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The Effect of Problem-Solving Training to Improve Student's Critical Thinking and Decision-Making Skills: Racked Analysis

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Abstract: Critical thinking and decision-making skills are essential for non-cognitive capabilities for students in the era of the industrial revolution. This is pilot study designed to measure the effect of problem-solving training in school counseling programs to improving students' critical thinking and decision-making skills. The one group pre-post test experimental design applied in this study. This study involved 35 second-grade students of SMA Negeri 4 Singaraja, Bali, Indonesia. Student's critical thinking and decision-making skills are measured by 13 items of critical thinking and decision-making scales. The Racked analysis by Rasch Model is conducted to seek the treatment effects for 6-times (55 minutes) counseling session on students' critical thinking and decision-making skills. The results demonstrated that students' critical thinking and decision-making skills is increase in each of the 13 scales used. The effect was consistent for a man and woman participants. This findings show that problem-solving training in counseling programs affects students' critical thinking and decision-making skills.

Key Words: Racked analysis; Problem-solving training; Critical thinking skill; Decision-making skill; Students in senior high school

INTRODUCTION

Currently, is an age of extraordinary transformation in which the development of information technology is raised and requires individuals to reflect more critically, globally and comprehend to handling complex varieties of communication and situation. Cognitive and non-cognitive factors both have fairly significant additions to academic success, careers and development for students (Schlegel, 2011). However, non-cognitive aspects cannot be simply ruled out by given the non-cognitive abilities; which include soft skills and emotional intelligence had a bigger input to one's progress than the technical abilities or cognitive ability of the students as a comprehensive person (Quieng et al., 2015).

Indonesia is presently owning a bonus demographic, where the number of productive citizens is higher than the non-productive one. If it is not planned with proper education, then the demographic bonus that is called might actually be an obstruction in national development. We affraid if many of Indonesia's human resources that should be productive actually grow into an overload to the society, or their groups because they do not have acceptable skills to clash with labour market requirements, or fallen in conditions that prevent it from being useful, i.e.,

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participating in drug abuse, or engaging in criminalization and much negative behaviour (Suranata, 2010; Suranata et al., 2019).

Enhancing students' critical thinking skills is of absolute priority to teaching; in fact, facilitating students to think critically is an essential objective of education. Preparing students for college and career should concentrate better on critical thinking and performance skills rather than rote learning of information or knowledge of subjects (Elias & Kress, 1994; Sahu & Gupta, 2013; Suranata, 2015). In mental health paradigm, critical thinking and decision making is one of the core psychological factors to determine how youth to resilience, overcome from obstacles, and perform a suitable outcome for working out any problem (Suranata, 2015). Students' need resources support to develop talents and strengths that can support them solve challenges, survive with pressure, and deal with any frustration. There are life skills to build up a child's self-esteem, a sense of competence and lead to social and emotional well being. If they have a solid relationships with a relevance adult, they maybe have a functional way to handling life's problems, and they understand by case how to handle with their own worries and misfortunes. But not all students are successful to have it in their family environment. Another expectation is that they meet it in the school environment.

School as an ecosystem becomes a decisive aspect in improving various abilities needed by youths to run into numerous problems in their lives and future (Martin et al., 2013; Pitzer & Skinner, 2017; Suranata et al., 2017). Students can practice a variety of abilities, including critical thinking and decision making through classroom learning activities, through discussion interactions with peers, and other extracurricular activities at school (Suranata, 2015). One of the strengths of the education system for senior high school in Indonesia is the existence of a guidance and counselling program as a curricular program. This gives the task of schools in providing support for the development of socio-emotional aspects and cognitive abilities needed related to solving psychological problems more optimally. The school counselors as psycho-educators in schools are reliable person for developing students' on their personal-social-emotional aspects. The cognitive behavioural is one model of counselling that is experiencing very rapid progress for school setting (Suranata et al., 2017). This counselling model emphasizes cognitive changes or ways of thinking, perceiving or beliefs in order to create emotions and behaviours that are more adaptive by focusing on present conditions of difficulty and are associated with causes of psychological distress or distress symptoms in the past actions (Shea et al., 2016). Problem solving and decision making skills is one techniques in cognitive behavioural counselling that intend to encourage students to develop problem solving and decision making skills, the ability to get alternative explanations and adopt the most appropriate solution of the problems encountered (Suranata et al., 2017).

This pilot study intends to demonstrate the effect of problem solving and decision-making exercises within the framework of cognitive behavioural to increasing critical thinking and decision-making skills of senior high school students. The critical thinking elements and decision-making skills applied in this study are reasoning, creativity, responsible problem solving, making judgments and decisions, and accessing, evaluating, and managing information (Wilson-Ahlstrom et al., 2014).

