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The potential of the discovery learning model integrated the reading, questioning, and answering model on cross-cultural high school students' problem-solving skills

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ABSTRACT

This study aims to test the discovery model integrated with the reading, questioning, and answering (RQA) model. This research is a quasi-study which involves the second semester XI grade students of state senior high school (SMA) Negeri in Situbondo as subjects. The number of students who studied was 160 people from four different classes in the 2018/2019 academic year. Sampling is done by class equality test. Each class is taught with a different model, for each class is grouped again based on the culture of residence of students, namely coastal students, urban and mountain students. Researchers used ANCOVA to test the research hypothesis followed by the least significant difference (LSD) test. The results showed that: i) RQA's integrated discovery learning model is able to improve students' problem-solving skills compared to the original model; ii) Culture has a significant role in shaping students' problem-solving skills, with the use of the same model given to students who have a background a different background will get different results; and iii) Learning in school and in the environment is an interrelated factor in shaping students' thinking patterns and problem-solving skills. Discovery learning model integrated learning RQA model is a combination of effective models to be applied to students who are trained with challenges where nature teaches them to think and act appropriately and quickly.

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1. INTRODUCTION

Industrial era 4.0 was born in Germany at the 2011 Hannover Fair meeting [1]. This term refers to the conditions of accelerating production, improving service and improving the income of a nation which all refer to economic acceleration [1]–[3] increased skilled labour and increased investment [4] as well as the efficiency of production financing [5]. Industrial era 4.0 requires five basic skills, namely complex problem solving, social skills, process skills, system skills, and cognitive abilities [6], of the five skills, complex problem-solving ranks first out of the five skills needed. Problem-solving is related to the decision-making

process when faced with a difficult choice to find a solution [7] when the objectives to be achieved are not clear [8] and find gaps in each problem [9]. Problem-solving is related to reflection skills, which are the skills needed to make analogies, conclusions, evaluations and explore a deep understanding of specific knowledge [10] and are part of critical thinking skills [11]–[14] that are important for everyone in their daily lives [15].

The reality in the field does not support the development of students' problem-solving skills. Teaching done in schools emphasizes rote learning and only focuses on content [16] teachers tend to dominate learning [17] and do not provide opportunities for students to practice their thinking skills [18], [19]. Learning is still traditional in nature where students act as listeners and passive learners [20] and the teacher becomes the main reference in accessing information for students [21]. Thus, it causes the lack of opportunities for students to develop thinking skills and problem-solving for them.

Technological advances also cause inefficient development of critical thinking skills and problem-solving [22]. Their ease of access to information causes them to be lazy in digesting the information obtained and analyzing it [23]. Any information that they get digested immediately without the need to be evaluated and tested for its truth. This is also when they get into trouble, they are lazy to use problem-solving skills because they can easily access problem-solving via the internet.

Besides external factors, it is known that internal factors also have a significant influence on students' problem-solving skills. Culture has an important role in honing students' problem-solving skills [24]. Culture can shape a person's pattern of finding and processing information, the assumptions they make, and the guiding principles they apply to consider and solve problems [25]. The development of one's mindset in thinking and solving problems is formed early on by cultural interactions where individuals live [26]. Skills in solving problems, finding solutions and responding to the surrounding situation are patterns formed from the culture and relationships that will simultaneously become a person's character [27].

Culture is a unique thing that can describe the characteristics of a particular society, special symbols and different procedures that are owned by the community to represent their existence in front of other communities [28]. Culture is also defined as knowledge, ways of behaving, acting, ways of thinking, beliefs, behaviour and values needed to survive in the midst of society [27], [29]. The elements that make the difference from other communities in the form of weapons used in various activities, forms of residence, jewellery used, how to use clothing, traditional and religious ceremonies, weddings are part of the culture [30]. Culture is also a set of rules that govern what can and should not be done by people who live in the environment, rules and penalties that will be applied to those who break them and are a social convention [31]. Knowledge and the way of communication possessed by someone is also a culture [31], [32]. Culture has a role in one's cognitive development and way of thinking [33], [34]. Repeated conditions created by the surrounding environment and culture will be able to hone one's critical thinking skills [35].

Based on the description above, we need a breakthrough in terms of learning to overcome these problems. Discovery learning model is felt appropriate as an alternative problem solving, because the discovery model has been proven to be able to improve problem-solving skills, decision-making skills and behave like scientists [36], [37]. Discovery models can improve student independence in learning and honing decision-making skills based on previous studies [38]. Discovery teaches students how to make observations and provides broad opportunities for students to develop the potential they have [39]. Discovery trains students to have problem-solving skills by solving problems from the surrounding environment through learning that begins with the problems presented by the teacher to be solved by students both in groups and individually [40]–[47]. Activities in discovery learning are carried out through a series of activities like scientists [48].

