DOI 10.5281/twist.10049652#436

TWIST, 2025, Vol. 20, Issue 2, pp. 328-335

TWIST

Journal homepage: www.twistjournal.net

Development of a Valid and Reliable Test Instrument to Measure the Critical Thinking Ability of Medical Students in Papua

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Abstract
This research aims to develop a valid and reliable test instrument to measure the critical thinking abilities of medical students in Papua, especially those living in Papua, which is one of the 3T (disadvantaged, frontier, and outermost) regions in Indonesia, where health challenges and needs require in-depth critical thinking. It is important to have appropriate evaluation tools. The test instrument development method involved a series of steps, including literature analysis, expert consultation, and testing. Data collected from medical students at the Faculty of Medicine, Cendrawasih University, Papua, were used to test the validity and reliability of the instrument. The results show that the developed test instrument has good validity and reliability. In addition, this instrument also showed high internal consistency, confirming its reliability in measuring the critical thinking abilities of medical students in Papua. These findings provide an important contribution to understanding and improving the critical thinking skills of medical students in Papua, as well as providing a basis for developing a more effective curriculum in supporting the development of these skills.

Keywords
Assessment instrument, Critical thinking skills, Medical education, Medical students, Papua

INTRODUCTION

Critical thinking is a systematic analytical process used to evaluate or interpret information (Tseng et al., 2011). The components of critical thinking identified by Peter and Facione included Interpretation, Analysis, Evaluation, Inference, Explanation, and Self-Regulation. Critical thinking is an important skill in everyday life, both in professional and personal contexts, because it allows a person to make better decisions, solve problems, and better understand the world (Facione & Facione, 2013). In the context of medical education, this ability includes the ability to identify problems, collect and evaluate evidence, and make the correct decisions in diagnosing and treating patients (Sharma et al., 2015; Sullivan, 2012; Robert & Petersen, 2013). Without these skills, the risk of errors in diagnosis and treatment can increase (Hausmann et al., 2016).

Critical thinking skills are an important aspect in forming professionalism and the quality of health services, especially for medical students (Farahmand et al., 2022). Several previous studies have shown a positive relationship between critical thinking skills and medical students' academic performance and professionalism (Kaddoura et al., 2016). The Watson-Glaser Critical Thinking Appraisal, Cornell Critical Thinking Test (CCTT), California Critical Thinking Skills Test (CCTST), and Halpern Critical Thinking Assessment are tools used to assess critical thinking abilities. The effectiveness of these instruments in measuring critical thinking skills can vary depending on the intended use, context, and population being tested (Chan, 2018).

Developing critical thinking skills in medical education in Papua is difficult. These difficulties include unequal educational opportunities, disparities in educational quality, and lack of funding for raising educational standards. The territory of Indonesia is vast and diverse. Progress in education development also differs between regions. Numerous factors affect the growth of education, such as the availability of teachers, state of the pupils, sufficiency of the infrastructure, availability of funding, and the location or geographical circumstances of the area. The frontier, most remote, and impoverished regions are those where overall development, including in the area of education, is comparatively lower than in other areas (Angreany et al., 2023). The education system in Indonesia's frontier, remote, and underprivileged districts (3T) has particularly challenging issues. Numerous obstacles still exist in these areas regarding the implementation of education. Some of these challenges are identified by the Ministry of Education and Culture, especially in the frontier, outermost, and disadvantaged areas (3T). These challenges include shortages, uneven distribution, low competencies, inadequate qualifications, and mismatch between teachers' educational backgrounds and the subjects they teach. The difficulty in comprehending ethnic distinctions in this nation is demonstrated by the disadvantages faced by medical and educational minorities, which have an impact on discrepancies in the labor market and poor enrollment in reputable higher education (Lengkong et al., 2023).

With an often-challenging health environment, such as limited access to health services and complex public health problems, medical students in Papua need to be equipped with strong analytical and problem-solving skills. Critical thinking is not just about logical analysis but also about the ability to understand the local context, deal with the complexity of information, and make impactful decisions. Thus, developing critical thinking skills not only supports the formation of professionalism but also prepares prospective doctors to become effective agents of change in improving the health and welfare of the Papuan people.

