

Validity and Reliability of Critical Thinking Disposition Inventory

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Abstract— The aim of this study was describing the validity and reliability of critical thinking inventory. The type of study was survey research. The study population was students of junior high schools in the Province of Bali, Indonesia. Samples were drawn by a multistage random sampling technique. In each district, one school was chosen as a sample and in each school, one class VII and one class VIII were selected as samples. The total samples were 531 students consisted of 271 students of class VII and 260 students of class VIII. The numbers of male and female students were 262 and 269 people, respectively. The critical thinking inventory instrument tested consisted of 62 items. The critical thinking inventory data of students were analyzed with the program of SPSS v.16. Data showed that 61 out of 62 items were valid and the reliability of inventory was 0.887.

Keywords—critical thinking; dispositions; inventory; reliability; validity.

I. INTRODUCTION

In a world that is always changing and challenging, mastery of subject matter content is indeed important, but there is something more prominent which is how learning can provide provisions to students as ways of thinking (learning how to think), especially in any levels of education that require students' critical thinking. Critical thinking is a prominent factor in helping students to solve a problem and make a decision both in the community and at work. It is also necessary for it has a role in success in a career.

Critical thinking is very important to be mastered because it is required in order to solve problems and make the right and responsible decisions. Therefore, students' critical thinking skills should be developed during learning. To achieve one of the education goals, one way that can be done is developing students' critical thinking [1]. Critical thinking helps students improving their way of thinking and preparing them to succeed in facing life [2]. By having critical thinking skills, students are expected to be able to help themselves and others in solving problems encountered in everyday life. The goal of learning critical thinking is to create citizens that have awareness of environmental literacy [3]. Moreover, it is crucial for teachers to apply critical thinking and for students to learn critical thinking to develop students' reasoning [4]. Besides, critical thinking develops awareness to people to

think deeply and consider many perspectives before making decisions. By thinking critically, someone will have a deep understanding of the problems he or she wants to solve. Also, critical thinkers tend to have insatiable curiosity. It is natural for critical thinkers to be curious and always wanting to know something beyond and deeper.

It is said that someone with critical thinking skills can analyze and solve the problem, ask questions, discover new answers, find recent information, and oppose dogma and doctrine [2]. Meanwhile, Lipman [5] revealed that critical thinking skills are very important to be mastered so that students can avoid fraud, indoctrination, and mind washing.

Critical thinking is needed so that students become adaptive and flexible in the information age [6]. Experts had studied and given reports about the importance of critical thinking for students and practitioners [7]. Dispositions and skills are included in learning critical thinking. Critical thinking by USA and Canada theorists in 1990 is defined as the abilities or skills in applying cognitive skills (interpretation, evaluation, and self-control) and dispositions to critical thinking skills (open-mindedness or intellectual honesty) [8, 9]. Critical thinking can be referred to the cognitive abilities of individuals in making decisions freely and using the mind logically [10, 11].

It is believed by most researchers that disposition is involved in critical thinking. The disposition of critical thinking is the integration between the attribute or habit of thinking with the individual's beliefs or actions for critical thinking [12]. It is needed to develop healthy critical thinking skills. The disposition of critical thinking is believed to be the internal tendency for someone in the application of critical thinking to solve problems and make decisions [13]. It is believed that being good at critical thinking dispositions means that someone is good at thinking critically, especially in solving problems and making decisions rather than someone who is not good at it [14]. Besides, the better critical thinking disposition someone has, the higher curiosity, intelligence, and dedication someone has compared to someone who does not have a critical thinking disposition [14].

Previous research has developed an inventory of critical thinking dispositions [15] which consisted of seven scales, 33

subscales, and 62 items. In the present study, the validity of the item and the inventory reliability were tested.

II. METHODS

The type of study conducted was survey research with the aim to describe critical thinking dispositions, the item validity, and inventory reliability. The study population was the students of grade VII dan VIII of junior high school in Bali Province, Indonesia. Samples were drawn by a multistage random sampling technique. One school was selected in each district and one class VII and one class VIII were selected from that school. The total number of samples drawn was 531 people. There were 217 students in class VII with the number of male and female students of 135 and 236 people, respectively. On the other hand, there were 260 students in class VIII with the number of male and female students of 127 and 133 people, respectively.

The inventories of critical thinking dispositions that will be tested for item validity and reliability have been developed in previous studies [15]. This inventory consisted of seven scales, 33 subscales, and 62 items. Each subscale contained a positive and/or negative statement. Each statement provided five response choices from 1-5 that described from strongly disagree to strongly agree. Table 1 presented the scales, subscales, and item numbers of the inventory.

