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Development and Validation of a Test to Measure the Secondary Students' Critical Thinking Skills: A focus on Environmental Education in Bangladesh

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Environmental Education (EE) is a learning process that provides necessary knowledge, attitudes, and skills toward the achievement of Sustainable Development Goals (SDGs). Critical Thinking Skills (CTS) is one of the vital Higher Order Thinking Skills (HOTs) necessary to acquire by the young generation to face the challenges of 21st-century education. Countries worldwide are focusing on the inclusion of EE and revising their curriculum and textbooks to improve the students' attainment of CTS achievement. As the focus of developing the CTS increases, the assessment of CTS has become more vital nowadays. The primary purpose of the current study was to develop and validate a test to measure students' critical thinking skills in a specific subject of environmental education. A Critical Thinking Skills Test of Environmental Education (CTSEE) was developed and validated with 444 secondary (grade 8) level students of Bangladesh. The developed test comprises 27 multiple-choice type items under three skills-conclusions, inferences, and identifying bias. Results were analyzed to measure the quality of individual test items, establish reliability estimates, and ensure the developed instrument's validity. Results showed substantial validity and reliability of the test items, along with a moderate level difficulty. It is hoped that the developed test contributes to the future educators and researchers by filling up the gap of a systematically designed and valid instrument for measuring the CTS among secondary level students in different environmental issues.

Keywords: Environmental education, critical thinking skills, sustainable development goals

INTRODUCTION

The importance of Environmental Education (EE) for ensuring environmental sustainability as well as Sustainable Development Goals (SDGs) has already been demonstrated by the international community and researchers in this field. Stevenson (2007) claims that EE is the most effective technique to identify and solve environmental difficulties in society. According to Arslan (2012), EE increases the specific knowledge about environmental issues and turns the conservational attitudes into human behavior. Many environmental disasters happen worldwide every year due to both human-made and natural reasons. As environmental calamity affects society, every community member must take equal responsibility to identify and solve those problems. Awareness about all kinds of environmental catastrophe is needed among the members of the society. Awareness and the responsibility to act against those disasters are essential to save the future generation from all types of natural disturbance. Well planned environmental education can solve those problems as the EE aims to create awareness among every individual of this universe about the current problems in the environment and enrich them with the skills by which they can solve those problems and prevent future environmental destruction (UNEP, 1976).

Critical Thinking Skills (CTS) is a set of essential skills to face the challenges in this era of environmental sustainability. Human life is becoming more challenging, and they need to think critically before making any decision about their surrounding environment. Although there is no actual definition of Critical Thinking (CT), different researchers tried to formulate the CT according to their understanding. According to Ennis (1989), CT is a rational and thoughtful thinking process that decides what to believe or do. Hatcher & Spencer (2000) proposed CT as a thinking style that tries to reach a valid conclusion after assessing all possible substitutes with a sincere examination of all existing opinions and evidence. Halpern (2014) suggested that CT accelerates the human ability to make logical decisions and resolve critical situations. He also proved that the

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people with CT skills become a dynamic and knowledgeable citizen of society who can easily handle complicated ecological difficulties. So, CT is a thinking process that helps people make logical decisions by considering every possible alternative (Kusumadewi & Subroto, 2019; Makhzoum & Jabbour, 2020; Tabun, Sunarno & Sukarmin, 2019)

There is a secure connection between environmental education and critical thinking skills. EE is aiming to produce every individual having all required quality to make an environmentally friendly decision for ensuring the environmental balance around the world, and CT is regarded as a set of skills by which citizen of the society can take responsible action for the sake of ecology (Marques, 2012). Education policy and the national curriculum focus more and more on including EE related issues in the textbook, and priority has been given to emerging environmental contents (Uddin, 2019). Emphasis on developing CT skills among the young generation is increasing day by day, and the need for assessing those skills has become more vital nowadays (Lin, 2014).

