Article

Online Problem-Based Learning in Child and Adolescent Psychiatry at Nagoya University, Japan

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Abstract: Purpose: Mental health care is limited worldwide, especially for children and adolescents. Moreover, there are barriers to using mental health services for children and adolescents, including a shortage of standardized training programs and the subsequent workforce. To solve this problem, Japan adopted problem-based learning (PBL) to enhance standardized medical education about child and adolescent psychiatry (CAP). This preliminary study aimed to evaluate online CAP studies at Nagoya University (NU), Japan, with a focus on PBL materials. Design and methods: A descriptive cross-sectional preliminary study was carried out at NU with a questionnaire developed under the Trondheim–Nagoya (TroNA) project by NU and the Norwegian University of Science and Technology (NTNU). The questionnaire, measuring students' perceptions and understanding of the PBL curriculum and PBL in the CAP, consisted of 15 questions answered on a three-point Likert scale. To compare the PBL CAP delivered online (2021) with the established PBL CAP carried out in person (2019) at NU, an identical questionnaire was used both in 2019 and 2021. Results: The majority of medical students in both in-person (82.5%) and online (91.2%) classes agreed that PBL helped them develop clinical problem-solving skills. In addition, 53.6% of the students in the in-person class and 75.8% of the students in the online class thought PBL enhanced their understanding of CAP. In terms of specific case scenarios, the majority of students in the in-person class (59.8%) and online class (74.7%) agreed that the PBL case helped them understand the importance of a multidisciplinary approach in CAP. Conclusions: Most of the NU medical students were generally satisfied with CAP's online PBL curriculum. The online PBL CAP curriculum with specific case scenarios can provide medical students with suitable educational means. This preliminary study can to a certain extent provide information relevant for the development of online PBL education in CAP patients and for planning to attract more future doctors to CAP.

Keywords: problem-based learning; child and adolescent psychiatry; medical school students; online class; TroNA project; Japan; medical education; COVID-19; workforce shortage

1. Introduction

1.1. Child and Adolescent Mental Health

Mental health is a principal factor in determining an individual's health. The combination of mental, physical, and social well-being determines individuals' health conditions [1].

However, mental health is still overlooked among health constituents compared to physical health [2]. Globally, 25% of people suffer from one or more mental or behavioral conditions during their lifetime [3–5]. People with mental disorders are more likely to develop other diseases, and mental disorders are 14% of the causes of death worldwide [6–8]. Notably, the COVID-19 pandemic has severely impacted people's mental health and well-being worldwide, and the importance of mental health management has been highlighted [9–11].

Since most mental disorders in adulthood originate in childhood or adolescence, managing mental health in children and adolescents is even more critical [12]. According to the World Health Organization (WHO), 10% of children and adolescents worldwide experience mental health disorders [13]. It is estimated that 3% of children aged 1 to 4, 7.6% of children aged 5 to 9, and 14% of adolescents aged 10 to 19 experience mental disorders [14]. Multiple factors affect the mental health of children and adolescents, but stress and trauma are critical causal factors of mental disorders in these individuals [15].

1.2. Child and Adolescent Mental Health in Japan

Up to 20% of Japanese children and adolescents have a mental health problem [16]. Additionally, as stated in the 2020 United Nations Children's Emergency Fund (UNICEF) report, the mental well-being of Japanese children and adolescents is rated not in the top tier among 38 Organization for Economic Cooperation and Development (OECD) countries and European countries [17]. Mental well-being includes all aspects of a child's mental well-being, such as life satisfaction and suicide rates [17]. Thus, in Japan, mental health is a pressing issue for children and adolescents.

However, Japanese children and adolescents have barriers to accessing mental health services [18]. Mental healthcare services for children and adolescents are insufficient because of the shortage of relevant professionals in Japan [19]. As of 2024, 626 medical specialists are certified by the Japan Society of Child and Adolescent Psychiatry (JSCAP) in Japan as child and adolescent psychiatrists [20]. Furthermore, there are certain problems related to standardized education programs for child and adolescent psychiatry (CAP) in Japan [21].

On that basis, the Japanese government has been working to increase the clinical skills of medical doctors and allied professionals to improve care for children and adolescents with mental health problems and disorders [22,23]. As part of that, the government has attempted to expose more psychiatric residents, medical students, general psychiatrists, and pediatricians to CAP [22,23]. In addition, Japanese higher education institutions are pursuing educational systems such as problem-based learning (PBL) that could develop better clinical problem-solving skills.