Prioritizing the development of critical thinking skills in medical education in Papua is an important effort to prepare prospective doctors to face complex and unique health challenges in this region more effectively and competitively. Measuring critical thinking skills is a difficult task. Challenges include subjectivity in assessment, difficulty in measuring complex thought processes, and the tendency to directly measure technical knowledge or skills rather than critical thinking abilities (Hwang et al., 2010). However, the lack of appropriate and valid evaluation tools can be a barrier in understanding and improving these capabilities. Before using a critical thinking instrument, it is important to consider its validity, reliability, and relevance to the needs and context of its use (Yuan et al., 2008). Critical thinking skills can be measured more accurately and reliably by selecting appropriate instruments and by understanding their limitations and advantages. In the Papuan context, especially for students living in Papua, which is one of the 3T (disadvantaged, frontier, and outermost) regions in Indonesia, where health challenges and needs require in-depth critical thinking, it is important to have appropriate evaluation tools. Therefore, this study aims to develop a valid and reliable test instrument to measure the critical thinking abilities of medical students in Papua.

MATERIALS AND METHODS

The research methods include expert consultation and student surveys. This study was approved by the Medical and Health Research Ethics Committee (of) Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada. Reference Number of Approval Letter: KE/FK/0130/EC 22 Januari 2024. Ethics Committee Approval by Medical and Health Research Ethics Committee (MHREC) Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada. Ref. No.:KE/FK/1131/EC/2022.

Research Method

Development and research are included in this category of research (R&D). Researchers develop instruments to measure critical thinking skills for medical students, thus producing a product in the form of an instrument that can be used as an example or reference to measure medical students' critical thinking (Farra et al., 2015). This test instrument development method involves a series of steps, starting with literature analysis, consulting with experts, and instrument testing.

A literature analysis was conducted to understand the key dimensions of critical thinking skills and to review existing test instruments. Furthermore, consultations with experts were conducted to obtain input and further validate the developed instruments. Subsequently, the instrument was tested on a sample of medical students in Papua to test its validity and reliability. The field test of this instrument was conducted on 184 medical students from the first to the fourth year.

Research on the development of guided discovery-based instruments to improve students' critical thinking skills using the Tessmer Development Model. These five steps constitute the development model. The following are the five steps: 1) self-assessment, 2) expert review and opinion, 3) one-on-one trials, 4) small-group trials, and 5) field test. This process produced valid and reliable instruments to measure the critical thinking skills of medical students in Papua. During the examination of the instrument, the formulation of the dimensions and indicators was compiled and reviewed by expert validators and experts in the field of medical education. Researchers ask for opinions based on their knowledge of the level of suitability and pattern of development of theoretical fiction (variables) into indicators to become problem points. After validation by experts in their fields, the formulation of indicators was arranged in the draft instrument and then tested.

Instrument Development

At the design stage, the activities carried out were designing critical thinking skills assessment instruments. The initial step was to compile a grid of assessment instruments based on basic competencies with indicators from Critical Thinking Skill (CTS) aspects, according to Facione and Facione (2013). The form of test used was a written test in the form of a description. The selection of this test was based on theoretical studies. From this preparation process, a grid of critical thinking skills assessment instruments on malaria was formed, including student identity, basic competencies, indicators, CTS aspects being measured, assessment techniques, and question item numbers.

Validity and reliability tests were used to determine the characteristics of the developed assessment instrument. Validity considerations were obtained by considering the content validity, construct validity, concurrent validity, and consequence validity. This study was designed in several stages to achieve these objectives. To produce good content validity, efforts were made from the start of planning to create question items. First, a blueprint was prepared based on the Indonesian Doctor Competency Standards. Next, an initial review of the blueprint was conducted by a panel of experts from several fields related to one malaria topic area (experts in tropical medicine, internal medicine, eyes, and medical education). The results of this review are used as a basis for improving the final blueprint.

The final blueprint was used by the researchers as a guide for creating question items. Regarding the design of the question items, a review of the question content was carried out by a panel of experts to improve the quality of the questions, including accommodating the principles of making questions in general and the objectives of the test itself. In this step, a revised draft of the questionnaire was produced. The revised draft question items were then tested and reviewed for clarity by the students at the trial stage, resulting in a final question paper as a test instrument. For comparison, this study also asked for the opinions of five doctors (mentors) to assess the questions created. All mentors stated that the questions (Malaria Cases) were essential in accordance with the General Practitioner Competency Standards.