Various research results have proven the potential of discovery learning models in empowering students' thinking abilities and problem-solving. However, there are some weaknesses that are owned by the model, one of them is because the discovery learning model spends a lot of time reading material in class [49], [50]. It is difficult to change student learning styles in adapting to this model [51], [52] and not all material is suitable for discovery models that have authentic problem-based learning characteristics [53].

The learning model that is able to overcome the weaknesses of the discovery model is the reading, questioning, and answering (RQA) learning model. This learning model has a syntax that requires students to read the material first [54] so that it will make the time more efficient in the implementation of learning in class, another advantage is that students will be better prepared during the implementation of learning because they have read the material to be taught previously in the individual home [55], students feel motivated in learning [56]. The RQA model is expected to be able to improve students' problem-solving skills because there is a syntax in the RQA model that requires students to find solutions to questions that they have previously compiled [57] so that their thinking skills are specifically problem solving will increase. From various existing studies, no research has been found that tries to collaborate between discovery models and RQA which are integrated with different cultures to find out their potential for high school students' problem-solving skills. This study was conducted to examine the effect of the discovery integrated RQA on students with different cultures on problem solving skills.

2. RESEARCH METHODS

The research was a quasi-experiment designed. It is to test the problem-solving skills of students with different cultures in class XI of high school students in the second semester of the 2018/2019 academic year in Situbondo, Indonesia. The research employed a combination of RQA integrated discovery learning models, models discovery, RQA models, and conventional models.

2.1. Research sample

The sample in this study represents the population of class XI students from state high schools in Situbondo, Indonesia, in the second semester of the 2018/2019 academic year consisting of 840 students with different cultural backgrounds. Sampling was carried out using an equality test so that four classes had equality with a total of 160 students. The equivalence test is done by providing multiple-choice biology questions that have been tested for the validity and reliability of items. The validity of items was carried out with expert validity and empirical validity. Expert validity consists of construct validity and content validity. Construct validity tests the suitability of the results of the measuring instrument with the ability to be measured, while content validity tests the suitability of the curriculum content. Empirical validity is done by testing the instrument on 60 XI-gradeudents of Situbondo state high school to determine the validity and reliability of the items. Reliability refers to the level of test scores, which are free from measurement errors or the confidence of the measuring instrument. Research instruments are valid and reliable. Analysis of sample class equality was carried out using analysis of the students' problem-solving skills scores obtained through research instruments. The analysis was performed using ANACOVA using SPSS 26 for Mac. The analysis shows that all classes are equal.

2.2. Instrumen and procedure

The rubric for assessing problem-solving skills was adapted from the rubric prepared by the Department of Chemical Engineering's culturally relevant cognitively demanding (CRCD) [58]. It has six assessment indicators namely: i) Identifying problems and main objective initials; ii) Applying previous knowledge; iii) Identifying information use; iv) Designing and conducting experiments; v) Analyzing and interpreting results; and vi) Assessing self and others, and have three assessment criteria, namely exemplary, good, and needs improvement. The four classes are each taught with the discovery-RQA, discovery, RQA and conventional learning models for one semester, for each class grouped again based on the culture of student residence, i.e students living in coastal areas, students living in mountainous areas and students who live in urban areas. At the end of the semester, students' problem-solving data based on their respective cultures were then analyzed to answer the research hypotheses, analysis of the results of problem-solving using ANCOVA after the prerequisites were fulfilled i.e normally distributed and homogeneous data, details of differences in problem-solving data of students would be tested through least significant difference (LSD) analysis with the help of SPSS 26.

3. RESULTS

The researcher analyzed the students' problem-solving skills scores obtained through research instruments. The analysis was performed using ANCOVA analysis. A summary of ANCOVA calculation results related to students' problem-solving skills is presented in Table 1. Based on the results of the ANCOVA test on problem-solving skills, it can be seen that the learning model influences students' problem-solving skills.

Table 1. ANCOVA test results on the influence of learning models on problem-solving skills (PB) in students with different cultures

Source	Type III sum of squares	df	Mean square	F	Sig.
Corrected model	6964.017[a]	11	633.092	107.599	.000
Intercept	807244.572	1	807244.572	137197.879	.000
Culture	362.830	2	181.415	30.833	.000
Model	5723.614	3	1907.871	324.258	.000
Culture*model	584.476	6	97.413	16.556	.000
Error	635.450	108	5.884		
Total	835608.000	120			
Corrected total	7599.467	119			

a. R Squared=.916 (Adjusted R Squared=.908)

Post hoc analysis related to the effect of learning models on students' problem-solving skills is presented in Table 2. LSD test results show that the average score of students' problem-solving skills taught by the combination of discovery models and RQA models is significantly higher compared to students' problem-solving skills taught with discovery models and RQA models and conventional models. The LSD results also showed that there were no significant differences in the problem-solving skills of students who were taught with the discovery model and students who were taught with the RQA model.

