Humanities & Social Sciences Reviews
eISSN: 2395-6518, Vol 9, No 3, 2021, pp 1278-1287
https://doi.org/10.18510/hssr.2021.93126

INVESTIGATING SECONDARY STUDENTS' CRITICAL THINKING: A CASE OF PUBLIC SCHOOLS

Muhammad Zafar Iqbal[1], Jahan Ara Shams[2], Tariq Javed[3*], Uzma Rao[4], Nighat Ara[5]
[1,3*]Lecturer Allama Iqbal Open University Islamabad, Pakistan; [2]Assistant Professor, Punjab Higher Education Department, Pakistan; [4]Deputy District Education Officer (WEE) Shahpur Sargodha, Pakistan; [5]Research Associate, PEC, Lahore, Pakistan.
Email: [*]tariq.benai@aiou.edu.pk

Article History: Received on 14th June 2021, Revised on 22nd June 2021, Published on 26th June 2021

Abstract

Purpose of the Study: The purpose of this research study was to measure and compare critical thinking among secondary school students in a district of Gilgit-Baltistan.

Methodology: Quantitative research approach was applied to study critical thinking. A sample of 400 students was selected through a convenient sampling technique to collect the data. Critical thinking was measured by applying an adapted tool (Sarigoz, 2012). Descriptive and inferential statistics were used to analyze the data.

Main Findings: Findings of the study revealed that female students, rural school students, and science group students showed slightly higher critical thinking than male, urban, and arts group students. The results were consistent with earlier studies having higher critical thinking among female and science group students. However, the results were inconsistent with the earlier research studies having slightly higher critical thinking among rural school students than urban school students. The study revealed that there is a discrepancy in aligning critical thinking with teaching and learning activities in secondary school classrooms.

Application of this study: The findings of the study help understand the level of male and female students' critical thinking at the secondary level. It will surely assist the teachers in designing their classroom activities and modifications in teaching methodologies for gender perspective.

Novelty/Originality of this study: The study is original as not a single research study investigated the critical thinking of secondary school students in the region of district Ghizar in Gilgit-Baltistan.

Keywords: *Critical Thinking, Assumption, Interpretation, Analysis, Deduction, Argumentation.*

INTRODUCTION

The trend of multitasking has become the demand in the current information age to manage various daily life activities. The busy routines require internalizing information from the environment to make it knowledge by making one's meaning out of that information. Resolving complexities, framing interpretations, calculating possibilities, and making meaningful decisions need careful and effective thinking for valid and synthetic results in certain emerging situations. Halpern (2014) suggested critical thinking to be employed for long a lasting impact to control over distinct prejudices in such situations.

The terms related to critical thinking in education were introduced by John Dewey when he wrote his book "How We Think" dates back to 1910 in which he discussed cognitive skills, namely reasoning, logic, and judgment, as essential components of critical thinking (Dilley, Kaufman, Kennedy & Plucker, 2015). Later on, in 1956, higher-order thinking abilities, namely application, analysis, synthesis, and evaluation were included in critical thinking. Educators used these levels of thinking as models for critical thinking. In the first decade of the 21st century, the language for levels of thinking was changed and named cognitive processes such as applying, analyzing, evaluating, and creating (Dilley et al., 2015: Yousufi & Mohammadi, 2016). To sustain survival within the changing society, the people need to possess some essential skills named 21st-century skills in light of the Sustainable Development Goals (SDGs) formulated by the United Nations (Chu, Reynolds, Notari, Taveres & Lee, 2017). One of those skills is critical thinking and problem solving, which are intended to be developed among the students through teaching and learning activities in educational intuitions (Nursa'adah, Sari & Affifah, 2021).

Critical thinking is defined as reaching a result of what to believe and what to do in a certain situation. It is such thinking which involves identifying and interpreting information, analyzing, evaluating arguments, and decision making (Nordin & Dakwah, 2015). Promoting thinking minds has been a goal in the Pakistani context, which means the people are having critical thinking based on research-oriented activities and practices (Planning Commission of Pakistan, 2007). These activities include tasks requiring well-organized intellectual, active, and skillful conceptualization, application, and analyzing exercises followed by synthesizing and evaluating data gathered through observation, experience, reflection, and dialogues based on reasoning. In this regard, students needed to be facilitated by providing learning opportunities to develop critical thinking among the students. Critical thinking is set among the students through embedded teaching in the current scenario of teaching and learning in public sector secondary schools. The earlier research studies revealed differences in critical thinking between male and female, urban and rural, science and arts group students at the secondary level (Kanbay, Aslan, Elif Kilic, 2017). Thus, these studies left the space open to

conduct studies regarding critical thinking. Therefore, this study was conducted to measure and compare the critical thinking of students based on gender, context, and subject areas.

This study was carried out to achieve the following objectives:

1. To measure the level of critical thinking among secondary school students.
2. To compare critical thinking concerning gender difference, context, and subject area.

LITERATURE REVIEW

Critical thinking is a well-arranged and systematic way of thinking leading towards analysis to solve emerging problems. Before analyzing and solving problems, one must know the relevant concepts or facts related to that particular problem. It will help to understand the situation to proceed towards application, analysis, and evaluation to solve the problem. Critical thinking is applying the cognitive abilities of a person to achieve intended results. Thus, it is a purposeful and goal-directed mental process (Facione, 2015) rooted in Dewey and Halpern's theories (Helpern, 2014). A good critical thinker must have the ability to think in multiple dimensions, such as cognitive skills and dispositions through deliberate, reflective, and logical thought in many situations. The sub-concepts of critical thinking include interpretation, analysis, inference, deduction, and evaluation according to various definitions, models and theories evolved from Dewey's work on critical thinking "how we think" in 1910 (Dilley, et al., 2015). Critical thinking is the application of skills and tactics to make sure the achievement of intended outcomes. It is focused, rational, and goal-driven thinking to effectively solve problems, make inferences and make meaningful decisions in a specific situation (Halpern, 2014).