In this research, the validity calculation aimed to determine the validity or invalidity of the critical thinking skills assessment instrument items being developed. This validity calculation used the help of the SPSS program by paying attention to the numbers in the Corrected Item-Total Correlation, which shows the total correlation of each item. A written test was used as the assessment technique. Researchers have created and developed essay questions and scoring guidelines that contain alternative student answers. The resulting questions were in the form of detailed questions, along with an assessment matrix containing assessment criteria for student answer performance. The description of each step in the preparation stage of this research carried out to develop critical thinking skills assessment instruments, development of learning tools using the guided discovery learning (GDL) model is explained as follows:

Preliminary Stage

The initial step of this research was to examine several references related to the development of instruments for evaluating students critical thinking abilities. According to Facione and Facione (2013) the theory applied to create the test items corresponds to six components of critical thinking: interpretation, analysis, evaluation, explanation, inference, and self-regulation. The Interpretation aspect can be seen from the students' ability to understand, explain, and provide meaning from the information obtained. From an analytical perspective, it can be seen from the students' ability to identify relationships from the information contained in the problem or question.

The evaluation aspect can be seen in the student's ability to provide an assessment of a statement or information obtained. Meanwhile, the inference aspect can be seen from the students' ability to identify the elements needed to make a conclusion. Each aspect was translated as an indicator of student achievement. The theory used in developing the test instruments refers to Facione and Facione (2013) and lists six components of critical thinking abilities: self-regulation, inference, analysis, interpretation, evaluation, and assessment.

Self-Evaluation Stage

At this stage, a set of critical thinking skills assessment instruments were obtained as prototype I. These stages include:

1. Curriculum Analysis

A curriculum analysis was carried out with the aim of examining the curriculum used at the research site, namely at FK Uncen. This study was conducted to determine the materials used in developing assessment instruments to measure students' critical thinking skills (CTS). Thus, this study was conducted to identify the scope of the learning material. The scope of material in the Block at FK Uncen includes one of the learning materials in the Tropical Medicine Block in Semester 7, Malaria, which requires students' ability to identify and analyze relationships from the information obtained. Therefore, the topic of malaria can be used to measure the extent to which students think critically about it. The critical thinking skills questions were designed based on malaria material, with basic competencies and indicators developed in accordance with the 2012 Indonesian Doctor Competency Standards (SKDI).

2. Material Analysis

Material analysis was performed to identify the concepts to be used in the test. Malaria was the material used in the design of the assessment instrument. Basic competency material on the topic of malaria was used as a reference for creating critical thinking skills assessment instruments based on the 2012 SKDI and 2017 FK Uncen curriculum.

Prototyping Stage

At this stage, the activities carried out include expert reviews, one-to-one, and small groups. An explanation of the results of prototyping activities is as follows:

1. Expert review stage

The instrument design obtained at the self-evaluation stage was validated by several experts or specialists in a particular field. The written test was validated by six lecturers with a master's educational background in Tropical Medicine and Internal Medicine. Table 1 show the validators determined in this research are as follows:

Table 1 Assessment Instrument Validator Data

No.	Name	Profession and Institution	Information
1.	Validator 1	Health Polytechnic Lecturer, Masters in Medical Education	Validator in the Education Sector
2.	Validator 2	Lecturer at FK Uncen, Masters in Tropical Medicine	Validator in the Field of Tropical Medicine
3.	Validator 3	Lecturer at FK Uncen, Internal Medicine Specialist	Validator in the Field of Tropical Medicine
4.	Validator 4	Lecturer in Anatomy FK Uncen	Validator as User or Practitioner
5.	Validator 5	Lecturer in Histology FK Uncen	Validator as User or Practitioner
6.	Validator 6	Lecturer in Public Health Sciences FK Uncen	Validator as User or Practitioner