1.3. PBL

At McMaster University in Canada, Howard Barrows proposed PBL to make medical students more amenable to solving problems in clinical settings [24]. PBL is a student-centered approach in which teachers act as facilitators of everyday problems encountered in clinical settings [25,26]. During PBL sessions, a few groups of students are asked to define the problem and decide on possible solutions based on the required skills and resources. Unlike students in one-sided lectures, students in PBL can learn more effectively with autonomy and collaboration during teamwork with other students [27]. PBL encourages students to acquire knowledge, have communication and problem-solving skills through teamwork, and develop independence by setting their own learning goals [28].

The PBL learning process commonly includes the following steps. First, students in groups of 10 or fewer are informed of the problem, and they establish learning goals and roles for solving the situation in the groups. Then, during the self-directed learning period, students accomplish their learning tasks individually. After that, students gather and conduct research together with their learning results. In this stage, students are beginning to revisit the problem. Finally, students derive conclusions from their learning activities by integrating the learning process outcomes from multiple stages at the final learning stage.

1.4. PBL in CAP at Nagoya University

Nagoya University (NU), one of Japan's leading medical education institutions, adopted PBL as a curriculum in medical education in 2003. Applying the PBL curriculum strengthened global competitiveness at NU through the use of Western teaching methods. PBL is conducted in English and facilitated by both non-Japanese and Japanese medical educators [29]. Currently, NU uses PBL only for fourth-year medical students because of the shortage of PBL experts. Furthermore, as the fertility rate is low and the population has been decreasing in Japan, the influx of international students into Japanese universities is also essential for NU [30,31]. For these reasons, it is critical to have good teaching materials in English, including PBL cases for CAP.

In NU, PBL-related studies are being conducted in collaboration with the Norwegian University of Science and Technology (NTNU), Norway, to enhance the globalization and standardization of medical education under the establishment of a Trondheim–Nagoya (TroNA) partnership. Through the TroNA partnership, related professionals from NTNU and NU jointly developed PBL scenarios and questionnaires to assess students' attitudes toward PBL. As part of this process, a revised version of the PBL tool for CAP at NU was developed by applying and evaluating NTNU cases to narrow the intercultural gap between Norway and Japan and strengthen its clinical applicability [29].

2. Methods

2.1. Study Design

This preliminary study used a descriptive cross-sectional approach to investigate the correlation between PBL and NU medical school students' understanding of CAP clinical problems. In addition, this study was designed to assess NU medical school students' perceptions of PBL in CAP and compare PBL CAP sessions delivered online with PBL CAP sessions provided in person at NU using an identical questionnaire.

2.2. Study Settings

The study was carried out in CAP PBL classes at the Nagoya University School of Medicine in Japan.

2.3. PBL Study Case

In this study, the 15-year-old girl (Mayumi) PBL case developed by clinical educators from NTNU and NU (TroNA project) was used with the aim of improving the clinical problem-solving ability of medical students at NU. The main problems of Mayumi were depression with carelessness, defiance, and absence from school. The objective of the session was to understand how depression occurs in adolescents, to study when and how to initiate antidepressant medication and nonmedical interventions, and to learn how to prevent depression [29].

2.4. Study Period

This research involved two studies.

The first study was performed with fourth-year students at the NU medical school in 2019 [29]. This study was conducted through an in-person PBL class (Figure 1). The students completed a questionnaire after two 90 min face-to-face PBL sessions. The two 90 min sessions consisted of a lecture on prior knowledge of PBL and CAP. In addition, there was personal study time for the students between the two sessions.

The second study was performed in the autumn semester of 2021. During the online PBL class held at NU, the survey was conducted immediately after the wrap-up session. There were two 90 min online sessions and a wrap-up session. The students completed a questionnaire after two 90 min online PBL sessions and a wrap-up session (Figure 1).
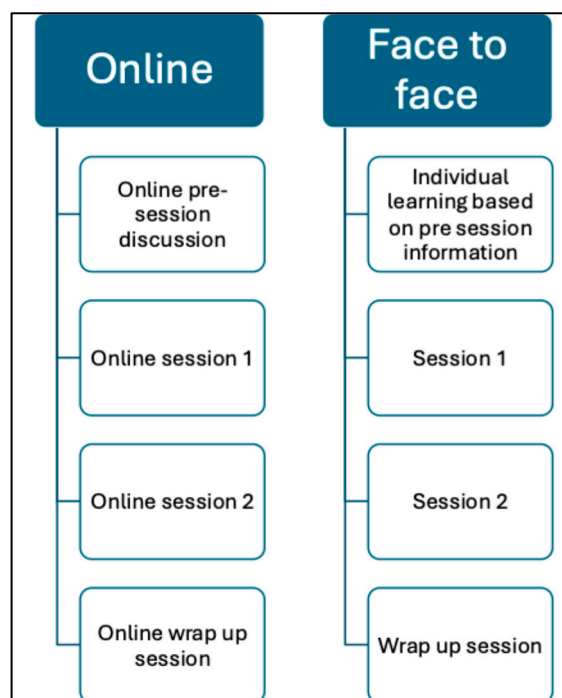
Figure 1. PBL implementation.