Models of Critical Thinking

John Dewey presented his critical thinking model in 1910 and modified it later in 1933, where he discussed hindrances for crucial thinking as stereotyping, narrow-mindedness, and decisions based on irrelevant evidence. He claimed that reflection is essential for decision-making. Critical thinking to be developed, he argued that curiosity plays an important role. According to the model, critical thinking is related to metacognition, which means thinking about their thinking (Dilley, et al., 2015). Critical thinking involves building reasons and meanings through critical dialogue and philosophical inquiry as embedded in Dewey's critical thinking model. Philosophical inquiry is questioning the assumptions that are not proved based on experiment and observation but through the formulation of arguments. While critical dialogue means the discussion is organized following rules of logic (Letseka & Zireva 2013).

The cognitive domain of Bloom's taxonomy given in 1956 was considered a model of critical thinking, which had initially comprised of six levels in hierarchical order from simple to complex as knowledge, comprehension, application, analysis, synthesis, and evaluation. The belief in the model is that some must have some background knowledge and understanding before proceeding towards higher-order thinking. Later on, in 2002, the language for the levels in the taxonomy as a model of critical thinking was revised, and the model was divided into two dimensions, namely the knowledge dimension and cognitive process dimension. The former dimension includes knowledge about facts, concepts, procedures, and meta-cognition, while the latter dimension involves the mental processes such as remembering, understanding, applying, analyzing, evaluating, and creating (Dilley, et al., 2015).

The development of science and technology-led cognitivism think differently involving information processing. In 1961, Newell and Simon presented information processing theory. It was argued that computer programs function like the human brain, which solves problems by breaking down the problem into pieces and employ techniques to solve that problem. The definition of critical thinking as what to do and what to believe in a particular situation is associated with the information processing theory of cognition.

While reflecting on developments in the science of human cognition, Sternberg in 1986 proposed three-part taxonomy and defined critical thinking as processes, strategies, and representations applied by people in problem-solving, decision making, and learning new things. The three parts of the taxonomy of critical thinking consisted of meta-components, performance components, and knowledge components. Meta-components encompass the processes to monitor cognition, evaluating the problem to be solved, and choosing the relevant action. Performance components include reading, imagining, and reasoning. Finally, the knowledge acquisition components consist of the processes necessary for making pertinent knowledge easier to acquire. RICOSRE model could be helpful to fill the critical thinking gap between high and low-ability students (Mahanal, Zubaidah, Sumiati, Sari, & Ismirawati, 2019).

Halpern in 1985 gave her model of critical thinking and later modified it in 2013 as critical thinking is the application of mental skills to achieve intended results. Thinking is focussed, logical, and targeted. The model includes a disposition of learning through effort, transfer of training, and metacognitive monitoring. The essence of learning through action is about personal characters having a desire to think on matters deeply. Transfer of training refers to the application of skills during different situations. Metacognitive monitoring involves acquiring information, analyzing, and synthesizing them to generate reasoning (Rasiman, 2015).

In 2011, in his book "Thinking Fast and Slow, " Kahneman explained thinking as a dual process where he argued one method includes thinking like spontaneous, unreceptive, and thoughts full of emotions. Another process of thinking includes is conscious, reflective, and conceived thinking. The second process of thinking is considered critical thinking.

Facione proposed this model of critical thinking in 1990 and it was applied by Zivkovica (2016) to study students' critical thinking. The model has six skills: interpretation, analysis, inference, evaluation, explanation, and self-regulation. Each skill consists of a set of sub-skills. The analysis consists of examining ideas, identifying arguments, and analyzing arguments. The skill of inference includes inquiring about evidence, guessing alternatives, and drawing conclusions. Evaluation is further divided into assessing claims and arguments. The explanation is broken down into sub-skills, such as describing results, justifying procedures, and presenting arguments. Self-regulation skill is expressed as self-examination and self-correction. According to (Arisoy & Aybek, 2021), critical thinking improves with practice and activities.

Critical Thinking Skills

Following are some critical thinking skills that a crucial thinker demonstrates, which are common in the models and definitions of critical thinking. There are three levels of critical thinking which were named as the critical, less critical, and uncritical level of thinking (Kurina, 2020). Another source of developing critical thinking is the utilization of online tutorial activities (Rahayu & Sapriati, 2018).

Analyzing assumptions

The skill to analyze assumptions deals with some degree of essential clarifications of different types. Assumptions made can be examined, seeking presuppositions required for propositions to make sense of the phenomena. The reasoning is needed but not logically necessary for making solid assumptions. With the help of hypothesis-testing procedures, assumptions used are judged. While analyzing assumptions, consideration is based on reasons from premises, factors, positions, and propositions within disagreement or doubt with their thinking (Halpern, 2014).

Interpretation

The skills to make one's viewpoint and justify them after incorporating dispositions and abilities are termed interpretation. It includes the ability to smoothly proceed according to the situation followed by a conclusion. They keep their thinking in observation through any mental exercise utilizing feelings, knowledge, and experiences of others f into the interpretation. Employing sequential techniques in printed and verbal communication is critical thinking (Ennis, 2011; Facione, 2015).