TABLE 1. SCALES, SUBSCALE, AND ITEM NUMBERS OF THE INVENTORY OF CRITICAL THINKING DISPOSITIONS.

Scales	Subscales	Items
Truth-seeking	1) Trying to find out the truth clearly	1, 22
	2) Having a spirit to ask questions	24, 41
	3) Being objective/honest toward information	2
	4) Trying to understand something well	23, 60
	5) Using trusted sources	3
Open-mindedness	1) Considering other ideas in making decisions in their own	5, 42
	2) Tolerating different ideas	4, 28
	3) Changing opinions when they were refuted by strong facts/evidence	58
Analyticity	1) (a) Being aware of the risks and possibilities that may occur from an event	7, 25
	(b) Giving reasonable opinion and ideas when faced with complicated problems	8, 43
	(c) Providing objective evidence against a particular problem	26, 44
	(d) Being able to think logically	9, 57
	(e) Estimating the advantages and disadvantages of phenomena	27, 59
	(f) Relating the results of observation with existing (knowledge) theories	6, 45
	(g) Looking for alternative solutions for problems	10, 29

	(h) Contemplating the understood basic concepts	11, 46
Systematicity	1) Thinking and acting in an organized manner	12, 30
	2) Focusing on facing the problems	31, 47
	3) Using inquiry methods to solve problems	13, 32
	4) Do not hurry to conclude information	34
CT self-confidence	1) Having the confidence in his own opinion and decisions	33, 56
	2) Believing on results of self-reasoning	14, 48
	3) Having the confidence to lead other people to rational problem solving	35, 49
	4) Taking action or a decision with no hesitation	15, 55
	5) Being proud of your abilities to solve problems	36, 50
Inquisitive-ness	1) Having high learning the spirit even when the application of the studied science has not been seen directly	16, 37
	2) Having the spirit to learn new things	17, 51
Cognitive maturity	1) Do not get rid of problems	18, 38
	2) Realizing that some problems are related to each other	39, 61
	3) Realizing that an assessment must be based on criteria	19, 52
	4) Avoiding actions that confuse/ intimidate others with critical thinking skills possessed	20, 62
	5) Showing calm in thinking	21, 53
	6) Understanding other people's way of thinking	40, 54

Based on the tabel, the inventory has 7 scales, namely truth-seeking, open-mindness, analyticity, systematicity, CT self-confidence, inquisitiveness, and cognitive maturity. Each scale is divided into 2-8 subscales. Then, each subscale exist in 1-2 items.

Truth-seeking scale consists of 5 subscales. The subscale "Trying to find out the truth clearly" exists in items number 1 and 22. The subscale "Having a spirit to ask questions" exists in items number 24 and 41. The subscale "Being objective/honest toward information" exists in item number 2. The subscale "Trying to understand something well" exists in items number 23 and 60. The subscale "Using trusted sources" exists in item number 3.

Open-mindness scale consists of 3 subscales. The subscale "Considering other ideas in making decisions in their own" exists in items number 5 and 42. The subscale "Tolerating different ideas" exists in items number 4 and 28. The subscale

“Changing opinions when they were refuted by strong facts/evidence” exists in item number 58.

Analyticity scale consists of 8 subscales. The subscale “Being aware of the risks and possibilities that may occur from an event” exists in items number 7 and 25. The subscale “Giving reasonable opinion and ideas when faced with complicated problems” exists in items number 8 and 43. The subscale “Providing objective evidence against a particular problem” exists in items number 26 and 44. The subscale “Being able to think logically” exists in items number 9 and 57. The subscale “Estimating the advantages and disadvantages of phenomena” exists in items number 27 and 59. The subscale “Relating the results of observation with existing (knowledge) theories” exists in items number 6 and 45. The subscale “Looking for alternative solutions for problems” exists in items number 10 and 29. The subscale “Contemplating the understood basic concepts” exists in items number 11 and 46.

Systematicity scale consists of 4 subscales. The subscale “Thinking and acting in an organized manner” exists in items number 12 and 30. The subscale “Focusing on facing the problems” exists in items number 31 and 47. The subscale “Using inquiry methods to solve problems” exists in items number 13 and 32. The subscale “Do not hurry to conclude information” exists in item number 34.