2.5. Study Participants

In the 2019 in-person class, 112 students participated in the study [29]. Among the 112 students, 109 completed the survey. Each PBL group consisted of 10 students and used the same English scenario (Figure 1).

The PBL sessions and survey were conducted with all of the fourth-year medical school students in the 2021 online class at NU. All 111 participants used the same English scenario in each session. After the two 90 min online sessions and wrap-up session, the students were asked to complete a questionnaire to assess their perceptions and attitudes toward the PBL curriculum. Among the 111 participants, 100 completed the questionnaire.

2.6. Data Collection

The questionnaire was designed by clinical educators in Norway and Japan (TroNA project). The questionnaire consisted of 15 questions and was divided into three subareas with a three-point Likert scale ranging between 1 = agree, 2 = neutral, and 3 = disagree. Informed consent was obtained from the participants via the PBL tutor. Questionnaires without personal information were excluded from the analysis.

In the in-person study (2019), among the 109 participants who answered the questionnaire, 12 participants were excluded because they missed their sex or age. Therefore, the answers of 97 students were used in the data analysis.

In the 2021 online class, among the 100 participants who answered the questionnaire, 8 participants were excluded because of the omission of their sex or age. Additionally, 1 participant who did not respond to all the questions was excluded. As a result, the answers of 91 students were used in the data analysis.

2.7. Data Analysis

The data were analyzed using SPSS v.20 statistics software based on the survey results. The results are presented in tables, and correlation measures were calculated for the three sections of the questions, PBL, PBL in CAP, and for the specific case scenarios using the Pearson correlation coefficient. Analyses were also performed to evaluate participants' perceptions and understanding of the PBL curriculum, of PBL in CAP, and of the specific

scenario. In addition, a comparison between the PBL CAP sessions delivered online and the PBL CAP sessions delivered in person was carried out.

3. Results

3.1. Characteristics of Participants

In 2019, 112 medical students at NU between the ages of 21 and 27 participated in an in-person study. Among these 112 students, 15 were excluded from the analysis because of their absence in the PBL class or lack of personal information. In total, data from 97 students were analyzed and are shown in Table 1.

Table 1. Demographic characteristics of participants (in-person study).

	N	%
Gender		
Male	74	76.3%
Female	23	23.7%
Age		
21	21	21.6%
22	42	43.3%
23	23	23.7%
24	2	2.1%
25	3	3.1%
26	4	4.1%
27	2	2.1%

In 2021, 100 medical students at NU participated in the survey. Of these 100 students, 9 did not provide personal information such as gender or age. Therefore, these 9 students were excluded from the data analysis. As shown in Table 2, 91 students were included in the data analysis.

Table 2. Demographic characteristics of the participants (online study).

	N	%
Gender		
Male	66	72.5%
Female	25	27.5%
Age		
21	17	18.7%
22	47	51.6%
23	18	19.8%
24	5	5.5%
25	1	1.1%
26	1	1.1%
31	1	1.1%
32	1	1.1%

In the 2019 in-person class, 109 out of 112 students participated in the questionnaire, with a high participation rate of 97.3%. On the other hand, in the 2021 online class, 100 out of the 111 students participated in the questionnaire, with a participation rate of 90.1%.

Comparison of Participants' Perceptions of PBL, PBL in CAP, and PBL Cases

Table 3 shows that the majority of the medical students (82.5%) in the 2019 in-person study thought that PBL helped them develop clinical problem-solving skills. Additionally, the majority of all the students (72.2%) considered PBL to be a good way of learning about the content of the course. In the evaluation of participants' attitudes toward PBL in the CAP section, more than half of the students (53.6%) thought that PBL enhanced their understanding of CAP. However, less than half of the students (45.4%) answered that teamwork and collaboration in PBL were particularly helpful for CAP learning. In the last question category about the case of "Mayumi", 59.8% of the students consented that Mayumi's case helped them understand the importance of a multidisciplinary approach in pediatric psychiatry.