Making inference

Apart from analyzing assumptions, making an inference is another skill of critical thinking. From a sample of statistical data, inferences can be made in the form of generalizations. Furthermore, inferences can also be made from explanatory hypotheses, including conclusions, specific and general causal claims as well as interpretations of its' intended meanings (Facione, 2015). The activities related to inference include designing small tests, seeking evidence and counter-evidence, seeking other possible explanations. According to Zivkovica (2016), criteria for making inferences involve; the inference needs to explain the evidence, consistent with all known facts, competent sincere effort to find supporting and opposing data and the inference needs to seem plausible, simple, fitting into a larger view.

Deduction

Another skill of critical thinking is making deductions from the subject matter of any verbal communication. Using the class and conditional logic, logical terminology, negation and double negation, necessary and sufficient language, people make deductions (Halpern, 2014).

Evaluating arguments

The skill to evaluate arguments is an important element of critical thinking. It includes the ability to identify conclusions, single out reasons, analyze and highlight worthlessness, and look for structure in an argument followed by summarising arguments (Zivkovica, 2016). Asking for clarifications and challenge arguments demonstrating agreement/disagreements are indicators of evaluating arguments. While evaluating arguments Halpern (2014) believes that it should expose the positive and negative features revealing a productive reflection on the matter. The unrevealed assumptions in arguments can be realized when there is a deliberate effort through considering the validity of the information source, leading towards deciding the best possible way (Pratiwi Cari, Aminah, & Affandy, 2019).

Measurement tools of Critical Thinking

There are many means of measuring critical thinking in general, but major tests or inventories used for research purposes are discussed here. California critical thinking skill test (CCTST) is an instrument that Facione developed at the dawn of the twentieth century to measure the critical thinking skills of nursing students. This test includes items that measure a moderate level of critical thinking. The skills of reminding facts, concepts, and procedures are measured through CCTST. Applying it to measure critical thinking is expected to provide a base for critical thinking and creativity. However, higher-order thinking skills such as using prior learning in a new situation are ignored (Sumarni, Supardi & Widiarti, 2018).

Watson-Glaser critical thinking assessment (WGCTA) is the old and most widely used method of measuring critical thinking by researchers and other education concerned individuals. It includes five subscales: inference, recognition of assumptions, deduction, interpretation, and evaluation of arguments. Among four versions of WGCTA, the latest version contains 40 items to be administered in 45 minutes. Several items measuring different constructs of critical thinking varies across different versions while descriptions being consistent (Bernard, Zhang, Abrami, Sicoly, Borokhovski & Surkes, 2008). However, there are validity issues with the WGCTA because of the vague, imprecise, confusing, and covert instructions. Moreover, in the case of inaccurate scoring, its validity further is lessened (Possin, 2014).

Cornell's critical thinking test (CCTT) is one of the measuring tools of critical thinking developed in series in two levels of testing, namely X and Z, from grade 6th onwards. According to Hasinger (2020), these tests are conducted to predict the students' future potentials and placement purposes. Level X includes more than 70 items to evaluate skills such as induction, deduction, credibility, and identification of assumptions. Passages are given to the students to read and answer the questions where they have to choose whether the statements support the argument or against or do neither of them. Similarly, level Z test having more than fifty items measures some more skills such as semantics, definitions, and predictions other than the constructs in level X. however, the children need to be well in reading comprehension and skillful in taking the test because the time is short for attempting these tests.

Halpern's critical thinking assessment (HCTA) measures critical thinking was designed to measure constructs, namely verbal reasoning, argument analysis, hypothesis testing, likelihood, and uncertainty. It is mainly applied in education and personal selection. The test takers are provided with 20 daily life situations where they respond with a brief explanation and then select an option from the given possible choices. There are four test forms of HCTA as version 'A' having two tests as form S1 and S2 while version 'B' has two forms as S3 and S4. Analogs covering the same skills in different contexts are included in versions A and B. respondents are allowed to take the HCTA twice without altering memory for test items. Forms of test S1 and S3 include scenarios and S2 and S4 include forced-choice items. The respondent has to go through two versions of the test while keeping the memory of items in the first version to be used in the second version (Halpern, 2014).

A tool was prepared and applied by Sarigoz (2012) to measure the critical thinking skills of high school students. The tool was designed to measure the constructs measured in the tools as mentioned above for measuring critical thinking. Each statement to be measured has a five-point scale from 0 to 4, denoting never to always (0=never, 1= rarely, 2=sometimes, 3=often, 4=always). The statements were based on analyzing assumptions, interpretation, making inferences, deduction, and evaluating arguments. Scoring or interpretation is made on a general arithmetic average for each point in the scale.

Empirical Evidence on Critical Thinking

Studies on critical thinking have been showing inconsistent findings across gender, context, and subject areas. Kanbay, et al., (2017) found no significant statistical variance in critical thinking between male and female students regarding critical thinking between males and females. The findings of another study revealed that males have slighter critical thinking than females (Oguz & Saricame, 2016). Inconsistent with this finding, Sarigoz (2012) also found the critical thinking of male students slightly higher than the female students. The study on critical thinking across different learning styles conducted by Fuad, Zubaidah, Mahanal, and Suarsini (2017) revealed that female students have a higher level of critical thinking than male students. The analysis of the findings of previous studies on critical thinking on gender exposes that there is variance among the studies regarding critical thinking based on gender. Male being participative in outdoor activities of daily life, encounter a variety of situations. Thus, it can be hypothesized that males have higher critical thinking than females. Problem-based learning was found to enhance students' critical thinking skills (Setiawan & Islami, 2020).

