Critical Thinking Disposition of Prospective Science Teachers at IKIP Mataram, Indonesia

H Fitriani¹, M Asy’ari¹, S Zubaidah², and S Mahanal²

¹Institut Keguruan dan Ilmu Pendidikan (IKIP) Mataram, Jl. Pemuda No. 59A, Mataram 83125, Indonesia
²Universitas Negeri Malang, Jl. Semarang No.5, Kota Malang, Jawa Timur 65145, Indonesia
Email: muhammadasyari@ikipmataram.ac.id

Abstract. This study aims to identify prospective teachers’ critical thinking disposition by gender that consist of seven components: 1) inquisitiveness, 2) self-confidence, 3) truth-seeking, 4) open-mindedness, 5) analyticity, 6) systematic, and 7) maturity. The survey methodology was used in this study. Research sample consisted of 100 students in Biology Education Program, Faculty of Science and Mathematics Education IKIP Mataram, Indonesia. Data on critical thinking dispositions were collected using The California Critical Thinking Disposition Inventory (CCTDI). The results showed that prospective science teachers’ critical thinking disposition generally neither strength nor weakness category (score 3.1 ≤ X ≤3.9). Based on the result, it can be stated that prospective science teachers’ critical thinking disposition is neither strength nor weakness and there are differences in critical thinking disposition based on prospective science teachers’ gender on the components: 1) inquisitiveness (p= 0.001); 2) self-confidence (t(100)= 2.331, p= 0.022); 3) open-mindedness (t(100)= 4.531, p= 0.000); and 4) maturity (p= 0.004).

1. Introduction

Critical thinking ability teaches humans to know better about thinking process, because it is a reasonable and reflective thinking focused on deciding what to believe or do [1]. Critical thinking is a controlled assessment with a logical purpose related to evidence, field, concept, method, and criterion [2]. One of the traits of a critical thinker is an ability to regulate his own knowledge [3]. An ideal critical thinkers have high curiosity, broad knowledge, trust in reason, flexible, open-minded to critical, honest in facing personal bias, wise in making judgments, willing to reconsider, formulate problems clearly, orderly in complex matters, diligently search for relevant information, right in the selection of criteria, focus on investigation, and persistent in the investigation [4]. Critical thinking requires the student to actively and skillfully conceptualize, apply, analyze, synthesize, and/or evaluate information gathered or resulting from observation, experience, reflection, communication reasoned, or as a guide to beliefs and actions [5] [6]. The process of inquiry can build students’ critical thinking skills [7] and educational demands also require students to build their own knowledge [8].

Critical thinking is often regarded as a general goal of learning in higher education but it is not specifically learned through the provision of relevant teaching materials to achieve these goals so that learning of students’ critical thinking skills in a comprehensive manner cannot be achieved. Good critical thinkers combine empowerment of critical thinking skills by maintaining a consistent critical thinking disposition [9] in finding problem-solving solutions [10]. The critical thinking disposition is important for learning because the cognitive component of critical thinking is not enough to be a critical thinker, critical thinking disposition also plays an important role and should be learned [1]. Disposition is a tendency of someone to do something, in certain circumstances, for example, someone tends to be...
open to alternative solutions to problems encountered from outside himself or consider other solutions of solutions owned. Critical thinking disposition is an attribute or habit of mind that is integrated into one's beliefs or actions [11] to effectively solve problems and make decisions as a product of thinking [9]. The three basic components of critical thinking as thought dispositions are willingness, sensitivity, and ability [12]. Learners should build their own knowledge [13] through inquiry processes, both independently and mentally [14] which in order to perform these processes requires the willingness, sensitivity, and ability to solve the problems encountered, thus thinking critically as a skill component lifelong learning [15] can be done well. Furthermore, [16] describes the critical thinking disposition of seven characteristics, namely; curiosity, open-minded, systematic, analytic, truth-seeking, critical thinking, confidence, and maturity.

The results of several studies show the positive impact of critical thinking on learning achievement [17] [18] and improving the performance of Special Education Integration Program (SEIP) teachers [19]. Furthermore, the results of the study [20] showed a positive and very significant correlation between students' critical thinking dispositions and their clinical performance with hemodialysis patients. The general procedure undertaken to teach students critical thinking is the integration of process skills in learning. Process skills or learning through discovery are basic skills for an inquiry [21] because in it students are taught to connect their prior knowledge or concrete knowledge of students with new learning concepts. The ability of discovery and inquiry independently is more important than the achievement of the concept that students learn [22]. Yuksel and Alci explained that the disposition or attitude of students to think critically is an important initial condition to be able to think critically and help students predict the tendency of better skills in making mature decisions [23]. The critical thinking disposition can also encourage students to train their critical thinking skills [24]. In line with this opinion, there is a positive and significant relationship between critical thinking dispositions and critical thinking skills [25] [26].

Critical thinking skills are one of the basic capital or intellectual capital that is very important for everyone and is a fundamental part of human maturity so it is important to be taught at every level of education. Critical thinking ability is used as a basis for analysing an argument and the emergence of an interpretation in developing a consistent and logical reasoning pattern, the ability to understand assumptions, formulate problems, make deductions and make decisions appropriately and can be developed through the process of learning activities or behaviours during the process. Gender is one of the factors that can influence one's behaviour [27].