Expert agreement was used to assess the validity of the content. The degree of content validity is determined by the consensus of experts on the topic of research, or what is commonly referred to as the domain being assessed. This is due to the fact that a measuring tool is considered legitimate if an expert certifies that it assesses mastery of the skills specified in the domain or construct being evaluated. The researcher asked experts to check the accuracy between the suitability of the question items and the indicators, editorial writing of the questions, and suitability of the assessment matrix. If errors remained, the instrument was revised again. After inspection by an expert, the expert provides an assessment of the instrument. The assessment consisted of five criteria, namely 1: irrelevant,; 2, less relevant; 3, sufficient; 4, relevant; and 5, very relevant. The experts provided an assessment to determine the critical thinking skill assessment instrument that has been developed and is suitable for use with a revision or unfit for use. The results of the validation by experts are worth using with several improvements, such as grammar, question bodies, and matrix assessment questions.

2. One-to-One Stage

Before the trial on the research subject, the questions that had been developed were tested on students other than the research subjects. The student represents three levels of ability: high, moderate, and low. The selection of the three students was based on their GPA. Based on the data description, it can be concluded that students can represent three levels of ability. Students with a high ability to obtain a score of 80. Students with high abilities are able to answer all the questions given correctly, but not all answers given are correct and appropriate, so that the student does not get the maximum score. Students with the ability to obtain a score of 60. Students with moderate abilities can also answer all questions given, even though the answers given do not obtain the maximum score. Students who had a low ability to obtain a score of 40. One reason is that students do not understand the topic of malaria or the ability of students to do reasoning. In addition, from the comments given to these students, almost all questions could be understood and answered easily. Based on the results of a one-to-one trial, the assessment instrument can be continued to the next stage.

3. Small Group Stage

The results of the revision from the expert review and the difficulties experienced by students when testing on three students (one-to-one) were used as the basis for revising the instrument, and Prototype I was then tested on research subjects, totaling 10 students. The aim of this stage is to find data on the characteristics of the assessment instrument that has been developed.

Data collection was carried out by providing revised descriptive questions at a one-to-one stage. The time to complete these questions was 3 questions × 15 minutes. The number of questions is three essay questions. In the written test, in the form of a description, each student answers the questions on the answer sheet provided and is collected after the specified time is finished.

The data obtained from the results of this study were used to determine the characteristics of the assessment instrument to determine its validity and reliability. Based on data from trials at this stage, it was used as a material to revise the instrument to produce a final prototype. Table 2 presents the revised descriptive tests.

Table 2 List of Revised Description Tests

Instrument	Before Revision	After Revision
Test Description	There are several errors in writing that do not match the EYD, improvements to the question scenario	Errors in writing have been adjusted to EYD, questions have been revised
Assessment Matrix	The differences in assessment in a criterion for each score need to be clarified	The difference in assessment in a criterion for each score is clear and focused

The following are the results of the reliability test of the assessment instrument that was developed at the trial stage (Table 3).

Table 3 Reliability Test Results

Instrument	Cronbach's Alpha	Nof items
Question description 1	0.855	6
Question description 2	0.686	6
Question description 3	0.906	6

Based on the table, the reliability test results show that the assessment instruments tested have varying reliability values. The descriptive questions developed generally have a reliability value above 0.7, which means that the instrument is classified as reliable with a "good" interpretation (Kasule, 2013). However, Question 2 had a reliability below 0.7, which requires improvement or revision. The factor that most influences reliability is the quality of the questions' validity. All three questions were declared valid.

RESULTS

The research results show that the developed test instrument has good validity, in accordance with the dimensions of critical thinking abilities identified in the literature. In addition, this instrument also showed high internal consistency, confirming its reliability in measuring the critical thinking abilities of medical students in Papua.

After calculating the validity of the assessment instrument, its reliability was calculated. An assessment instrument is said to be reliable if it is tested repeatedly on the same subject and the results are consistent, stable, or relatively the same. Reliability testing was carried out using the SPSS program by examining the internal consistency based on Cronbach's alpha coefficient. The following is a description and analysis of the data on the characteristics of the assessment instrument based on the trial results.