The focus of education has been shifted from quantity to quality in this period of 21st-century skills. Most countries worldwide have already achieved the goals of access to education and now searching for quality. Their focus has been lifted from lower-order thinking skills to higher-order thinking skills in this competitive period. Critical Thinking Skills (CTS) is a higher-order thinking skill, and research about measuring CT skills is growing fast. Most of the research in CT skills focuses on general CT skills rather than domain-specific CT skills. Facione (1990) claims that the general CT tests can only assess academic actions rather than CTS expertise. Additionally, the necessity for measuring subject-specific CT skills is growing because it can assess the skills of a limited subject area (Lin, 2014). McPeck (1990) shows that critical thinking is initially connected to an exact field of study. So, it is essential to measure specific subject related CT skills to ensure the student's ability to make an informed decision in their real-life happenings. Nevertheless, more focus has been given to developing CTS tests on a particular subject, especially EE.

There are different CTS tests (Table 1 and 2) that measure the general CT skills and subject-specific CT skills. Subject-specific CTS test includes the subject such as Chemistry, Biology, Physics, and Language learning.

Table 1: Instrument that measures general CTS

Name and source of test	Question Type	Skills assessed	Time required
The Ennis-Weir Critical Thinking Essay Test (EWCTET), Ennis and Weir, 1985	Open-Ended (Participants required to write an essay based on each provided paragraph)	Getting the point, Seeing the reasons and assumptions, stating one's point, offering good reasons, seeing other possibilities, responding appropriately	40 minutes
California Critical Thinking Skills Test (CCTST), Insight Assessment, 2013	Multiple choices (40 items based on five skills)	Analysis, Evaluation, Inference, Deduction, and Induction	45-50 minutes
The Watson-Glaser Critical Thinking Appraisal (WCGTA-S), Pearson, 2015	Multiple choices (85 items to measure five skills)	Inferences, Deduction, drawing conclusions, making assumptions, and assessing arguments	30 Minutes
The Watson-Glaser Critical Thinking Appraisal (WCGTA), TalentLens, 2017	Multiple choices (85 items to measure five skills)	Inferences, Deduction, drawing conclusions, making assumptions, and assessing arguments	60 minutes
The Cornell Critical Thinking Test Level Z (CCTT-Z), 2017	Multiple choices (52 items based on seven skills)	Induction, Deduction, Credibility, Identification of Assumptions, Semantics, Definition, and Prediction in planning experiment	50 minutes
The Halpern Critical Thinking Assessment (HCTA), Halpern, 2016	Open-Ended and Multiple Choice (25 multiple choice questions	Verbal reasoning, Argument analysis, hypothesis testing, Likelihood and uncertainty, decision-making, and problem-solving.	40-60 minutes
Critical Thinking Assessment (CAT),	Open-Ended (15 questions)	Inference, assessing arguments, Correlation vs. causation, Analyzing, Interpreting and evaluating information, and Communication	30-45 Minutes

The above table shows the necessary information about the instrument that are available commercially and non-commercially for measuring the general CTS. Most of the instruments focus on multiple-choice questions except CAT and EWCTET. Almost all the test focuses on measuring the higher-order thinking skills by emphasizing the Inference, Drawing Conclusion, Deduction, Induction, and Analyzing skills. The open-ended test requires more time than multiple-choice questions to be answered by the student.