The students who live in city areas have higher critical thinking than the rural students who live in village areas (Kanbay et al., 2017). It can be justified that the students who live in urban areas have excess to education, health, recreational, and other production facilities. There are fewer such facilities in rural areas where life is at its monotone routine. Therefore, students in urban area schools have higher critical thinking than students in rural schools.

A study conducted by Hassan and Madhum (2007) found a significant variation between levels of critical thinking between students of different streams of research. The students who opted for science subjects at the secondary level showed higher critical thinking than the students who opted for arts subjects. The students who study science subjects practice science process skills such as observation, prediction, testing, analyzing, interpreting, and communication skills, supporting students in developing critical thinking.

The following hypotheses were designed to be tested during this research study:

H_{01}: There is no significant difference between male and female students' critical thinking.

H_{02}: There is no significant difference between urban and rural school students' critical thinking.

H_{03}: There is no significant difference between science and art students' critical thinking.

Humanities & Social Sciences Reviews
eISSN: 2395-6518, Vol 9, No 3, 2021, pp 1278-1287
https://doi.org/10.18510/hssr.2021.93126

METHODOLOGY

To measure and compare critical thinking among the students of public sector secondary schools, a quantitative approach was applied. The overall population in this study was public sector secondary school students of grade ten in district Ghizar. The total number of tenth-grade students in district Ghizar was 1256 (738 male and 518 female), according to the information obtained from District Education Office Ghizar. At the secondary level, there are two streams of study which go side by side, namely science and arts groups in public sector secondary schools. Therefore, male and female students of both streams were taken as the population in this study.

Applying a convenient sampling technique, a sample of 400, which became 32% of the whole population was selected from the entire population to save time and make the procedure of data collection sample (Gay & Airasian, 2003). In this study, it was difficult to collect data from 400 selected samples due to COVID-19. Thus, out of 400 selected samples, two hundred and forty-four (244, male=116 and female=128) students responded by filling the questionnaire because which becomes 61% response rate.

The instrument used in this study to measure critical thinking skills was the adapted questionnaire to measure critical thinking (Sarigoz, 2012). The adapted questionnaire as a data collection tool was used in this study translated into the Urdu language from English. Usually, in public sector schools, students are not good enough in English because of the bilingual medium of instruction. The adapted tool was validated by two bilingual experts and two experts in the Urdu language to ensure validity. For content validity, the tool was reviewed by experts in the critical thinking and research process. The initial draft of the tool was modified based on feedback given by experts where changes were made in terms of language structure and terminology in Urdu.

Table 1: Alpha reliability coefficient of CT before item deletion (N=40)

Scale	Cronbach's Alpha	Number of items
Critical Thinking	.824	25

The tool was then pilot tested with forty students of public sector secondary schools. Using SPSS, the reliability of twenty-five items was found 0.824 through Cronbach's alpha. As it is across constructs of critical thinking such as analysis of assumptions, inference, deduction, interpretation, and evaluation of arguments which were found respectively 0.520, 0.509, 0.590, 0.672, and 0.546 for five items each.

Table 2: Alpha reliability coefficients it item deleted

Items	Cronbach's Alpha if item Deleted	Items	Cronbach's Alpha if item Deleted
1	.819	14	.816
2	.810	15	.819
3	.819	16	.818
4	.819	17	.829
5	.823	18	.815
6	.814	19	.816
7	.816	20	.819
8	.822	21	.816
9	.822	22	.827
10	.814	23	.815
11	.808	24	.811
12	.815	25	.813
13	.833		

The response rate remained 61% (244 out of 400). It was because of the start of COVID-19 when the instrument was being developed. In the first week of December 2019, the proposal was approved for this research study to be carried out. It took two months (December 2019 and January 2020) to develop, pilot, and validate the tool. Meanwhile, the Coronavirus had started to be spreading. In February, data collection was started in this study, and on collecting data from more than 200 sample schools were closed in March 2020. Still, 35 to 40 sample was accessed going door to door because the technique was convenient for selection of sample. This way, data were collected from 244 students out of 400 hundred planned samples.

During the process of this research study, the ethics of the research was ensured. In the very beginning, informed consent was received from the supervisor. The literature review is an important segment of the research study. Various sources, books, journals, and articles were used in this study during the literature review. The ideas and findings of research studies taken and paraphrased were cited and referenced using APA style. Before collecting data, permission was taken from the Headmasters/headmistresses to collect data from their students. Verbal informed consent was taken from the students before collecting data. The Students were informed and ensured about the confidentiality of the data provided

Humanities & Social Sciences Reviews
eISSN: 2395-6518, Vol 9, No 3, 2021, pp 1278-1287
https://doi.org/10.18510/hssr.2021.93126

by them. They were also made sure that the data would only be used for this study. It was also informed that they can leave the session of data collection any time if they want.

Data Analysis

While analyzing data collected from 244 respondents, it was found that 127 out of 244 respondents had cleared their annual examination. 117 students had supplementary in their annual examination results. Therefore, their academic achievement could not be measured, and they were excluded from the analysis. Statistical tests for data analysis were applied to 127 respondents. Analyzing collected data in quantitative research enables the researcher to find significant facts studying intensely using statistical technics. For this purpose, numerical data is tabulated and simplified using statistical procedures to make it easy to comprehend. This process is known as data analysis (Frankel & Wallen, 2006). This study involved a t-test in finding the difference in critical thinking levels between two categories: male and female students, urban and rural school students, science group, and art group students of public sector secondary schools.