Test Instrument Description

The questions developed in this research consisted of three descriptive questions, (2) homogeneity of the questions, and (3) homogeneity of the questions, namely the similarity of the content of the questions being developed. The homogeneity of the questions is high because it only contains questions that measure students' critical thinking skills in solving relationship and function questions; and (3) heterogeneity or diversity of abilities of the subjects used for field testing. Fk Uncen students are classified as heterogeneous because of their diverse abilities. There are students who have high, medium and low abilities.

Validity

The following is an analysis of the results of calculating the validity of the test questions, which consisted of three student descriptive questions (Table 4).

Table 4 Validity Data for Test Items

Instrumen	Cronbach's Alpha	N of items
Question description 1	0.855	6
Question description 2	0.883	6
Question description 3	0.906	6

Based on the results of the validity calculation, the test items can be said to be valid if $r$count> rtable might. From the analysis of the value of the value of $r$count> rtable.

Reliability

The following are the results of the reliability test of the assessment instrument developed (Table 5).

Table 5 Reliability Test Results

Instrumen	Cronbach's Alpha	N of items
Question description 1	0.855	6
Question description 2	0.883	6
Question description 3	0.906	6

Data analysis for the reliability of this instrument used the internal consistency estimation technique with the Chronbach-alpha formula assisted by the SPSS application. A strong correlation or reliability is indicated by an instrument if its Cronbach's alpha value is 0.60 and less than 1, and a poor correlation or unreliability is indicated by a value of 0.50 or below. Based on the table, the reliability test results of the assessment instruments that were tested can be observed. The descriptive questions developed have a reliability value of > 0.7, meaning the descriptive questions developed have a reliable value with a"good" interpretation.

DISCUSSION

Critical thinking abilities are valuable life skills that are applicable to all facets of daily living. Making rational, reasonable, thoughtful, responsible, skillful, and focused decisions about what to believe or do to successfully solve problems is the main goal of critical thinking abilities. Critical thinking is one of the main pedagogical issues that still need to be solved, as evidenced by its significance as an educational objective. The main objective of education in all civilizations is to help students become more critical thinkers so that teachers can plan lessons that will help them become more critical thinkers. Critical thinking abilities are a vital component of human maturation and intellectual capital that should be possessed by all, so it is essential to teach every student at the education level (Larsson, 2017).

Several studies that have been undertaken on students' critical thinking skills, such as those conducted by Li et al. (2023), have shown that critical thinking can have a favorable impact on student accomplishment. Additionally, according to Bezanilla et al. (2019), critical thinking abilities can enhance students' competency. Additionally, the critical thinking abilities of Papuan high school students have grown. Finally, critical thinking disposition can motivate students to hone their critical thinking abilities. Critical thinking abilities are crucial in empowering students. To ensure that they are always prepared for the issues they encounter, it is crucial that students' critical thinking abilities are strengthened. Thompson (2019) said that children should be encouraged to think critically at all times to improve their critical thinking abilities. Additionally, a number of research studies assert that students should foster critical thinking abilities to prepare them for a variety of obstacles that they may encounter in the future (Khoiriyah et al., 2015; Ismail et al., 2018; Pu et al., 2019).

Based on the results of Nugraha and Suparman (2021), one of the key variables influencing the variability of elementary school pupils' mathematical critical thinking skills is their demographic makeup. This indicates that the demographics of students are the reason for the moderate to strong impact of problem-based learning on the mathematical critical thinking skills of elementary school pupils. However, Suparman et al. (2021) discovered that student demographics had little bearing on the diversity of mathematical critical thinking abilities among elementary, middle, and high school students. These results suggest that student demographics are not the causative element that consistently affects the variability of students' mathematical critical thinking skills. Numerous studies in frontier, remote, and impoverished districts (3T) have been carried out, including the border areas of Kayan Hulu Malinau (A'ing, 2015) and Bintan Pesisir Riau Islands (Auldina, 2018); remote areas such as Loru Sigi Biromaru (Imran, 2014) and Buntu Mondong Enrekang (Sulfasyah & Nur, 2016); and islands such as Pulau Nasi Aceh Besar (Adlim et al., 2016) and the Talaud islands of North Sulawesi (Londa, 2016). These studies regularly show that there are still many barriers to education in these communities and that marginalization and prejudice are commonplace.