METHOD

Study Design

This study conducted by one group pre and post-test experimental design. The participants of the study was 35 of second grade students at SMA Negeri 4 Singaraja, Bali,

Indonesia (16 Male and 19 female, age average 15.8 years old, SD 0.65). The participant was assigned to follow problem solving and decision-making training for six sessions of 55 minutes group counselling activity. The participant involved measuring their critical thinking and decision-making skills the day before and one week after the training.

The problem solving and decision making training is a group of psycho education that designed to train students in making the finest decisions about their problems (Suranata et al., 2017; Suranata et al., 2020). This training program used a cognitive behavioural approach (Beck, 1993). The syntax is consisting of: (1) defines the problem; (2) identify alternative solutions; (3) accept the best solution from alternative solutions; (4) create a program; and (5) checks of the adjustments after the solution is completed. Every group of training consists of 18 and 17 students and one school counsellor for facilitating the training for every group student. The facilitator has followed coaching to grow into a facilitator in the study activity.

Instrumentation

The critical thinking and decision-making skills are measured by 13 items of Indonesian critical thinking and decision-making scale. Both scales were translate and adaptation from the critical thinking subscale of the non-cognitive skill scale from Wilson-Ahlstrom et al. (2014). The participants take one of the four response options provided on each item with scores ranging from four (4) for response strongly agree and score one (1) for strongly disagree. The validation of the 13 items of Indonesian critical thinking and decision-making scale is evaluated by Rasch analysis.

Data Analysis

This study used the restructured assessment and focused on applying the Rasch model to examine change in measures over time. The Racked Analysis via Rasch Model is carried out to describe of changes in scores on a scale from baseline to post test to detect variation in item difficulties (Racking) over time (Wright, 2003). Differential Item Functioning (DIF) by gender were used to determine different effect of training for man and woman participants. All analysed was performed by Winsteps Version 4.1.0 (Linacre, 2011).

RESULT

Properties and Quality of Critical Thinking and Decision-Making Scale

There are 3 aspects of testing performed to evaluate the critical thinking and decision-making scale in this study, namely (1) reliability and separation index of item and person, (2) dimensionality test, also (3) fit and misfit items. The summary is reported in Table 1.

Table 1. The Summary Item and Respond Quality

Estimation	Values
Item Reliabilities	0.90
Person Reliabilities	0.92
Cronbach Alpha (Kr- 20) Person Raw Score "Test" Reliability	0.88
Separation Index of Items	3.06
Separation Index of Person	3,40
Raw variance explained by measures	60.3 %
Raw variance unexplained by measures	39.7 %

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Table 1 presented the result of the estimation in indicates that the reliability of the critical thinking and decision-making scale is at an excellent level (0.90). This is also supported by person reliability (0.92), and the stability of person and item interaction is good (0.88) according to van der Linden (2001). The separation index proves that we can organize the items into three parts, from the item accessible to agree by respondent to the hardest. The person separations index also three parts, from students with highest level of critical thinking and decision-making skill to the lowest.

The categorization of fit and misfit items on the scale testified by connecting the OUTFIT MNSQ value of each item test with the Mean OUTFIT MNSQ value of +1.50 logit (Bond et al., 2020). The results showed, all of item of the scale (13 item) is meet at fit criteria. The results could be access at https://osf.io/9gxah/. The validity of the scale could be evaluated by unidimensional estimation through Principal Component Analysis (PCA) described the value of raw variance explained by measures of 60,3%. This means that the unidimensional conditions of the instrument is excellent (Bond & Fox, 2007; Boone et al., 2013; Seo & Taherbhai, 2013), or in other words, the items involved in the scale are applicable to measure students' critical thinking and decision making scales.

Racked Analysis

In this study, Racked analysis was used to measure change in difficulty approving items on the scale of critical thinking and decision making felt by participants between before and after the training program problem solving and decision making (Wright, 1996). This study did not involve a control group, so an examination of the differences between the experimental and control groups after the treatment carried out in the stacked analysis was not carried out.

The Item Map in Figure 1 generated by Racked data shows the items from the baseline assessment (with E codes, such as E1, E2 and so on) and post training problem solving assessment (with O codes, such as O1, O2 and so on) on the same item map possible examination of changes in the distribution of items along a continuum of student performance. Figure 1 also indicates that's racked items and Person Map shows students' responses to each item on the scale of critical thinking and decision-making.

The items that are in the upper position on are the more easily approved, while those below are more difficult. The items person and maps clearly show students' responses to all items changed very significantly from baseline to post test. At the baseline, students with code 029L agree with items E10 (I try to work out problems by talking or writing about them) and E9 (I identify and ask significant questions that clarify various points of view and lead to better solutions), but did not approve on 11 other items. While students with codes 033P and 034P only agreed on E10, and did not approve the 12 other of items. In this baseline assessment, the other students (n=32) did not approve all (13) items on the scale. The score of students at baseline is lower than M-1SD. This condition show that's the ability of critical thinking and decision-making on baseline is low.