Table 2: Subject Specific Critical Thinking Skills Test

Name and source of test	Question Type	Subject and Skills assessed	Time required
Critical Thinking Skills in Electricity and Magnetism (Tiruneh et al. 2017)	Multiple choices (20 items)	Physics (Reasoning, Hypothesis testing, Argument analysis, Likelihood and uncertainty analysis, and Problem-solving and decision-making)	50-60 minutes
Danczak-Overton-Thompson Chemistry Critical Thinking Skills Test (Danczak, 2018)	Multiple choices (30 items)	Chemistry (Making Assumptions, analyzing arguments, Developing Hypothesis, testing hypothesis, Drawing Conclusion)	30-40 minutes
Designing and implementing a test for measuring Critical Thinking in primary school (Gelerstein et al., 2016)	Multiple choices (29 items)	Language Arts (Interpretation, Analysis, Evaluation, Inference, Reasoning/ Explanation	30-40 minutes
The Influence of Environmental Education on Critical Thinking and Environmental Attitude (Arslan, 2012)	Multiple Choice (15)	Environmental Education (Conclusion, Inference and Identifying Bias)	45 minutes
Measuring Critical Thinking skills of 11th-grade students on temperature and heat. (Aminudin et al., 2019)	Open-ended (5)	Physics (Elementary clarification, Basic support, Inference, Advanced clarification, Strategies, and tactics)	90-120 minutes
The analysis of critical thinking skills tests in social problems for physics education students with the Rasch Model. (Marfu et al., 2019)	True-False and Essay type (23)	Physics (Interpretation, Analysis, Evaluation, Inference, Explanation, Self-regulation)	Not mentioned
Development of Assessment Instruments in Measuring Critical Thinking Skills of Senior High School Participants of Biology Subject (Hidayat & Fadillah, 2019)	Multiple Choice (22)	Biology (Interpretation, Analysis, Evaluation, Inference, Explanation, Self-regulation)	80 minutes
The development and validation of critical thinking skills test on photoelectric effect for pre-service physics teachers (Sutarno et al., 2019)	Multiple choices and giving Reason (10)	Physics (Reasoning, Hypothesis testing, Argument analysis, Likelihood and certainty analysis, Problem-solving, and decision making)	90 minutes
Development and validation of an integrated assessment for measuring critical thinking and chemical literacy in chemical equilibrium (Sadhu & Laksono, 2018)	Open-ended two-tier multiple-choice question (37)	Chemistry (identifying a problem, reconstructing an argument, evaluating an argument, determining a solution, and drawing the conclusion	90-120 minutes

Table (2) shows the specific subject-related critical thinking skills test for measuring CTS's different skills, focusing on chemistry, biology, physic, language, and arts. It is found that many tests used multiple choice type questions with a special focus on a particular subject. The minimum and maximum time required for answering the test mentioned above were 30 minutes and 120 minutes, respectively.

The development of a test focusing on environmental education to measure students' critical thinking skills is essential because it can measure the future generation's real situation with evidence about the real environmental issues. Bangladesh is an environmentally vulnerable country, and different kinds of natural disasters are happening almost every year. The seasonal diversity has got a shocking change there, and the nation is looking for a way to get rid of it. The education sector can make some significant contributions to this matter. A student with proper CTS can perform as an environmental leader to solve the current problem and protect against future attacks. This study sought to measure the environmental CTS by focusing on

environmental issues, both local and national. Before doing that, it is essential to develop a widely acceptable CTS test that measures the skills by maintaining validity and reliability. This study's main problem is developing and validating the CTS test for measuring the secondary level mastery in Environmental Education. This research attempts to solve this problem. The study's key aim is to develop and validate a test for measuring the CT skills among the secondary level students of Bangladesh by focusing on a specific subject environmental education.

RESEARCH DESIGN and METHOD

This part contains an explanation about the development and validation of the Critical Thinking Skills of Environmental Education (CTSEE) test, an instrument designed to measure secondary level students' critical thinking skills about environmental issues. The entire process of development and validation was done through different steps.

The draft of the questionnaire was prepared based on a wide range of related literature reviews. The test's idea was adopted from the previous research (Cheak, 1999), but its internal organization was different from the original one. A pilot study was conducted with the initial version of the questionnaire to check the developed test's quality and validity. Twenty-four secondary level students have participated in the pilot study. The second version of the questionnaire was organized based on the students' suggestions and the pilot results. The researcher conducted another survey with the edited version of the test to confirm its validity and reliability. A total of 444 students took part in the 2nd survey. The test's validity and reliability were examined again and compared with the previous results to confirm the developed test's internal and external validity.