To build dependable human resources for frontier, remote, and impoverished districts (3T), it is essential to improve students' competencies as future generations by fostering high-quality instruction throughout the learning process (Ryan et al., 2019). In the field of education, the learning method has a significant impact on how intelligent students become. Additionally, higher education helps students expand their intellectual capacity so that they can compete on a worldwide scale. Additionally, higher education is necessary to generate graduates who are independent, creative, logical thinkers, professionals in their subject of study, and professionally prepared for the workforce (Ismail & Siswandani, 2018).

The development of valid and reliable test instruments makes an important contribution to the understanding and improvement of the critical thinking abilities of medical students in Papua. This instrument can be used as an effective evaluation tool to support curriculum development that focuses on developing critical thinking skills. In addition, this study also provides a basis for further research in the context of evaluating medical education in areas with similar health challenges.

Developing critical thinking skills in medical education in Papua is critical because it helps students face unique local health challenges, such as infectious diseases, lack of access to health services, and public health issues. These capabilities enable them to make informed decisions in situations with limited resources, hone analytical skills to evaluate complex health information, and drive innovation in healthcare. Additionally, critical thinking strengthens professionalism by building an attitude of responsibility, integrity, and involvement in sustainable practices (Immonen et al., 2019).

Factors that can affect the validity and reliability of an assessment instrument include the characteristics of the instrument, the characteristics of respondents, consistency of assessment, sample characteristics, data analysis methods, and research context. The type of instrument, the number and variety of items, and the suitability of the content with the construct measured are important aspects of instrument characteristics. The cognitive maturity and psychological condition of the respondents also played a significant role. The consistency between the appraiser, size, and diversity of samples, as well as the statistical methods used in the data analysis, also influence the results. In addition, contextual factors, such as the trial environment and the characteristics of the institution where the research was conducted, can also affect the validity and reliability of the instrument. Understanding these factors is important for designing valid and reliable assessment instruments and correctly interpreting the results of research.

CONCLUSION

This study successfully developed valid and reliable test instruments to measure the critical thinking skills of medical students in Papua. These findings make an important contribution to supporting the development of medical education

that is more adaptive and responsive to local health needs as well as providing a foundation for further research in this field. The validity and reliability of critical thinking assessment instruments for medical students in Papua are important aspects in ensuring that medical education in the area can produce competent graduates and face challenges in the professional world. By focusing on the methods and strategies mentioned above, it is expected that medical education institutions in Papua can develop valid and reliable assessment instruments to measure the critical thinking skills of students effectively, which will ultimately improve the quality of medical education.

This study suggests the dissemination of research results to ensure extensive and effective applications, as well as implications in the medical education curriculum to improve students' critical thinking skills. Training and self-development for students and lecturers are also recommended to support the use of this instrument. Further research is also advised to continue testing and improving instruments as well as to explore more effective learning strategies to improve the critical thinking skills of medical students in Papua. By applying these suggestions, the results of this study can make a significant contribution to improving medical education and health services in Papua and the surrounding areas.

FUNDING INFORMATION
The research, writing, and publication of this work were all done without financial assistance from the authors.

DECLARATION OF CONFLICT
There were no disclosed conflicts of interest by the authors.

ACKNOWLEDGMENTS
The authors will want to acknowledge the enabling research environment provided by the management of Gadjah Mada University.

AUTHOR CONTRIBUTIONS
The roles and task of each author to the paper should be described. Conceptualization: SR. Data collection: SR, TS. Data analysis: SR, TS, DW. Visualization: SR. Interpretation: SR, TS. Writing–original draft: SR. Writing–review & editing: SR, TS, DW.