Items with code O, which are post-test items are all in the top position of the map (higher than M+SD), some items are aligned with some students (items O10, O11, and O13 are parallel with student's code 004L, 005P, and 011P). While 12 other items are above or exceeded by all respondents. The position of items that are parallel to the person or items that are tracked by the person on the Wright Map basically mean the items are successfully understood by the respondents (Wright, 2003), in terms of scale, it can be meaningfully agreed upon. Thus, it can be seen from those the flews of responded approved all of items in the critical thinking and decision-making. Another path to represent of this condition can be realized in Figure 2.

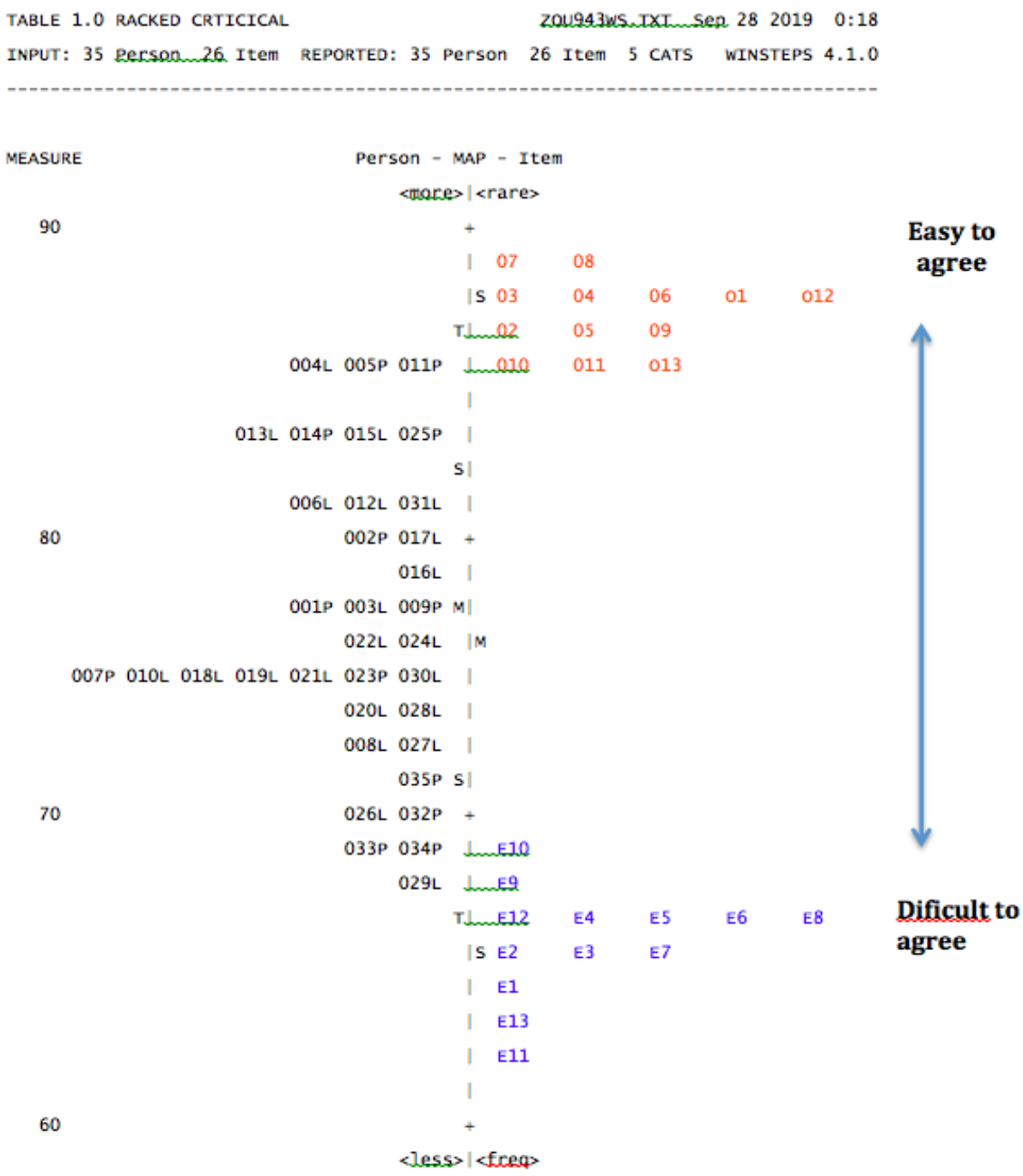

Figure 1 Racked Items Persons Map. Note: E for baseline score item; O for post-test score of items

In Figure 2 it can be observed that the overall item measure at baseline is at the value of ≤ 70 (logit), while at the post-test the value of each item is ≥ 80 (logit). The condition basically shows that after participating in the problem solving and decision-making training program, all students have perceived themselves as experiencing critical thinking and decision making abilities based on 13 items on the scale used. This is different from before training. In other words, it can be stated that the problem solving and decision making training has had an impact on improving the critical thinking and decision making abilities of all students participating in the training.