CT self-confidence scale consists of 5 subscales. The subscale “Having the confidence in his own opinion and decisions” exists in items number 33 and 56. The subscale “Believing on results of self-reasoning” exists in items number 14 and 48. The subscale “Having the confidence to lead other people to rational problem solving” exists in items number 35 and 49. The subscale “Taking action or a decision with no hesitation” exists in items number 15 and 55. The subscale “Being proud of your abilities to solve problems” exists in items number 36 and 50.

Inquisitive-ness scale consists of 2 subscales. The subscale “Having high learning the spirit even when the application of the studied science has not been seen directly” exists in items number 16 and 37. The subscale “Having the spirit to learn new things” exists in items number 17 and 51.

Cognitive maturity scale consists of 6 subscales. The subscale “Do not get rid of problems” exists in items number 18 and 38. The subscale “Realizing that some problems are related to each other” exists in items number 39 and 61. The subscale “Avoiding actions that confuse/ intimidate others with critical thinking skills possessed” exists in items number 20 and 62. The subscale “Showing calm in thinking” exists in items number 21 and 53. The subscale “Understanding other people’s way of thinking” exists in items number 40 and 54.

The data obtained in this present study were in the form of students’ critical thinking disposition scores. These data were analyzed with the program of SPSS v.16 to determine the item

validity and the reliability of the inventory at a significance level of 5%.

III. RESULTS AND DISCUSSION

A. Results

The data obtained in the form of students’ critical thinking disposition scores were analyzed with the program of SPSS v.16. Analysis of the item validity produced 61 valid items from 62 items. Invalid item was item number of 52. Validity values for valid items range from 0.177-0.522 ($N = 531$; $\alpha = 0.05$; $r_{\text{critical}} = 0.085$). Meanwhile, the reliability of Cronbach's alpha value was 0.884. Next, item number 52 is dropped and the validity of items and the inventory reliability are re-analyzed. The results of re-analyzed items showed the reliability of inventory was 0.887 and the item validity was shown in Table 2.

TABLE 2. THE VALIDITY OF CRITICAL THINKING DISPOSITION IN INVENTORY ITEM.

No. of items	$N = 531, \alpha = 0.05, r_{\text{critical}} = 0.087$	Information
	$r_{\text{calculation}}$	
1	0.359	Valid
2	0.394	Valid
3	0.311	Valid
4	0.347	Valid
5	0.322	Valid
6	0.352	Valid
7	0.229	Valid
8	0.307	Valid
9	0.385	Valid
10	0.357	Valid
11	0.383	Valid
12	0.338	Valid
13	0.345	Valid
14	0.476	Valid
15	0.363	Valid
16	0.301	Valid
17	0.498	Valid
18	0.318	Valid
19	0.261	Valid
20	0.327	Valid
21	0.363	Valid
22	0.504	Valid
23	0.522	Valid
24	0.421	Valid
25	0.337	Valid
26	0.367	Valid
27	0.434	Valid
28	0.428	Valid
29	0.177	Valid
30	0.352	Valid
31	0.473	Valid
32	0.413	Valid
33	0.326	Valid
34	0.458	Valid
35	0.243	Valid
36	0.213	Valid
37	0.328	Valid
38	0.436	Valid
39	0.184	Valid
40	0.266	Valid
41	0.489	Valid
42	0.503	Valid

43	0.322	Valid
44	0.379	Valid
45	0.422	Valid
46	0.419	Valid
47	0.333	Valid
48	0.401	Valid
49	0.353	Valid
50	0.345	Valid
51	0.464	Valid
53	0.400	Valid
54	0.191	Valid
55	0.381	Valid
56	0.438	Valid
57	0.489	Valid
58	0.179	Valid
59	0.341	Valid
60	0.402	Valid
61	0.325	Valid
62	0.202	Valid

B. Discussion

Critical thinking dispositions and skills are included in critical thinking. Attitude aspects of critical thinking are the dispositions of critical thinking. On the other hand, the skills of critical thinking are the ability to solve problems and make responsible decisions. In order for someone to have good critical thinking skills, it is required for him/her to have critical thinking. The dispositions of critical thinking will become the soul or spirit to apply critical thinking skills. In other words, the dispositions of critical thinking must be acquired before someone applies critical thinking skills.

Studies on critical thinking dispositions are rarely done by researchers. Usually, researchers directly measure students' critical thinking skills that are realized in the process of problem-solving and/or decision making. This is not wrong, but it would be better if the students' critical thinking disposition is measured before developing their critical thinking skills.