Table 3. Participants' perceptions of PBL, PBL in CAP, and PBL in the case (in-person study).

General Questions About PBL at NU				
NO.	**QUESTIONS**	**A (%)**	**N (%)**	**D (%)**
Q1	PBL helps me develop skills in solving clinical problems.	80 (82.5%)	14 (14.4%)	3 (3.1%)
Q2	PBL is a good way of learning the content of the course.	70 (72.2%)	22 (22.7%)	5 (5.1%)
Q3	PBL encourages my self-directed learning.	64 (66.0%)	28 (28.9%)	5 (5.1%)
Q4	PBL helps me develop communication skills.	67 (69.1%)	24 (24.7%)	6 (6.2%)
Q5	I think that PBL is a more effective way of learning compared with traditional lectures.	64 (66.0%)	28 (28.9%)	5 (5.1%)
Questions about PBL in Child and Adolescent Psychiatry				
Q6	PBL enhanced my understanding of child and adolescent psychiatry.	52 (53.6%)	35 (36.1%)	10 (10.3%)
Q7	PBL increased my interest in child and adolescent psychiatry.	54 (55.7%)	31 (32.0%)	12 (12.3%)
Q8	Child and adolescent psychiatry, because of its emphasis on teamwork and collaboration, would be a specialty learned optimally through PBL.	44 (45.4%)	43 (44.3%)	10 (10.3%)
Q9	The duration of the PBL session was enough to learn about child and adolescent psychiatry.	46 (47.4%)	34 (35.1%)	17 (17.5%)
Q10	I enjoyed learning about child and adolescent psychiatry via PBL.	43 (44.3%)	42 (43.3%)	12 (12.4%)
Questions about the Case of "Mayumi"				
Q11	I think Mayumi's case is common in clinical settings in Japan.	55 (56.7%)	34 (35.1%)	8 (8.2%)
Q12	Mayumi's case was well written and understandable.	56 (57.7%)	32 (33.0%)	9 (9.3%)
Q13	Mayumi's case had an interesting clinical trigger.	41 (42.3%)	47 (48.5%)	9 (9.2%)
Q14	Mayumi's case has an appropriate level of difficulty/challenge.	53 (54.6%)	38 (39.2%)	6 (6.2%)
Q15	Mayumi's case helped me to understand the importance of multidisciplinary approaches in child and adolescent psychiatry.	58 (59.8%)	33 (34.0%)	6 (6.2%)

Abbreviations: A, agree; N, neutral; D, disagree.

Table 4 shows that most medical students (91.2%) in the online class agreed that PBL helped them develop clinical problem-solving skills. In addition, the majority of all the students (85.7%) considered PBL to be an appropriate learning method.

Table 4. Participants' perceptions of PBL, PBL in CAP, and PBL in the case (online study).

General Questions About PBL at NU				
NO.	QUESTIONS	A (%)	N (%)	D (%)
Q1	PBL helps me develop skills in solving clinical problems.	83 (91.2%)	6 (6.6%)	2 (2.2%)
Q2	PBL is a good way of learning the content of the course.	78 (85.7%)	11 (12.1%)	2 (2.2%)
Q3	PBL encourages my self-directed learning.	72 (79.1%)	17 (18.7%)	2 (2.2%)
Q4	PBL helps me develop communication skills.	59 (64.8%)	27 (29.7%)	5 (5.5%)
Q5	I think that PBL is a more effective way of learning compared with traditional lectures.	65 (71.4%)	22 (24.2%)	4 (4.4%)
Questions about PBL in Child and Adolescent Psychiatry				
Q6	PBL enhanced my understanding of child and adolescent psychiatry.	69 (75.8%)	19 (20.9%)	3 (3.3%)
Q7	PBL increased my interest in child and adolescent psychiatry.	59 (64.8%)	24 (26.4%)	8 (8.8%)
Q8	Child and adolescent psychiatry, because of its emphasis on teamwork and collaboration, would be a specialty learned optimally through PBL.	50 (54.9%)	37 (40.7%)	4 (4.4%)
Q9	The duration of the PBL session was enough to learn about child and adolescent psychiatry.	50 (54.9%)	31 (34.1%)	10 (11.0%)
Q10	I enjoyed learning about child and adolescent psychiatry via PBL.	61 (69.3%)	21 (23.9%)	6 (6.8%)
Questions about the Case of "Mayumi"				
Q11	I think Mayumi's case is common in clinical settings in Japan.	53 (58.2%)	27 (29.7%)	11 (12.1%)
Q12	Mayumi's case was well written and understandable.	71 (78.0%)	17 (18.7%)	3 (3.3%)
Q13	Mayumi's case had an interesting clinical trigger.	57 (62.6%)	28 (30.8%)	6 (6.6%)
Q14	Mayumi's case has an appropriate level of difficulty/challenge.	70 (76.9%)	18 (19.8%)	3 (3.3%)
Q15	Mayumi's case helped me to understand the importance of multidisciplinary approaches in child and adolescent psychiatry.	68 (74.7%)	22 (24.2%)	1 (1.1%)