RESULTS

Results and discussion part are considered to be the most important part of a study. This part of the discussion will be divided into two parts- a) test development and b) test validation.

a) Test Development

Selection of CT Skills

After an extensive review of related literature, a framework of critical thinking was identified. A framework is a pathway to develop a test and ensure its acceptance in the research community. The planned framework was based on the critical thinking test in environmental education by Cheak (1999), covering three skills (Conclusion, Inferences, and Identifying Bias) from wide-ranging areas of critical thinking skills. Besides, these three skills were found common in most of the commercially available test that can measure the general critical thinking skills, such as the California Critical Thinking Skills Test (CCTST), the Watson-Glaser Critical Thinking Appraisal (WCGTA-S), and Critical Thinking Assessment (CAT). In terms of measuring subject-specific critical thinking skills, many researchers used Conclusion, Inference, and Identifying bias by using different terms in their research.

Selection of Specific Subject

Environmental education was selected as a subject to develop critical thinking skills. The global environment has a significant effect on our everyday life, and the effect is widespread. The participation of every individual is necessary to ensure environmental sustainability. Critical thinking skills are required to decide about any environmental issue, especially to solve local environmental problems. CTS also essential to make an informed decision and responsible action about global environmental agendas. No test has been found that intended to assess CTS regarding environmental issues in the Bangladeshi context. Thus, EE has been selected as a subject to develop the CTS test.

Choose the Item Format

Most of the available CTS tests (California Critical Thinking Skills Test, The Watson-Glaser Critical Thinking Appraisal, The Watson-Glaser Critical Thinking Appraisal, The Cornell Critical Thinking Test Level Z, and The Halpern Critical Thinking Assessment) use multiple-choice item format. However, Norris (1989) suggested easy type or a combination of closed-ended and open-ended questions for measuring critical thinking skills, but reliability cannot be controlled in essay type questions. On the other hand, multiple-choice type question allows increasing the items number that can increase the reliability. It also permits maintaining

the internal consistency of the test items. Therefore, the multiple-choice format was chosen for the test. There was a total of 27 items in the test.

Overview of the Test

The entire test is divided into three sections (Section 1- Drawing Conclusion, Section 2- Inference Making, and Section 3- Identifying Bias). Every section of the test starts with an example for a better understanding of the answering system. The student needs a reading paragraph before answering a certain number of questions. There are six paragraphs in the test (Conclusion-2, Inference-3, and Identifying bias-1). Item 1 to 19 contains three alternatives for each question, and 20 to 27 have four alternatives. There is a correct answer in every question, and the student can score 0 to 27 according to the number of correct answers. An overview of the developed test has been shown below Table 3

Table 3: Overview of test and question pattern

Name of Critical Thinking Skill	Number of Questions	Type of Questions
Drawing Conclusion	Item 1 to 5	Graph about the number of trees in a garden
	Item 6 to 9	Graph about the number of native and non-native fish in the sea
Inference Making	Item 10 to 12	Paragraph about new railway construction through a rural area
	Item 13 to 15	Paragraph about oil tanker accident in the river
	Item 16 to 18	Paragraph about uses of chemical fertilizer in the soil
Identifying Bias	Item 19 to 27	Paragraph about the construction of a power station near the mangrove forest

Participants Selection

The first stage of developing the test was selecting the target participant. Bangladeshi students need to choose one specific subject area (Science, Arts, and Business) after the 8th grade. They need to study similar subjects to this level. It is strongly believed that understanding any specific issue will be the same at this education level. Therefore, the study participants were 444 students (male-241, female-203) from 13 secondary schools (8th grade) of Bangladesh.

