hours, and more than that tends to be tiring. The average conventional learning process in the medical faculty studied requires 16-24 credits or an average of eight hours a day. If given a recovery time of 10 minutes every 1.5 hours every day, one day requires an extension of approximately 50 minutes. One factor that affects student readiness in implementing flipped classroom learning is sufficient time to prepare and respond to learning experiences [14]. Thus, students have time to prepare references and prepare for the exam.

The division of groups in each meeting session affects the time. Flipped classroom lectures using video conferencing media with more than 100 participants cause psychological fatigue for teachers and students. Flipped classroom activities will be more effective with a maximum of 16 students [15]. The division of time and class into 16 students per class is not feasible in Asian culture. This adds to the burden on teacher time and resources. Therefore, learning using a learning management system is an alternative to achieving cognitive learning objectives. The use of learning management systems also emerged from student feedback. A learning management system's contents promote effective learning. Students benefit from interactive tools and their conceptual incorporation into in-person instruction. The availability of learning

materials and organizational needs were two areas where the learning management system was particularly crucial [6], [7].

b. Theme 2: The structure of the formulation of learning activities in the flipped classroom learning requires the support of activities and supporting media

The formulation of learning activities in a flipped classroom requires a variety of activities supported by technology or technology-enhanced learning. This approach is a follow-up to mitigating the source of the burden on learners with the character of the millennial generation. Students need interaction in the learning process. Students and lecturers face each other in space when using the technique of moving face-to-face to virtual face [4], [9], [10]. Distraction fills this space, the distraction can be in the form of students doing different activities in parallel, such as doing daily activities, traveling, and falling asleep [4], [13]. This distraction adds a burden in addition to cognitive load [5], [11]. Therefore, the flipped classroom needs a method to fill the space.

Flipped classroom interaction requires two-way communication methods such as telehealth experiences, discussion forums between lecturers and students, discussion forums between students, and stress assistance [1], [12], [16]. Therefore, the flipped classroom does not only rely on one simple seminar method, which is commonly done in traditional oriental classes [13], [14], [16]. Simple technology, varied teaching skills, and facilitating two-way communication can support the formulation of the flipped classroom design.

c. Theme 3: The burden of the flipped classroom learning experience raises a critical point between meaningful knowledge retention and psychological burn-out.

Students explained that time was tight when the learning process was not effective. The inefficient process is reflected in the perception of the learning burden, the feeling of not having the opportunity to learn earlier, difficulty adapting to the block structure, and difficulty retaining knowledge. Ineffective flipped classroom learning creates a burden due to weaknesses in self-regulation such as timing, coordination, and task management [10], [14]. The community of inquiry (COI) approach model makes flipped classroom learning effective by designing the presence of three elements, namely teaching techniques, student interaction patterns, and understanding design structures [10], [14], [15]. Lecturers teaching with the flipped classroom method are more focused on planning variations of the interaction of the learning experience rather than completing the material face-to-face. Student interaction patterns can be improved with various two-way activities. The learning design pays attention to psychological fatigue by including the stages of conducting supervision and psychological mentoring of students and providing the material structure and focus of the subject at the beginning of the block activity. Interpreting the COI approach will reduce unnecessary cognitive load when students attend flipped classrooms.

d. Theme 4: Flipped classroom teaching requires different pedagogic training from conventional classes

Flipped classroom teaching skills require improvement in time management; teaching techniques are supported by various media and learning experiences, as well as the ability of lecturers to design a COI approach. Traditional oriental classes hold lecturer training related to the preparation of modules and teaching materials but do not emphasize the concept of delivering learning experiences. The curriculum manager submits to lecturers regarding how to teach [17]–[19]. Flipped classroom teaching training needs to include material on designing the use of online modalities, creating learning plans that reduce cognitive load and have a variety of learning experiences, methods for including self-explanation and self-monitoring in flipped classrooms, and topics to motivate students [15], [19]. The issue is a differentiating material for training lecturers using the flipped classroom method.

The phenomenon of online learning is very dynamic in various flipped classroom studies. Millennial students are considered as a generation that likes and masters technology. However, the actual condition is that students are unprepared to carry out the flipped classroom. This creates anxiety when there is a transition from face-to-face to virtual face-to-face activities. This is because the key is a lack of preparation and awareness of accepting new experiences. The longer students have experienced past conditions; the more critical they are in evaluating new situations [20], [21]. New students will tend to be more receptive to the flipped classroom method. Students in higher classes tend to be more dynamic in providing input due to differences in the self-regulatory context that has been embedded previously [18], [22]. Students are using the support of teacher's pedagogical method to self-regulate [23].

The balloon model in Figure 1 shows that when the learning design compresses time and material, it will suppress the student balloon. Student balloons contain self-regulatory abilities, distractions from the surrounding environment, and students' readiness and awareness to accept learning experiences and

contextual gaps. These balloons develop students' emotional stress. Students will provide feedback when the moving balloon is at a critical bursting point. A burst balloon will bring students to a state of psychological exhaustion. It is crucial for medical educators to understand that learning and teaching methods may vary throughout time. Students today are from generation Y-Z, while medical lecturers today are from generation X [24], [25]. The instructors should be conscious of these variations and act coherently.

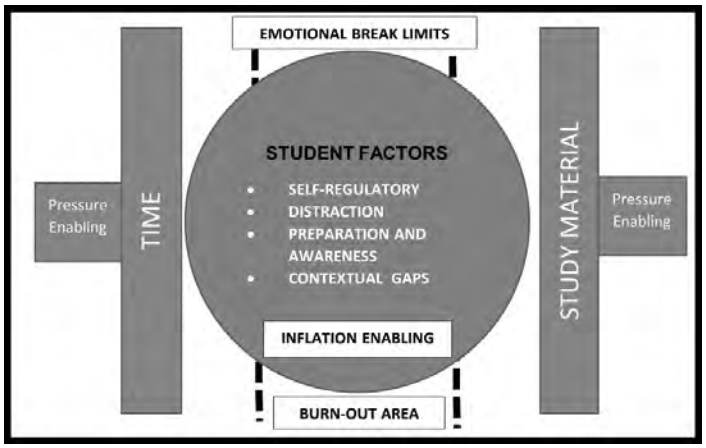

Figure 1. Factors influencing flipped classroom in PBL block system

4. CONCLUSION

The PBL block implementation of distance learning with flipped classrooms during the COVID-19 pandemic was able to produce valuable experiences. The lessons mainly arise from the need for time perception management, the preparation of learning design structures, providing a variety of learning activities supported by effective media, the need for training related to presenting interactions in flipped classrooms, and identifying input from groups that have large contextual gaps. Recommendations are especially on the management of time lags, a phase for students to prepare themselves, a step to mitigate psychological burdens, and the use of media to create various learning experiences.

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