Abbreviations: A, agree; N, neutral; D, disagree.

In the second category, the majority of the students (75.8%) thought that PBL enhanced their understanding of child and adolescent psychiatry. However, only 54.9% of the students agreed that the duration of the PBL session was enough to learn about child and adolescent psychiatry.

In terms of the case of "Mayumi", many students (78%) agreed that Mayumi's case was well written and understandable, while 62.6% of students answered that Mayumi's case had an interesting clinical trigger. Finally, only 58.2% of the students agreed that Mayumi's case is common in clinical settings in Japan.

In both the in-person (82.5%) and online (91.2%) classes, most students answered that PBL helped them develop skills in solving clinical problems. Additionally, 53.6% of in-person class students and 75.8% of online class students consented that PBL enhanced their understanding of child and adolescent psychiatry. However, comparatively fewer students in both in-person (47.4%) and online (54.9%) classes thought that the duration of PBL sessions was enough to learn about CAP. Moreover, only 42.3% of the students from the in-person classes and 62.6% of the online class students thought that Mayumi's case had an interesting clinical trigger.

3.2. Comparison of Correlations Among PBL Question Categories Between the Classes

To understand the relative influence of the three question categories (A, B, C) in the in-person study, a Pearson correlation analysis was also performed to observe the correlation between the two question categories. The questions in each category were A (general questions about PBL at NU), B (questions about PBL in child and adolescent psychiatry),

and C (specific questions about the case of "Mayumi"). Consequently, the correlations between B and C were r = 0.731 and $p < 0.001$, indicating that they had the highest positive correlation. In contrast, A and C had the lowest positive correlations, with r = 0.418 and $p < 0.001$.

To understand the relative influence of the three question categories (A, B, and C) in the online class, a Pearson correlation analysis was also conducted to investigate the correlation between the two variables. As a result, the correlations between B and C were r = 0.795 and $p < 0.001$, indicating that they had the highest positive correlation. Conversely, A and C had the lowest positive correlation, with r = 0.544 and $p < 0.001$.

In both the in-person and online class questionnaires, the question category about PBL in CAP and the question category about the "Mayumi" case showed a strong correlation.

4. Discussion

To our knowledge, this is the first study of online PBL in CAP in Japan. The preliminary results revealed that the students had a positive impression of online PBL CAP. Overall, online class students responded more positively, but their participation in the survey was lower than that of the in-person class students. The students' participation rate in the questionnaire was 90.1% in the online class. On the other hand, the 2019 in-person class had a high participation rate of 97.3%. In general, online surveys tend to have a lower response rate than in-person studies [32].

In addressing the lower participation rate in the online format, the survey was disseminated through digital communication channels, including email and the e-classes web portal. In contrast, during the face-to-face format, students were prompted to complete the survey during class, leading to higher immediate participation. The reduced response rate in the online format may be due to some students missing the posted information or not consistently engaging with the online platforms. Furthermore, the utilization of online resources and digital devices is expected to continue in the post-COVID era, as they have become essential for modern education due to their flexibility and accessibility. As these tools continue to be integrated into learning environments, it will be crucial to assess their long-term impact on student engagement, learning outcomes, and equitable access to education [33].

For the general impressions of PBL, 82.5% of the in-person class students and the majority of the online class students (91.2%) thought that PBL would help them solve clinical problems. Online clinical training in CAP may be an effective option for future medical students compared to an in-person class [34].

In our study, 75.8% of the online class students agreed that PBL enhanced their understanding of CAP. However, only half of the students (54.9%) agreed that the duration of their PBL sessions was sufficient. A learning period that was too short was a common opinion of students in both in-person and online classes. Since the PBL curriculum at NU provided only two ninety-minute case scenario sessions and a short wrap-up session to examine Mayumi's case, students might have had an insufficient duration of PBL CAP. An increase in allotted class time can be a solution, but a number of Japanese medical schools have difficulty expanding their PBL courses because of the shortage of skilled PBL tutors [29].