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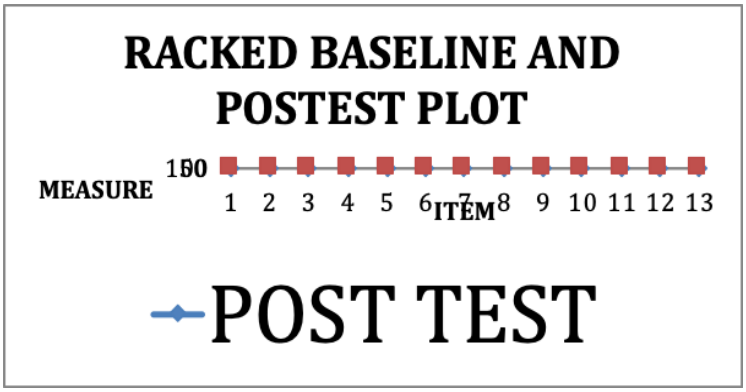

Figure 2 Racked Baseline and Post-test Plot

Comparison Effect Training Based on Gender

Comparison of the impact of training on male and female students can be evaluated based on difference item functioning in Figure 3.

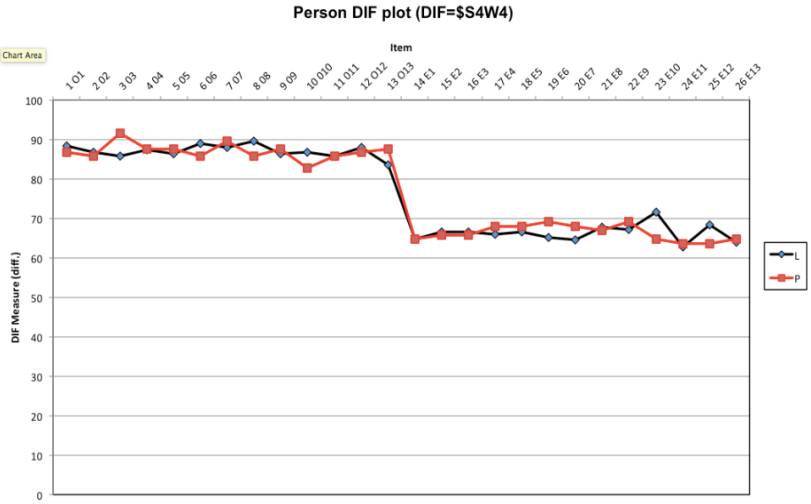

Figure 3 Racked Dif. Person Based on Gender

In Figure 3 we can be seen that the movement of the plot lines of male (green) and female (red) is in rhythm. At the post-test, there were no significant differences that showed differences in achievement of male and female students. This shows that the problem solving and decision-making training programs have the same impact for critical thinking and decision-making ability on both male and female students.

DISCUSSION

This study confirms that the decision-making and problem-solving (CBT-based) training program was appropriate as an intervention to enhancing students' critical thinking and decision-making skills. The consistency improved of the critical-thinking and decision-making ability in both male and female students.

Critical thinking and decision making are non-academic abilities or often referred to as non-cognitive skills that are very important to be developed for students to prepare them for the future (Koenig, 2011). The results of previous studies have confirmed that critical thinking

skills and problem-solving are important psychological abilities components forming the resilience of youth and students (Benard, 1995, 1996; Gruman et al., 2013; Mosely et al., 2006; Wong, 2012). Resilience is a strong determinant of mental health and wellbeing (Sagone & De Caroli, 2013; Zautra et al., 2008).

This study uses analysis of changes in baseline and post-test scores with the Racked analysis. This analysis shows detailed information about changes in student scores on each item after training. This information was important for researchers and practitioners who want to improve their intervention programs. Especially in the initial study, before the program was used in the wider population.

CONCLUSION

The results of this study showed that: (1) the 13 item of Indonesian critical thinking and decision making scala meet the fit criteria of a good psychometric properties based on Rasch Model; (2) The problem solving and decisions making training program effective to increase the student critical thinking and decision making skill; and (3) there was not different effect of the training based on gender.

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