Critical thinking between male and female students

One hundred twenty-seven respondents, including 59 male and 68 female respondents, took part in a data collection session regarding critical thinking. An independent sample t-test was applied using SPSS to compare the means of male and female students.

Table 3: Comparison of critical thinking between male and females students

Gender	N	Mean	Df	t	Sig
Male	59	2.57	125	1.48	.142
Female	68	2.68			

Table 3 shows respondent size based on gender (male=59) and (female=68) and means of critical thinking. It is evident that mean of female students (2.57) is greater than the mean of male students (2.68), which reveals that female students have slightly higher critical thinking than the male students at secondary grades. The observed t-value is 1.48, which is greater than the observed probability value 0.142 at 5% chance of sampling error. Thus, there is a statistically significant difference between the means of male and female respondents. Therefore, there is a significant difference in critical thinking between male and female public sector secondary school students.

According to Figure 1, on comparing means between male and female students across different constructs of critical thinking, female students have slightly higher than male students in analysis of assumption, interpretation, and evaluation of arguments. However, there is no significant difference in inference and deduction between male and female students.

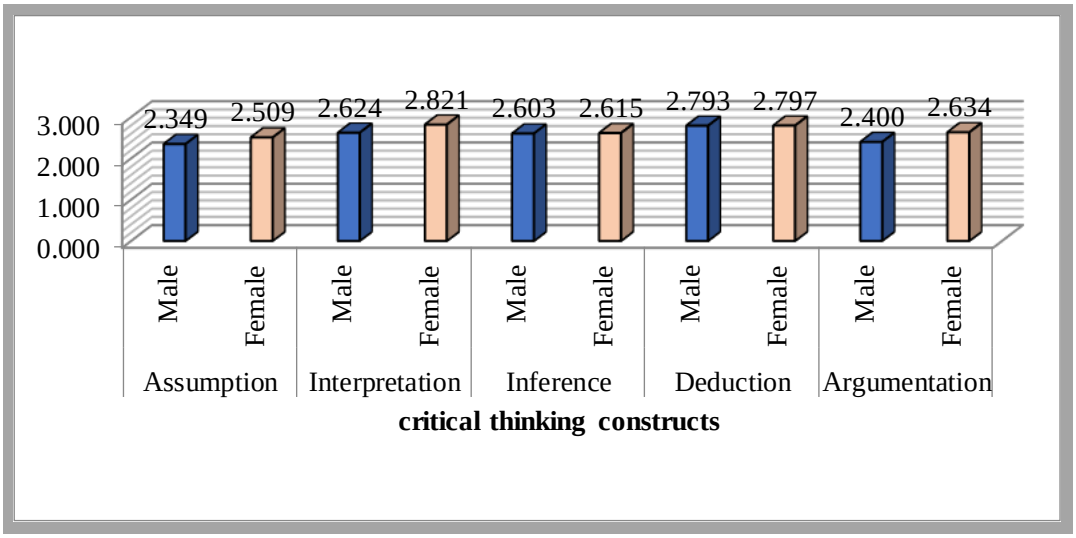

Figure 1: Graph on gender difference on constructs of critical thinking

Critical thinking between urban and rural school students

In terms of urban and rural schools, 32 out 0f 127 (25%) urban school students while 95 (75%) rural school students were respondents in this research study. To compare the means of critical thinking between urban and rural school students, an independent sample t-test was calculated.

Table 4: Critical thinking group between urban and rural school students

Context	N	Mean	Df	t	Sig
Urban	32	2.59	125	0.52	.61

Humanities & Social Sciences Reviews
eISSN: 2395-6518, Vol 9, No 3, 2021, pp 1278-1287
https://doi.org/10.18510/hssr.2021.93126

Rural	95	2.63

Table 4 shows the sample size of urban and rural school students' means 2.59 and 2.63, respectively. It can be observed that the mean of rural school students is slightly higher than the mean of urban school students. The observed t-statistic is 0.52, which is smaller than the observed probability value 0.61. It reveals that there is not a significant difference between the means of urban and rural students' critical thinking. Therefore, the null hypothesis is rejected rather than accepted as there is no significant difference in critical thinking between urban and rural students in grade ten.

Figure 5 reveals that rural school students show slightly higher critical thinking than urban school students in analyzing assumptions, interpretation, deduction, and evaluation of arguments. However, in making inferences, students of both contexts are more or less the same at critical thinking.

Figure 5 reveals that rural school students show slightly higher critical thinking than urban school students in analyzing assumptions, interpretation, deduction, and evaluation of arguments. However, in making inferences, students of both contexts are more or less the same at critical thinking.

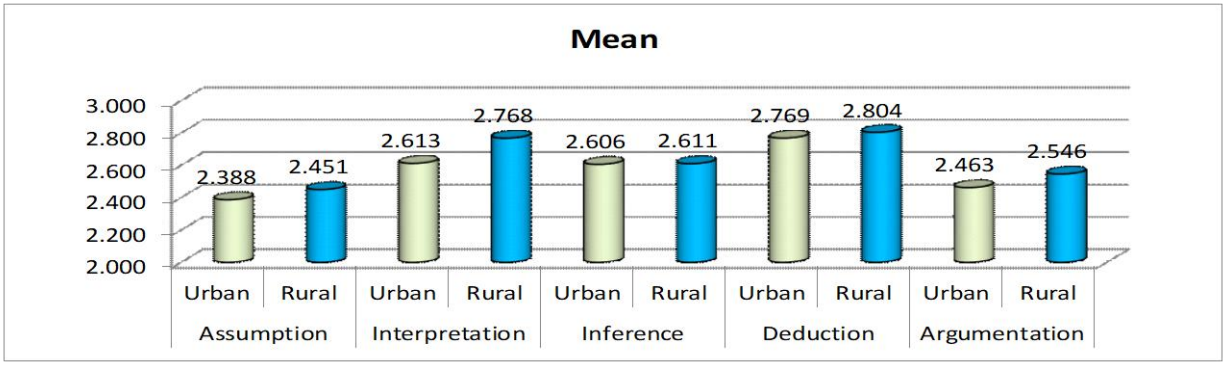

Figure 1: Graph on the difference in critical thinking regarding the area of school