Table 4: Participant in the study according to gender and School Type

Gender		School Type		School Area	
Male	241	Public	182	Rural	218
Female	203	Private	262	Urban	226

Sampling Techniques

The schools were selected from 4 different administrative districts based on both rural and urban areas. Stratified random sampling methods were followed to select four districts among 64. A total of 13 schools (9 private and 4 Public) were selected through the simple random sampling process. 30-40 students from each school were selected based on their academic achievement. The whole class was divided into three major groups (High achiever, Middle achiever, and Low achiever) according to their previous test. The researcher tried to select the same number of students from each group if more than 40 students were in a class. There were three schools where the total number of students was 30 -34. All of them were selected as a sample in that case.

b) Process of test validation

Expert review (1st phase)

After finishing the test's initial version, it was sent to the two prominent researchers of the EE field from Australia and Indonesia to review the 27 items. The review's primary purpose was to check each item's relevance in line with the desired objective. Another aim of the review was to check the correctness of the information presented throughout the questionnaire and ensure language accuracy. The reviewers reported that most of the CTSEE items were appropriate and relevant to measure the targeted CTS in EE except for some minor corrections. Suggested revisions were made accordingly, and the test was ready for the pilot testing.

Piloting

The initial version of the test was pilot tested on a small group of 8th-grade students (N= 22) in a secondary school in Bangladesh. The purpose was to assess the quality of the items selected for the CTSEE and calculate the time required to answer all the questions. There was a brief discussion/interview between the researcher and participant to know the questionnaire's students' insight. There were five questions (Item 3, 8, 13, 19, and 25) unclear to the students. There was no example in the 3rd section (Identifying Bias).

After getting feedback from the student, the example was added in the 3rd section to ensure that part's clarity. Necessary corrections (changes in the language/ easy words, avoid similarity in the options, removing unnecessary sentences, adding sentences for describing the graph) were made. The average time required for the test was 40 minutes.

Review of Language Expert

According to the students' age, the test was sent to the language experts (N=2) to translate it from English to Bengali. Both experts were the teacher and graduated from the English language (1st expert) and Bengali language (2nd expert). They made essential revisions for ensuring the easiness and readability of the items by the 8th-grade students of Bangladesh.

Revision and Administration of Test Items

Different suggestions for revising the preliminary version of the items were found from the interview and pilot test data. The interview notably indicated that one item (Item_3) was lengthy and complicated to recognize for the participants. Thus, a decision was made during the revision to decrease the length of that item. The provided alternatives were somehow similar in three questions (Item 13,19 and 25) revised in the final version. Unnecessary sentences were removed in item number 8 to make it easy for the students. There was no example in part three. The example was set in this part also according to the opinion of the student.

After incorporating all the revisions, the revised version of the test was administered to 444 students of 13 different secondary schools in Bangladesh. There were participants of different ages range from 12 to17 years old. An oral instruction about participation in this study and the purpose of the research was provided to the participants to ensure the research ethics. The test was administered into the regular classroom, and prior permission from the authority was taken by maintaining official procedures. A teacher was accompanying the researcher during the test to ensure the environment for test administration and to confirm the students that the test was not related to their academic grade but essential for the study as the regular class time was 50 minutes, so the students were requested to try to complete answering the all the items within 40-45 minutes. Most of the students were able to finish within the time frame, and additional 5 minutes were given to the students who could not do it within 45 minutes.

FINDINGS

This section deal with the preliminary results of the developed test for critical thinking skills of environmental education based on validity (Face/content validity, Pearson product-moment correlation), Reliability (Internet consistency by showing Cronbach's Alpha), and Item difficulty index. The test-retest reliability is also included to ensure the same results every time.