Table 2. Post hoc results about the effect of learning models on problem-solving skills

Learning model	Average value of PB (Pretest=X)	Average value of PB (Posttest=Y)	Gain score	Corrected value of PB	LSD notation
Conventional	68.70	71.26	2.56	71.27	a
RQA	68.73	84.60	15.87	84.60	b
Discovery	68.76	85.43	16.67	85.43	b
Discovery+RQA	68.53	90.06	21.53	90.07	c

After analyzing the effect of learning models on students' problem-solving skills, the researcher continued the further analysis with LSD. A summary of the Post hoc results of the interaction of learning models with different cultures is shown in Table 3. Post hoc test results related to the combination of learning models and culture show that the combination of discovery+RQA is more potential in improving problem-solving skills of students with high academic and low academic compared to the model the other.

Table 3. Post hoc results about the effect of learning models with different cultures

Learning model	Culture	Average value of PB (Pretest=X)	Average value of PB (Posttest=Y)	Gain score	Corrected value of PB	LSD notation
Conventional	Mountain	60.20	70.40	10.20	64.30	a
Conventional	Coastal	62.10	70.70	8.60	64.40	a
Conventional	Urban	61.30	73.10	11.80	68.20	b
RQA	Mountain	60.10	81.50	21.40	70.30	c
Discovery	Mountain	60.30	82.20	21.90	70.50	c
RQA	Coastal	63.20	84.50	21.30	72.10	d
RQA	Urban	63.60	85.30	21.70	72.30	d
Discovery	Coastal	64.20	86.30	22.10	76.10	e
Discovery	Urban	63.10	88.30	25.20	76.30	e
Discovery integrated RQA (DisRQA)	Mountain	61.10	89.70	28.60	80.70	f
DisRQA	Urban	64.70	90.40	25.70	83.20	g
DisRQA	Coastal	64.90	93.60	28.70	86.40	h

4. DISCUSSION

Discovery learning model is more dominant in developing students' problem-solving skills both students who come from urban or coastal compared to RQA or conventional models, this is because the discovery model implements team learning in analyzing and solving problems [59], [60], [61] there is a syntax for find solutions to the problems being faced [51], [53], [62] and students are trained to become experts and adult learners in solving real-life problems [60], [63]. Discovery learning model is able to provide an increase in students' problem-solving skills, this can be noticed from the increase before and after learning with discovery models [64]. The model is able to provide space for students to hone skills in finding solutions to the problems provided [65]–[67]. Discovery provides opportunities for students to collaborate in gathering information to obtain conclusions and solutions to the problems they face [66], [68]–[71]. These skills are able to hone the ability of students to do problem-solving so that their skills improve, this can be seen from the score before and after research results with the discovery model.

These results are in accordance with the findings of Purwanto *et al.* who reported that the discovery model was able to make students excited in finding solutions to problems given by the teacher, in line with these findings [72]. The discovery model made students honed their problem-solving skills and found solutions to problems given by teachers [37], [73]–[75]. Other findings suggest that the discovery model is able to train critical students in determining appropriate solutions to the problems faced [76]–[78]. Other studies report that discovery learning models make students trained independently when facing problems and are confident not to depend on others in finding solutions [79], students are calmer when faced with problems and do not act hastily [80]. Martaida *et al.* report that students who are trained with discovery models are able to think structured in finding solutions when facing problems, are not in a hurry and are able to hold emotions [81].

Besides the discovery model, there was also an increase in students' problem-solving taught with the RQA model. Post hoc results show the results of students' problems taught by the RQA model increased from before the study and after the study. These results illustrate the effectiveness of the RQA model in an effort to develop students' potential in solving problems and finding solutions to the problems they face. RQA model has a syntax that requires students to read and analyze the material to be taught [57], [82] so students are accustomed to analyzing the problems they face and fostering strong problem-solving skills towards themselves student. The RQA learning model trains students to develop problem solving skills based on their own level of ability by analyzing and finding problem-solving for questions that they themselves arrange [20], [44], [57], so the level of difficulty will be in accordance with the academic level they have, this is because the questions they are looking for a solution come from their own.

The results of Bahri and Corebima's research, reported that students who were trained with the RQA model showed rapid development in logical, creative and critical thinking in finding solutions to every problem given by teachers in the classroom after being given learning by the RQA model [44]. Similar results were also reported by Hariyadi *et al*. who stated that students who were taught with the RQA model had higher problem-solving skills compared to other students who were taught with conventional models [57]. The RQA model is reportedly also able to make students more mature in choosing appropriate solutions to the problems they face, trying several alternatives to solve existing problems and being calm [20].