Critical thinking between science group and arts group students

There are two streams, namely science and arts in public sector secondary schools in district Ghizar. Table 5 shows that 103 out of 127 students were selected as respondents who opted for the science group at the secondary level. In comparison, 24 out of 127 students were selected as a sample who opted for the arts group at the secondary level. It shows a tendency to opt for science in public sector secondary schools in district Ghizar.

Table 5: Comparison of critical thinking between science and arts group

Group	N	Mean	Df	t	Sig.
Science	103	2.6	125	1.14	.26
Arts	24	2.5			

It can be observed from table 5 that the mean (2.6) of critical thinking of science group students is slightly higher than the mean (2.5) of critical thinking of arts group students. Therefore, students who are science group students are better at critical thinking than students who are in the arts group. The t-value 1.14 is greater than the observed probability value 0.26. Therefore, there is a statistically significant difference in critical thinking between science group students and arts group students at 5 percent chance of sampling error.

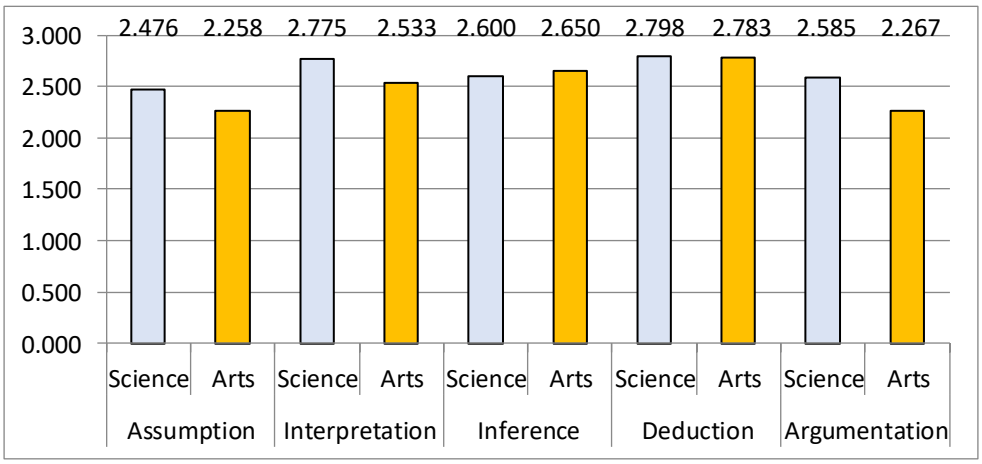

Figure 2: Graph on constructs of CT between science and arts groups students

Figure 6 reveals the comparison of means across constructs of critical thinking between science and arts group students. The means (2.5, 2.8, 2.6) of science group students are greater than the means (2.3, 2.5, 2.3) of the arts group in assumption, interpretation, and argumentation, respectively. However, the means of science group students are the same as the means of arts group students in inference and deduction. Therefore, science group students are better than arts group students in assumption, interpretation, and argumentation. On the other hand, science group students and art group students are at the same level in inference and deduction.

FINDINGS

The data about critical thinking among the students was collected on a five-point scale 0-4 (low-high). After collecting data, for analysis of data, scores obtained from five-point scales were converted into three categories as high, moderate, and low where high was quantified as 3, medium to 2, and low to 1 (Udi & Cheng, 2015). The calculation of mean revealed that in critical thinking, female students' mean score was slightly higher than the means of male students.

Hypothesis (H_{o1}): There is no significant difference between male and female students' critical thinking

The difference in critical thinking between male and female public sector secondary school students was studied by applying an independent sample t-test. The results revealed a significant difference between the mean score of male and the mean score of female students in critical thinking. It means that female students are possessing slightly higher critical thinking than male students in public sector secondary schools in district Ghizar. Comparison of male and female students' means across constructs showed that means of female students in assumption, interpretation and argumentation are slightly higher than means of male students in assumption, interpretation, and argumentation. On the other hand, the mean of male and female students is the same in making inference and deduction.

Hypothesis (H_{o2}): There is no significant difference between urban and rural school students' critical thinking

To find whether there is a difference in critical thinking between urban and rural secondary school students, an independent sample t-test was applied. The results produced by the t-test depicted no difference between mean scores of urban and rural school students in critical thinking. The calculated t-value was smaller than the observed probability value. It reveals that there is no significant difference in critical thinking between urban and rural school students. While comparing across constructs of critical thinking, it was observed that rural school students show slightly higher critical thinking than urban school students in the analysis of assumptions, interpretation, deduction, and evaluation of arguments. However, in making inferences, students of both contexts are more or less the same at critical thinking.

Hypothesis (H_{o3}): There is no significant difference between science and arts students' critical thinking

The analysis of data by using t-test to compare a difference in critical thinking between science group and arts group students, it was revealed that the mean score of critical thinking of science group was higher than the mean of arts group students. This shows that there is a significant difference in critical thinking between the science group and arts group secondary school students. Therefore, students who study in the science group are better at critical thinking than students who study in the arts group. Comparison of critical thinking between science group and arts group students across constructs revealed that the mean of science group students is greater than the means of arts group in assumption, interpretation, and argumentation, respectively. However, the means of science group students were negligibly different otherwise same as the means of arts group students in inference and deduction. Thus, science group students are better than arts group students in assumption, interpretation, and argumentation. On the other hand, science group students and art group students are more or less at the same level in inference and deduction.