The inventory of critical thinking dispositions development in this study is intended to provide a valid and reliable instrument. With a valid and reliable instrument, strong information about students' critical thinking dispositions will be obtained so that stakeholders can use students' critical thinking disposition information for various purposes.

In the present study, the validity and reliability of critical thinking dispositions inventory were tested. From 62 items originating from seven scales and 33 subscales, there were 61 valid items with the reliability of 0.887. This means that to measure students' critical thinking dispositions, the valid and reliable inventory can be used.

Studies on developing critical thinking disposition instruments have been carried out by several researchers [16, 17, 18]. Hwang et al developed scales of critical thinking dispositions [16]. These scales included systematic analysis, thinking in the box, and thinking out of the box. The results of their studies showed that to measure the critical thinking dispositions of nursing students in Taiwan, this instrument was

reliable. Meanwhile, the psychometric properties of the construct validity of the adapted California Critical Thinking Disposition Inventory (CCDTI) had been evaluated [19]. The results of their studies showed that the validity of the CCDTI constructs was satisfactory with seven scales extracted and confirmed through confirmatory and explanatory factor analysis. This instrument was considered valid and reliable to use in measuring critical thinking dispositions since this construct validity was supported by high Cronbach's alpha value. The Turkish version of the critical thinking disposition scales' validity and the reliability were provided by Akin et al [17]. There are two factors produced in confirmatory factor analysis, namely critical openness and reflective skepticism. The results of the validity and reliability analysis showed that this inventory was valid and reliable to measure the students' critical thinking dispositions. On the other hand, Wang et al. [18] have developed and validated an inventory of critical thinking dispositions for medical students in China. They found three subscales of critical thinking dispositions based on explanatory factor analysis, namely open-mindedness, systematicity/analyticity, and truth-seeking. This inventory was also valid and reliable to be used in measuring the critical thinking dispositions of medical students in China.

Studies describing the dispositions of critical thinking have also been reported by several researchers. Ozahrhman and Yildirim [20] defined and evaluated the critical thinking dispositions of nursing students in Turkey using CCTDI. The studies showed that there was a significant difference in the dispositions of critical thinking between nursing students who took in-service training and nursing students who did not take in-service training, especially on the truth-seeking and open-mindedness scale. Meanwhile, Salsali et al. [21] identified that Asian nursing students' critical thinking dispositions were lower than that of non-Asian nursing students. This was caused by differences in issues, such as the environment, learning methods, and culture. Karagöl and Bekmezci [22] reported that there was a weak relationship between the dispositions of critical thinking and the academic achievement of prospective teachers. Bell and Loon [23] discovered the dispositions of critical thinking had a positive impact on student learning. On the other hand, Biber et al. [24] confirmed that the prospective mathematics teachers in Turkey had relatively low critical thinking dispositions. Cekin [25] found that the prospective culture/religion teachers at Ankara University of Turkey had good critical thinking dispositions. Ekinci and Ekinci [26] reported that the critical thinking dispositions of teachers were closely related to the teachers' perception of professional works.

The instructional strategy's effect on increasing critical thinking dispositions has also been reported by several researchers. Qing et al. [27] investigated the inquiry-based chemistry experiments' effect on the prospective chemistry teachers' critical thinking dispositions. The results showed that the inquiry-based chemistry experiments were able to improve students' critical thinking dispositions between before and after learning. Qing et al. [28] investigated the

increase of students' critical thinking dispositions through task-based learning in chemistry experiments. They concluded that significant differences were found in students' critical thinking dispositions at the posttest between the two classes. An effective way for chemistry teachers in developing students' critical thinking dispositions was provided in these positive findings. The influence of learning techniques on students' critical thinking dispositions was investigated [29]. They concluded from the results of their study that the significant difference was not found in the dispositions of critical thinking between pretest and posttest. Foluso [30], on the other hand, reported that nursing students in the Southwestern Faculty of Nigeria had positive critical thinking dispositions with the highest score was found on the subscales of inquisitiveness and confidence in reasoning, while the lowest score was found on the subscales of truth-seeking and open-mindedness.

IV. CONCLUSIONS

The critical thinking dispositions inventory is an instrument in measuring attitude aspects, soul, or spirit of critical thinking. The inventories developed consisted of seven scales, 33 subscales, and 61 valid items and the reliability of the instrument was 0.887. Thus, this inventory can be used in measuring students' critical thinking dispositions. Information about the critical thinking dispositions of students is very important to help teachers in making lesson plans so that the learning carried out by teachers takes place more efficiently and effectively.

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