Validity

The test's content/face validity was measured by both subject experts group(N=2) and and respondents group (N=24). The percentage of agreement with the developed test by both experts and respondents' group were 85% and 91% accordingly. The result demonstrated the appropriateness of the items for measuring the targeted critical thinking skills. Two experts agreed that the items were clear enough to meet the purpose, and the instructions were appropriate for the participants. According to respondents, the graph, image, and illustration used in the questionnaire were suitable for the students' age. The necessary correction has been done in the final version of the test according to the experts' and respondents' instructions.

Pearson product-moment correlation was calculated to check the validity of each item by using SPSS. Each item's significance value (Table 2) showed the instrument's validity by comparing its value with the total score.

Table 5: Validity analysis of test item by Pearson product-moment correlation

Item	Significance Value	Criteria
Item_1	0.003	Valid
Item_2	0.001	Valid
Item_3	0.005	Valid
Item_4	0.000	Valid
Item_5	0.003	Valid
Item_6	0.002	Valid
Item_7	0.001	Valid
Item_8	0.002	Valid
Item_9	0.001	Valid
Item_10	0.000	Valid
Item_11	0.000	Valid
Item_12	0.002	Valid
Item_13	0.000	Valid
Item_14	0.000	Valid
Item_15	0.002	Valid
Item_16	0.015	Valid
Item_17	0.020	Valid
Item_18	0.001	Valid
Item_19	0.006	Valid
Item_20	0.002	Valid
Item_21	0.005	Valid
Item_22	0.015	Valid
Item_23	0.010	Valid
Item_24	0.002	Valid
Item_25	0.000	Valid
Item_26	0.002	Valid
Item_27	0.001	Valid

*The Sig. Value <0.05 indicate the item is valid

Reliability

The Cronbach's Alpha of the test was measured to check the internal consistency of the item. SPSS was used to measure Cronbach's Alpha based on the following criteria (Table 6).

Table 6: Criteria of Cronbach's Alpha Value

No.	Category	Reliability
1.	0.800 – 1.000	Very high
2.	0.600 – 0.799	High
3.	0.400 – 0.599	Moderate
4.	0.200 – 0.399	Low
5.	0.000 – 0.199	Very low

Case processing summary

		N	%
Case	**Valid**	444	100.0
	Excluded	0	.0
	Total	444	100.0

Reliability Statistics

Cronbach's Alpha	N of Items
.7756	27

According to the above statistical value, Cronbach's Alpha for the test was .7756, showing its high reliability.

Item difficulty

Item difficulty was measured by calculating the difficulty index of each item. The criteria for selecting the difficulty level of each item has been listed below-

a. Question with the difficulty index of $0.00 \leq P < 0.30$ is difficult item.
b. Question with the difficulty index of $0.30 \leq P < 0.70$ is moderate item.
c. Question with the difficulty index of $0{,}70 \leq P \leq 1{,}00$ is easy item.

Difficulty analysis of test items:

Table 7: Item difficulty index

Item No.	Difficulty Index	Criteria
Item_1	0.541	Moderate
Item_2	0.246	Difficult
Item_3	0.763	Easy
Item_4	0.289	Difficult
Item_5	0.249	Difficult
Item_6	0.372	Moderate
Item_7	0.576	Moderate
Item_8	0.296	Difficult
Item_9	0.415	Moderate
Item_10	0.454	Moderate
Item_11	0.376	Moderate
Item_12	0.396	Moderate
Item_13	0.483	Moderate
Item_14	0.445	Moderate
Item_15	0.375	Moderate
Item_16	0.456	Moderate
Item_17	0.487	Moderate
Item_18	0.332	Moderate
Item_19	0.471	Moderate
Item_20	0.641	Moderate
Item_21	0.264	Difficult
Item_22	0.284	Difficult
Item_23	0.537	Moderate
Item_24	0.212	Difficult
Item_25	0.537	Moderate
Item_26	0.345	Moderate
Item_27	0.543	Moderate

According to the above criteria, only one item was found in the easy category (Item no 3). There were 7 items found in difficult category (Item 2,4,5,8,21,22,24). The rest of the items were at a moderate level. Heavy items were further edited (Question pattern and language) to ensure the acceptable difficulty level.