DISCUSSION/ANALYSIS

This research study investigated the relationship between critical thinking and the academic achievement of secondary school students. Through a questionnaire, critical thinking was measured while the cumulative scores of the annual board examination were taken as academic achievements. Critical thinking was compared based on gender, context, and stream of study at the secondary level. To find out differences t-test was applied, while for correlation, Pearson correlations coefficient was calculated. Critical thinking articulated as high, medium, and low were used in this study. Analysis of the data revealed that their female students and science group secondary school students have slightly higher critical thinking than male and arts group students. This result is consistent with a research study carried out by Kanbay et al., (2017). In a study, differing levels of critical thinking in different areas of academic tasks were found between male and female students (Fuad et al., 2017). Comparing with respect to gender, the results of this study showed that female students have a high level of critical thinking than male students. This result is consistent with the results of the study (D'Alessioa, Avolioa, and Charles 2019). Regarding streams of study at the secondary level, Hassan and Madhum (2007) found a significant variation between levels of critical thinking between students of different streams of study. This research study found that the students who study in the science group have higher critical thinking skills than the students who study in the arts group. Conversely, the results of this study are inconsistent as rural school students have slightly high critical thinking than urban school students.

CONCLUSION

The gender difference was the same as shown by many of the researchers that females have a high level of critical thinking as compared to the male students. The comparison concerning context was inconsistent with the previous studies where the students from urban backgrounds had a higher level of critical thinking. However, this study revealed that there was a slight difference in critical thinking between rural school students who have slightly higher critical thinking than urban school students. Stream of studies like science and arts contributed to variance in critical thinking levels among public sector secondary school students. Female students and science group students have higher critical thinking than male students and arts group students, respectively. In classrooms, if activities to develop critical thinking are incorporated in teaching and learning, then academic achievement can be enhanced. According to Helpern (2014), teachers can achieve what they expect from the students when they explicitly teach critical thinking in classrooms. In this regard, critical thinking skills such as analysis of assumptions, interpretation, inference, deduction, and evaluation of argumentation if are given space in curricular areas they lead towards maximized academic achievement among secondary schools students.

RECOMMENDATIONS

Based on findings and discussion of this research study, the following recommendations are made;

- It is recommended that critical thinking needs to be developed among the students and particular focus needs to be paid to male and arts group students.
- Critical thinking is recommended to be aligned with teaching and learning on a priority basis.
- The sub-constructs of critical thinking such as analysis, interpretation, inference, deduction, and argumentation need to be developed among the students.
- As critical thinking is one of the important skills of the twenty-first century. Thus, workshops, seminars should be held for teachers and students at the secondary school level to provide awareness on critical thinking.
- Due to coronavirus disease-2019 (COVID-19), this research study was conducted for 244 samples. It is also recommended that in the future, researchers may work with a large sample in this area.

LIMITATIONS OF THE STUDY

This research study was conducted without taking any type of financial help from institutions.

AUTHORS CONTRIBUTION

Muhammad Zafar Iqbal conceptualized this research and analyzed the data and Jahan Ara Shams worked on introduction, research methodology and collected data. Tariq Javed assisted in completing literature review while Uzma Rao wrote conclusions and recommendations. Nighat Ara done formatting and proof reading of the paper.

REFERENCES

1. Arisoy, B., & Aybek, B. (2021). The effects of subject-based critical thinking education in mathematics on students' critical thinking skills and virtues. *Eurasian Journal of Educational Research*, *92*, 99-119. https://doi.org/10.14689/ejer.2021.92.6
2. Bernard, R. M., Zhang, D., Abrami, P. C., Sicoly, F., Borokhovski, E., & Surkes, M. A. (2008). Exploring the structure of the Watson–Glaser Critical Thinking Appraisal: One scale or many subscales?. *Thinking Skills and Creativity*, *3(1)*, 15-22. https://doi.org/10.1016/j.tsc.2007.11.001
3. Chu, S. K. W., Reynolds, R. B., Tavares, N. J., Notari, M., & Lee, C. W. Y. (2017). Twenty-first century skills and global education roadmaps. *In 21st century skills development through inquiry-based learning* (pp. 17-32). Springer, Singapore. https://doi.org/10.1007/978-981-10-2481-8_2
4. D'Alessio, F. A., Avolio, B. E., & Charles, V. (2019). Studying the impact of critical thinking on the academic performance of executive MBA students. *Thinking Skills and Creativity*, *31*, 275-283. https://doi.org/10.1016/j.tsc.2019.02.002
5. Dilley, A., Kaufman, J. C., Kennedy, C., & Plucker, J. A. (2015). What we know about critical thinking. *Partnership For 21st Century Learning*.
6. Ennis, R. H. (2011). Critical thinking: Reflection and perspective Part II. *Inquiry: Critical thinking across the Disciplines, 26(2)*, 5-19. https://doi.org/10.5840/inquiryctnews201126215
7. Facione. (2013) Critical thinking: Why is it important and what is it anyway? (n.d.). *Critical Thinking Skills for Education Students* (pp. 1-11). Learning Matters.
8. Frankel, J. R., & Wallen, N. E. (2006). *How to design and evaluate research in education*. New York, NY: McGraw-Hill.
9. Fuad, N. M., Zubaidah, S., Mahanal, S., & Suarsini, E. (2017). Improving junior high schools' critical thinking skills based on test three different models of learning. *International Journal of Instruction, 10(1)*, 101-116. https://doi.org/10.12973/iji.2017.1017a