REFERENCES

1. Angreany, R., Madihah, H., & Susanto, D. (2023). Quality Management of Frontier, Outermost and Disadvantaged Schools in Improving Achievement In Junior Secondary Schools. *Al-Fikru: Jurnal Ilmiah*, *17*(2), 358-370. https://doi.org/10.51672/alfikru.v17i2.294
2. Adlim, M., Gusti, H., & Zulfadli, Z. (2016). Problems and solutions of education in the island region: Case study at SMA Negeri 1 Pulau Aceh, Aceh Besar District. *Jurnal Pencerahan*, *10*(2). https://doi.org/10.13170/jp.10.2.4910
3. A'ing, A. (2015). Study on Development of Education Sector in Border Area of Kayan Hulu District, Malinau Regency. *Pemerintahan Integratif*, *3*(4), 545-559.
4. Auldina, L. (2018). Marginalization of education in border areas (case study in Mapur Village, Bintan Pesisir District, Bintan Regency, Riau Islands Province). Marginalization of Education in Border Areas (Case Study in Mapur Village, Bintan Pesisir District, Bintan Regency, Riau Islands Province).
5. Bezanilla, M. J., Fernández-Nogueira, D., Poblete, M., & Galindo-Domínguez, H. (2019). Methodologies for teaching-learning critical thinking in higher education: The teacher's view. *Thinking skills and creativity*, *33*, 100584. https://doi.org/10.1016/j.tsc.2019.100584
6. Chan, Z. C. (2018). A systematic review on critical thinking in medical education. *International journal of adolescent medicine and health*, *30*(1), 20150117. https://doi.org/10.1515/ijamh-2015-0117
7. Facione, P. A., & Facione, N. C. (2013). Critical thinking for life: Valuing, measuring, and training critical thinking in all its forms. *Inquiry: Critical thinking across the disciplines*, *28*(1), 5-25. https://doi.org/10.5840/inquiryct20132812
8. Farahmand, S., Rad, E. M., & Keshmiri, F. (2022). Exploring the effective elements on the personal and professional development among health-care providers: a qualitative study. *Journal of Education and Health Promotion*, *11*(1), 256. DOI: 10.4103/jehp.jehp_1405_21
9. Farra, S., Smith, S., French, D., & Gillespie, G. (2015). Development of an assessment instrument to evaluate performance of the skill of decontamination. *Nurse Education Today*, *35*(10), 1016-1022. https://doi.org/10.1016/j.nedt.2015.04.010
10. Hausmann, D., Zulian, C., Battegay, E., & Zimmerli, L. (2016). Tracing the decision-making process of physicians with a Decision Process Matrix. *BMC Medical Informatics and Decision Making*, *16*, 1-11. https://doi.org/10.1186/s12911-016-0369-1
11. Hwang, S. Y., Yen, M., Lee, B. O., Huang, M. C., & Tseng, H. F. (2010). A critical thinking disposition scale for nurses: short form. *Journal of clinical nursing*, *19*(21-22), 3171-3176.