Conclusion

This study's objective was to develop and validate a test to measure environmental education's critical thinking skills, and it was successfully designed and validated. Different environmental contents from the secondary level textbook were considered for creating the items of the test. Current environmental issues also got focus on the development process of the test. Three critical thinking skills (Concluding, making an inference, and Identifying bias) were selected for the test among many skills. A total of 27 multiple choice type items was included after the careful analysis of piloting results and expert's opinion.

Validity, reliability, item difficulty index, and item discrimination index were checked with 444 secondary-level Bangladesh students. It was found valid and reliable for measuring the CT skills of students. Item difficulty index showed that all the items were at a moderate level. It can be used to measure secondary level students' CT skills, although there were some limitations.

The main limitation of the test was not to include all the CT skills. There are many skills, but this study only considered 3 of them. Future research can be conducted focusing on more skills. The second constraint

was the level of the participant. Only 8th-grade students participated in the research, but it would be better to ensure participants from every secondary education level in Bangladesh. Thirdly, the number of questions was limited to 27 because of time (the actual period of a class was 50 mins) constrains. More items can ensure a more valid and reliable test.

Despite having many limitations, this study bears enormous importance. It could be used to measure Bangladeshi students' CT skills for ensuring their level of quality towards sustainability issues. A future researcher can use this test as a model to produce more tests for measuring these essential skills in different levels of education and by focusing on a different subject. Policymakers could get some insights concerning the students' CT skills that could be further developed by focusing on new policy initiatives in this education field. Finally, students will know their CT skills level by using this test and can improve themselves as a resource for achieving environmental sustainability and sustainable development goals.

REFERENCES

Aminudin, A. H., Rusdiana, D., Samsudin, A., Hasanah, L. & Maknum, J. (2019). Measuring critical thinking skills of 11th-grade students on temperature and heat. *Journal of Physics: Conference Series*, 1280 (2019) IOP Publishing DOI:10.1088/1742-6596/1280/5/052062

Arslan, S. (2012). The ınfluence of environmental education on critical thinking and environmental attitude. *Social and Behavioral Science, 55*, 902-909.

Danczak, S. M., Thompson, C. D., & Overton, T. L. (2017). What does the term critical thinking mean to you? A qualitative analysis of chemistry undergraduate, teaching staff, and employers' views of critical thinking. *Chemistry Education Research and Practice, 18*(3), 420-434

Ennis, R.H. & Wier, E. (1985*). The Ennis-Wier critical thinking essay test*. Pacific Grove, CA: Midwest publications.

Ennis, R.H. (1989). Critical thinking and subject specificity: Clarification and needed research. *Educational Researcher*, 18(3), 4-10.

Facione, P. A. (1990). *Critical Thinking: A statement of expert consensus for educational assessment and instruction executive summary "the Delphi report* Vol. 423 (c). The California Academic Press 1-19. https//doi.org/10.1016/j.tsc.2009.07.002

Gelerstein, D., Rio, R.D., Nussbaum, M., Chiuminatto, P. & Lopez, X. (2016). Designing and implementing a test for measuring critical thinking in primary school. *Thinking Skills and Creativity*. 20, (2016). 40-49.

Halpern, D. F. (2016*). Manual: Halpern critical thinking assessment* Retrieved from https://drive.google.com/file/d/0BzUoP_pmwy1gdEpCR05PeW9qUzA/view Accessed on 29/01/2020

Halpern, D.F. (2014). *Thought and knowledge: An introduction to critical thinking (5th Ed.).* New York, NY: Taylor & Francis.

Hatcher, D. & Spencer, L.A. (2000). *Reasoning and writing: From critical thinking to composition*. Boston, MA: American Press.