10. Gay, L. R., & Airasian (2003). *Educational research: Competencies for analysis and applications*. Upper Saddle River, NJ: Merrill/Prentice Hall.
11. Halpern, D. F. (2014). *Halpern Critical Thinking Assessment*. Austria: Schuhfried.
12. Hasinger, E. (2020). *Cornell critical thinking test guide.* Retrieved August 2020, from https://www.tests.com/Cornell-Critical-Thinking-Testing
13. Hassan, K, E., & Madhum, G. (2007). Validating Watson Glaser critical thinking appraisal. *Higher Education, 54*, 361–383. https://doi.org/10.1007/s10734-006-9002-z
14. Kanbay, Y., Aslan, o., Elif, I., & Kilic, N. (2017). Problem solving and critical thinking skills of undergraduate nursing students. *Journal of Higher Education and Science, 3(3),* 244-254.
15. Kurnia, I. (2020). Students' critical thinking ability in solving contextual problems at a junior high school. *In Journal of Physics: Conference Series* (Vol. 1521, No. 3, p. 032067). IOP Publishing. https://doi.org/10.1088/1742-6596/1521/3/032067
16. Letseka, M., & Zireva, D. (2013). Thinking: Lessons from John Dewey's how we think. *Academic Journal of Interdisciplinary Studies, 2(2),* 51-60. https://doi.org/10.5901/ajis.2013.v2n2p51
17. Mahanal, S., Zubaidah, S., Sumiati, I. D., Sari, T. M., & Ismirawati, N. (2019). Ricos: A learning model to develop critical thinking skills for students with different academic abilities. *International Journal of Instruction, 12(2),* 417-434. https://doi.org/10.29333/iji.2019.12227a
18. Nursa'adah, E., Sari, D., & Affifah, I. (2021). Domain-specific critical thinking skills: Designing and analysis the instrument test on thermochemistry. *In Journal of Physics: Conference Series* (Vol. 1731, No. 1, p. 012025). IOP Publishing. https://doi.org/10.1088/1742-6596/1731/1/012025
19. Nordin, N. & Dakwah, J. (2015). Critical thinking as a predictor of student's academic achievement: A study on Islamic studies students. *Journal of Education and Social Sciences, 1(1),* 46-56.
20. Oguz, A. & Saricam, H. (2016). The relationship between critical thinking dispositions and locus of control in pre-service teachers. *Journal of Education and Training Studies, 4(2),* 1-11. https://doi.org/10.11114/jets.v4i2.1196
21. Pratiwi, S. N., Cari, C., Aminah, N. S., & Affandy, H. (2019). Problem-based learning with argumentation skills to improve students' concept understanding. *In Journal of Physics: Conference Series* (Vol. 1155, No. 1, p. 012065). IOP Publishing. https://doi.org/10.1088/1742-6596/1155/1/012065
22. Planning Commission Government of Pakistan. (2007). Pakistan in 21st Century: Vision 2030. Retrieved December 01, 2019 from http://www.planningcommission.gov.pk
23. Possin, K. (2014). Critique of the Watson-Glaser critical thinking appraisal test: The more you know, the lower your score. *Informal Logic, 34(4),* 393-416. https://doi.org/10.22329/il.v34i4.4141
24. Rahayu, U., & Sapriati, A. (2018). Open educational resources based online tutorial model for developing critical thinking of higher distance education students. *Turkish Online Journal of Distance Education, 19(4),* 163-175. https://doi.org/10.17718/tojde.471914
25. Rasiman, R. (2015). Leveling of critical thinking abilities of students of mathematics education in mathematical problem solving. *Journal on Mathematics Education, 6(1),* 40-52. https://doi.org/10.22342/jme.6.1.1941.40-52
26. Sarigoz, O. (2012). Assessment of the high school students critical thinking skills. *Procedia: Social and Behavioral Science, 46,* 5315-5319. https://doi.org/10.1016/j.sbspro.2012.06.430
27. Setiawan, H. J., & Islami, N. (2020). Improving critical thinking skills of senior high school students using the problem based learning model. *In Journal of Physics: Conference Series* (Vol. 1655, No. 1, p. 012060). IOP Publishing. https://doi.org/10.1088/1742-6596/1655/1/012060
28. Sumarni, W., Supardi, K. I., & Widiarti, N. (2018). Development of assessment instruments to measure critical thinking skills. *In IOP Conference Series: Materials Science and Engineering* (Vol. 349, No. 1, p. 012066). IOP Publishing. https://doi.org/10.1088/1757-899X/349/1/012066
29. Udi, E.A & Cheng, D. 2015. Developing critical thinking skills from dispositions to abilities: Mathematics education from early childhood to high school. *Creative Education, 6(4),* 455-462. https://doi.org/10.4236/ce.2015.64045
30. Yousufi, S., & Mohammadi, M. (2016). Critical thinking and reading comprehension among postgraduate students: The case of gender and language proficiency level. *Journal of Language Teaching and Research, 7(4),* 802-807. https://doi.org/10.17507/jltr.0704.23
31. Zivkovica, S. (2016). A Model of Critical Thinking as an Important Attribute for Success in the 21st century. *Procedia - Social and Behavioral Sciences 232,* 102-108. https://doi.org/10.1016/j.sbspro.2016.10.034