The findings of this study reveal that the combination of the discovery integrated RQA (DisRQA) learning models has greater potential in improving problem-solving skills compared to the other three models. the combination of DisRQA learning models is proven to complement each other to improve students' problem-solving skills compared to the discovery and RQA models that stand alone. The results showed that the discovery model and the RQA model independently had the same potential in developing students' problem-solving skills. The combination of DisRQA learning models combines the strengths of each model and complement the weaknesses of existing models, discoveries that require more time than other models are covered by the existence of RQA syntax that requires students to read the material and arrange questions at home, while the weaknesses of RQA that do not have syntax for exploration in answering questions that have been made previously, equipped with syntax discovery so that both of these models can optimally improve students' problem-solving abilities.

Besides the learning model, another unique thing that can be found in this research is culture. Post hoc calculations show that cultural factors have a role in developing students' problem-solving abilities. Data on the results of problem-solving students who were taught with the same learning model showed different results, on the results of problem-solving students who were taught with the combined DisRQA model showed that the ability of coastal students was superior compared to urban students and was followed by students from the mountains.

These results reinforce the findings of Ferguson who reported that the patterns of the ability of individuals living in different cultures would have differences [83]. This difference is not only in verbal abilities but also found in non-verbal abilities [27]. Non-verbal performance such as critical thinking, numerical, drawing, finding solutions to problems influenced by the culture of the individual concerned [84]. A person's actions in determining a solution when there is a problem and how they think alternatives to solving the problem are often trained by the culture of the environment in which they live [85], [86].

Environments with extreme challenges often force individuals who live in the area to always be alert and accustomed to critical thinking, always ready for the worst possibilities [83]. This is the basis for coastal students' problem-solving abilities higher than the results of students from other regions. Critical thinking skills are high because the demands of nature form an adaptive and solusive soul to all existing problems [83], [87]. The implications of cognitive differences resulting from different cultures conclude that the same model cannot be applied to individuals from different cultural settings, because it will have different effects [88]. The findings in this study indicate that the DisRQA combined model has different results for individuals who come from different cultural backgrounds.

Coastal children are often trained by their parents in understanding natural phenomena and being adaptive to changes that occur, seeing how the water currents and the direction of the wind to determine whether a storm will or not, must read the constellations to be able to determine the way home at night day and also can see the direction of movement of the animals around in seeing whether environmental conditions allow or not to sail. This ecological demand trains students' personalities so that they are accustomed to problem conditions and find solutions to those problems and make their problem-solving abilities superior to students from urban areas and students from mountain areas. Cultural practices and ecological demands trained early on significantly influence the individual's perceptual and cognitive skills [27], [89].

The ability of coastal children who learn directly with natural phenomena is not possessed by children from other regions, they have been introduced to natural analysis since the age of six years. The

ability to determine precisely and quickly to weather changes whether to go home or keep on sailing makes them adaptive individuals, they are accustomed to evaluating all the changes that occur to produce the right solution to the problems that arise. The talent that arises from coastal children for solutive thinking comes from their culture and daily habits [90], [91]. Children are born with their own talents and are developed by local culture, while learning is a process to mature and differentiate these abilities and help them to reach their zone of proximal development [33], [34], [83].

The problem-solving ability of urban students is superior to the ability of students from the mountain. Urban culture accustoms children to communicative in presenting ideas from childhood, accustom them to engage in adult conversation and give opinions, this ability has an important role in honing their intelligence [34], [92]. These results are consistent with the findings of ferguson who reported that urban society excelled in verbal tests compared to rural and marginalized communities [83]. Urban children are trained by their parents to be independent in their learning process, give great confidence to manage their talents and be given a lot of space and opportunities to deepen the things they like. It is this social pattern and care that has an impact on children to be independent when there are problems and shape their mindsets [31].

Access to technology and greater modernity than mountain children have its own advantages for urban children to hone their abilities in terms of access to information so that they have more data and references in finding solutions to every problem they face. The modern culture of European society shows a higher academic value than African society provides evidence that culture has a significant role in developing one's thinking patterns [31]. Cultural communities that are more in touch with the wild and are not touched by the modernity of life force individuals who live in these areas must rely entirely on strong instincts and solid understanding to be able to find solutions quickly and precisely for any problems that come [87]. These findings are the reasons why coastal students have superior problem-solving abilities, followed by students from urban areas and students from mountains.

5. CONCLUSION

Based on the results of the research above, it can be concluded that the integrated discovery learning model of RQA can improve students' problem-solving skills compared to the original model. The results of this study also found that culture has a significant role in shaping students' problem-solving skills, with the use of the same model given to students who have different backgrounds will get different results. The results of subsequent studies reported that learning in school and in the environment are interrelated factors in shaping students' mindset and problem-solving skills.

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