Hidayat, S. & Fadillah, E. N. (2019). Development of assessment instruments in measuring critical thinking skills of senior high school participants of biology subject. *Journal of Physics: Conference Series*, 1241,DOI:10.1088/1742-6596/1241/1/012040.

Insight Assessment. (2013). *California critical thinking skills test (CCTST). Request information.* Retrieved from http://www.insightassessment.com/Products/Products Summary/Critical-Thinking-Skills-Tests/California-Critical-Thinking-Skills-Test CCTST, Accessed on 30/01/2020

Kusumadewi,R.A. & Waspodo Tjipto Subroto,W.T. (2019). Development of quiz card media to improve reading skills and critical thinking on student. *International Journal of Educational Research Review,4*(3), 367-372.

Lin, S.-S. (2014). Science and non-science undergraduate students' critical thinking and argumentation performance in reading a science news report. *International Journal of Science and Mathematics Education*, 12(5), 1023-1046. DOI: 10.1007/s10763-013-9451-7.

Makhzoum,V. & Jabbour,M. (2020). Critical thinking and it is role in facing Coronavirus. *International Journal of Educational Research Review,5(*4),389-406.

Marfu'i, L. N. R., Nurihsan, A. J., Nurhudaya, and Vismaia, S. D. (2018). Self-regulation in critical thinking skills of Buddhist teenagers for solving problems in Indonesia. *BRAIN – Broad Research in Artificial Intelligence and Neuroscience,* 9(1), pp. 101–113.

Marques, J.F. (2012). Moving from trance to think.: Why we need to polish our Critical Thinking Skills. *International Journal of Leadership Studies,7*(1), 87-95.

McPeck, J. (1990). *Teaching critical thinking: Dialogue and dialect*. New York, NY: Routledge.

Norris, S. P. (1989). Can we test validity for critical thinking? *Educational Researcher*, 18(9), 21-26. DOI:10.2307/1176715.

Pearson. (2015). Watson-Glaser critical thinking appraisal - short form (WGCTA-S). Retrieved from https://www.pearsonclinical.com.au/products/view/208, Accessed on 23/01/2020.

Sadhu, S. & Laksono, E.W. (2018). Development and validation of an integrated assessment for measuring critical thinking and chemical literacy in chemical equilibrium. *International Journal of Instruction,* 11(3), 557-572.

Stevenson, R. (2007). Schooling and environmental education: Contradictions in purpose and practice. *Environmental Education Research*, 13(2), 139-153

Sutarno, S., Setiawan, A., Suhandi, A., Kaniawati, I., & Malik, A. (2019). The development and validation of critical thinking skills test on photoelectric effect for a pre-service physics teacher. *Journal of Physics: Conference series.* 1157, DOI:10.1088/1742-6596/1157/3/032032.

Tabun,Y.F., Sunarno,W. & Sukarmin (2019). The effectiveness of critical thinking ability on learning outcomes at SMP Katolik Stella Maris Biudukfoho, Indonesia. *International Journal of Educational Research Review,4*(4),593-601.

TalentLens. (2017). *The gold standard critical thinking test*. Retrieved from http://www.thinkwatson.com/assessments/watson-glaser, Accessed on 29/01/2020

The Critical Thinking Co. (2017). *Cornell critical thinking tests.* Retrieved from https://www.criticalthinking.com/cornell-critical-thinking-tests.html, Accessed on 29/01/2020.

Tiruneh, D. T., De Cock M., Weldeslassie, A.G., Elen, J. & Janssen, R (2017). Measuring critical thinking in physics: Development and validation of a critical thinking test in electricity and magnetism. *International Journal of Science and Mathematics Education, 15*(4), 663-682.

Uddin, M. R. (2019). Environmental contents distribution in the primary level textbook of Bangladesh. *Canadian International Journal of Social Science and Education*. Vol. 20 (2020). 58-80.

UNEP (1976). *The Belgrade charter*. Connect UNESCO-UNEP Environmental Education Newsletter, 1(1).