Less than half of the in-person class students (42.3%) and 62.6% of the online class students agreed that Mayumi's case had an interesting clinical trigger. English could also be a barrier to Japanese students learning with PBL [35]. In Mayumi's case (written in English), we can only wonder whether language played a role in defining a case with an "interesting" trigger. However, the further development of PBL should include additional English case scenarios for the training of globalized experts. The implementation of various standardized cases, such as Mayumi's case, developed by CAP experts under the TroNA project, will improve the clinical skills of Japanese medical students. Moreover, incorporating social media platforms like Instagram as educational tools can enhance student engagement during PBL sessions.

The Pearson correlation analysis shows that, in both the in-person and online classes, the strongest correlation exists between categories B (questions on PBL in child and adolescent psychiatry) and C (specific questions about the case of "Mayumi"). This indicates a close relationship between case-specific knowledge and its application within the field of child and adolescent psychiatry. In contrast, the lowest correlation in both settings is observed between categories A (general PBL questions at NU) and C, suggesting a weaker connection between broader PBL principles and case-specific discussions. This pattern highlights the more focused relevance of B and C to understanding case-based learning in psychiatry.

This study has several limitations. The main limitations of this study were the self-reported nature of the questionnaire, the subjective perspectives of the individuals surveyed, and the challenges of gathering questionnaires online. However, self-report questionnaires are widely accepted in PBL studies, and a lower response rate on an online questionnaire does not necessarily increase the level of selection bias [32,34].

Another limitation of this study is the lower participation rate in the online format. The survey was disseminated through digital channels such as email and the e-classes web portal, which may have led some students to miss the information or engage less consistently. In contrast, the face-to-face format allowed for immediate participation during class, resulting in higher response rates. This reduced online engagement likely impacted the overall response rate and may have introduced a bias. Moreover, only 47.4% of students in in-person classes and 54.9% in online classes felt that the duration of the PBL sessions was adequate for learning about CAP, indicating a potential gap in effective learning time.

Furthermore, the chosen semi-quantitative approach, while informative, did not fully capture the reasoning behind participants' responses. Future studies should consider using qualitative or mixed methods to provide deeper insights. Additionally, the role of English proficiency, though suggested as a factor, remains speculative without concrete evidence. Future research should directly assess language barriers to better understand their influence. Expanding the sample size and refining the methodology will strengthen the findings and contribute to a more comprehensive understanding of the topic. This study has several key strengths. First, this is the first cross-sectional study to assess both in-person and online PBL CAP classes in Japan. Therefore, this study can serve as a baseline for future assessments and PBL CAP classes. In addition, this study could prompt an increase in the duration of PBL CAP sessions in NU, Japan.

5. Conclusions

It is important to note that our preliminary findings are limited to a single institution. Therefore, conducting cross-cultural, multicenter studies will be necessary to assess cultural biases in PBL and examine the effects of differing modes of implementation [36,37] across diverse educational contexts. This broader approach will enhance the generalizability of the results and provide deeper insights into how cultural factors influence the effectiveness of PBL [38]. An online PBL curriculum with specific case scenarios can provide medical students with suitable CAP educational means against changing educational environments compared to an in-person curriculum. Developing clinical capability through PBL for CAP can be a major asset in attracting future doctors to CAP and increasing the number of qualified CAP specialists for children and adolescents in Japan. Although the current study did not assess students' clinical performance following their PBL experience, future research should include this evaluation. Understanding how PBL influences clinical performance is vital, as it directly relates to the effectiveness of the educational approach in preparing students for real-world clinical scenarios. By measuring clinical performance post-PBL, researchers can determine whether the skills and knowledge gained during sessions translate into practical competencies, thus providing valuable insights for refining the PBL curriculum to better support student learning and readiness for clinical practice. Through this process, the continuous revision and supplementation of the PBL program

are necessary, as are complementary educational methods such as internships, practical workshops, or simulation-based learning.

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Institutional Review Board Statement: All procedures performed in the study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. This study was approved by representatives of the ethical committee at Nagoya University (Approval Code: 2021-0482; Approval Date: 22 March 2022).

Informed Consent Statement: Details of the study were explained to participants beforehand, and signed consent was obtained from all participants.

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