12. Immonen, K., Oikarainen, A., Tomietto, M., Kääriäinen, M., Tuomikoski, A. M., Kaučič, B. M., ... & Mikkonen, K. (2019). Assessment of nursing students' competence in clinical practice: A systematic review of reviews. *International journal of nursing studies*, *100*, 103414. https://doi.org/10.1016/j.ijnurstu.2019.103414
13. Imran, M. (2014). Education for remote communities in Tompu Hamlet, Loru Village, Sigi Biromaru District. *Jurnal Pendidikan Geografi*, *1*(2).
14. Ismail, N. S., Harun, J., Zakaria, M. A. Z. M., & Salleh, S. M. (2018). The effect of Mobile problem-based learning application DicScience PBL on students' critical thinking. *Thinking Skills and Creativity*, *28*, 177-195. https://doi.org/10.1016/j.tsc.2018.04.002
15. Ismail, R., & Siswandani, E. D. (2018). The Learning Concept of the Higher Education Students in the Central Mountainous Region of Papua, Indonesia: A Case Study of Students at the STISIP Amal Ilmiah YAPIS Wamena. *HONAI*, *1*(2). https://doi.org/10.2121/.v1i2.1109.g988
16. Kaddoura, M., Vandyke, O., Smallwood, C., & Gonzalez, K. M. (2016). Perceived benefits and challenges of repeated exposure to high fidelity simulation experiences of first degree accelerated bachelor nursing students. *Nurse education today*, *36*, 298-303. https://doi.org/10.1016/j.nedt.2015.07.014
17. Khoiriyah, U., Roberts, C., Jorm, C., & Van der Vleuten, C. P. M. (2015). Enhancing students' learning in problem based learning: validation of a self-assessment scale for active learning and critical thinking. *BMC medical education*, *15*, 1-8. https://doi.org/10.1186/s12909-015-0422-2
18. Larsson, K. (2017). Understanding and teaching critical thinking—A new approach. *International Journal of Educational Research*, *84*, 32-42. https://doi.org/10.1016/j.ijer.2017.05.004
19. Lengkong, J. S., Rotty, V. N., Teol, M., Rawis, J. A., & Koessoy, H. M. (2023). Innovation of Education Models in Islands and Border Areas Based on Digital and Spatial Approaches as a Regional Development Policy Concept for the Province of North Sulawesi in Opening Indonesia's Gateway to the Pacific and East Asia Regions. *International Journal of Multicultural and Multireligious Understanding*, *10*(5), 346-358. http://dx.doi.org/10.18415/ijmmu.v10i5.4818
20. Li, W., Liu, C. Y., & Tseng, J. C. (2023). Effects of the interaction between metacognition teaching and students' learning achievement on students' computational thinking, critical thinking, and metacognition in collaborative programming learning. *Education and Information Technologies*, *28*(10), 12919-12943. https://doi.org/10.1007/s10639-023-11671-2
21. Londa, V. (2016). Implementation of basic education policies in the island region (Study in Talaud Islands Regency, North Sulawesi Province). *Journal of Social Science and Humaniora*, 263-271.
22. Nugraha, T & Suparman. (2021). Does Students' Demography Cause Heterogeneity of Students' Mathematical Critical Thinking Abilities through Problem-Based Learning? A Meta-Analysis. *Journal of Hunan University Natural Sciences*, *48*(8). http://www.jonuns.com/index.php/journal/article/view/687/684
23. Pu, D., Ni, J., Song, D., Zhang, W., Wang, Y., Wu, L., ... & Wang, Y. (2019). Influence of critical thinking disposition on the learning efficiency of problem-based learning in undergraduate medical students. *BMC medical education*, *19*, 1-8. https://doi.org/10.1186/s12909-018-1418-5
24. Robert, R. R., & Petersen, S. (2013). Critical thinking at the bedside: Providing safe passage to patients. *Medsurg Nursing*, *22*(2), 85. PMID: 23802494.
25. Ryan, J., Jones, S., Hayes, P., & Turner, M. (2019). Building student resilience for graduate work readiness. *Employability via higher education: Sustainability as scholarship*, 135-154. https://doi.org/10.1007/978-3-030-26342-3_10
26. Sharma, R., Gordon, M., Dharamsi, S., & Gibbs, T. (2015). Systematic reviews in medical education: a practical approach: AMEE guide 94. *Medical Teacher*, *37*(2), 108-124. https://doi.org/10.3109/0142159X.2014.970996
27. Sulfasyah, S., & Nur, H. (2016). Discrimination in Education of Remote Communities. *Equilibrium: Jurnal Pendidikan Sosiologi*, *4*(2), 60747.
28. Sullivan, E. A. (2012). Critical thinking in clinical nurse education: Application of Paul's model of critical thinking. *Nurse education in practice*, *12*(6), 322-327. https://doi.org/10.1016/j.nepr.2012.03.005
29. Suparman, D. J., & Tamur, M. (2021). Problem-based learning for mathematical critical thinking skills: A meta-analysis. *Journal of Hunan University Natural Sciences*, *48*(2). http://www.jonuns.com/index.php/journal/article/view/521
30. Thompson, C. C. (2019). Advancing critical thinking through learning issues in problem-based learning. *Medical Science Educator*, *29*, 149-156. https://doi.org/10.1007/s40670-018-00649-2
31. Tseng, H. C., Chou, F. H., Wang, H. H., Ko, H. K., Jian, S. Y., & Weng, W. C. (2011). The effectiveness of problem-based learning and concept mapping among Taiwanese registered nursing students. *Nurse education today*, *31*(8), e41-e46. https://doi.org/10.1016/j.nedt.2010.11.020
32. Yuan, H., Williams, B. A., & Fan, L. (2008). A systematic review of selected evidence on developing nursing students' critical thinking through problem-based learning. *Nurse education today*, *28*(6), 657-663. https://doi.org/10.1016/j.nedt.2007.12.006