Gender is a generic term that refers to male and female [28] that make up the psychology and social role of a person [29] so that it impacts on how individuals think, behave, and perceive a phenomenon within the self [30]. Based on the description, male and female may differ in the context of thinking skills and thinking dispositions, [31] suggesting that male in thinking are more analytical and flexible than female, while female are less skilled in abstract and logical thinking [32]. Further [29] states that male and female have no distinction in conceptual understanding, but male are superior in solving problems rather than female. On the other hand, [33] mentions that there is no significant correlation between critical thinking between male and female. On the other hand, [34] state that critical thinking dispositions differ according to the sex that supports female students.

This study aims to identify differences in critical thinking disposition of prospective teachers in Biology Education Studies Program, Faculty of Science and Mathematics Education IKIP Mataram, Indonesia that specifically based on gender, consisting of seven components: 1) inquisitiveness, 2) self-confidence, 3) truth-seeking, 4) open-mindedness, 5) analyticity, 6) systematics, and 7) maturity [35] [36]. The results of this study also present an intersection between each component that becomes a special characteristic of prospective male and female teachers’ critical thinking disposition.

2. Method
The survey methodology was used in this study to identify students’ critical thinking disposition by giving The California Critical Thinking Disposition Inventory (CCTDI) questionnaire compiled by [35] [36]. CCTDI is the principal tool for surveying the dispositional aspects of critical thinking containing 75 items of statements for the 7 critical dispositional components of thinkers: 1) inquisitiveness (10 items), measuring one's intellectual curiosity level; 2) self-confidence (9 items), refers to a person's level
of trust in reasoning; 3) truth-seeking (12 items), refers to the someone’s spirit to seek the truth, dare to ask questions, and be honest and objective in the quest for problem solving faced, even if the findings do not support the interests or opinions of someone previously formed; 4) open-mindedness (12 items), refers to the disposition of open-mindedness and one's tolerance to different views and sensitivity to the possibility of one's bias; 5) analyticity (11 items), refers to one's awareness of potentially problematic situations, anticipates possible outcomes or consequences, and prioritizes the application of the reason and use of evidence even if the problem is difficult to resolve; 6) systematics (11 items), referring to the disposition of an organized, orderly, focused, and diligent investigation; and 7) maturity (10 items), referring to a reflective assessment of an individual. CCTDI is designed for use in adults in general. Scores for each of the seven dispositions can range from 1 to 6. "Score 3 or below shows a weak disposition. Score between 3.1 until 3.9 does not indicate the strength or weakness of the respondent's critical thinking disposition. A score of 4.0 to 4.9 shows a minimal disposition of critical thinking disposition. A score of 5.0 to 5.9 shows a minimal disposition of critical thinking disposition. A score of 6.0 or above shows a strong disposition of critical thinking disposition. A score of 4.0 to 4.9 shows a minimal disposition of critical thinking disposition. A score of 5.0 to 5.9 shows a minimal disposition of critical thinking disposition. A score of 6.0 or above shows a strong disposition of critical thinking disposition."

The sample in this research is 100 prospective teacher students (50 male and 50 female) of biology education where selected purposively. The prospective teachers’ critical thinking disposition then categorized using Table 1 below:

| Skor     | Category                  |
|----------|---------------------------|
| X ≥ 5    | Strong                    |
| 4.0 ≤ X ≤ 4.9 | Enough                  |
| 3.1 ≤ X ≤ 3.9 | Neither Strength nor Weakness |
| X ≤ 3.0  | Weak                      |

Adopted from [36]

Prospective teachers’ critical thinking disposition was analyzed using SPSS for Windows software. The analysis results include t-test and Mann-Whitney to identify differences in each component of the prospective teachers’ critical thinking disposition and the correlation between each component of the prospective teachers’ critical thinking disposition.

### 3. Result and Discussion

The result of prospective teachers’ critical thinking disposition questionnaire is classified by gender. Subsequently, independent sample t-test and Mann-Whitney test are conducted to determine the difference between prospective teachers’ critical thinking disposition. The results of the students’ differences analysis are briefly presented in Table 2.

| Dispositions   | Gender | N   | Mean | SD | df  | T    | p     |
|----------------|--------|-----|------|----|-----|------|-------|
|                |        |     |      |    |     |      |       |
| Self-Confidence| Male   | 50  | 3.0330 | .37810 | 100 | 2.331 | .022  |
|                | Female | 50  | 2.8552 | .38455 |    |       |       |
| Open-Mindedness| Male   | 50  | 2.9230 | .32115 | 100 | 4.531 | .000  |
|                | Female | 50  | 2.6360 | .31216 |    |       |       |

| Dispositions   | Gender | N   | Mean | SD | ΣN | p     |
|----------------|--------|-----|------|----|----|-------|
|                |        |     |      |    |    |       |
| Inquisitiveness| Male   | 50  | 40.47 | .47406 | 100 | .001  |
|                | Female | 50  | 60.53 |     |    |       |
| Maturity       | Male   | 50  | 43.50 | .36480 | 100 | .004  |
|                | Female | 50  | 57.50 |     |    |       |

Based on Table 2 it can be seen that the critical thinking disposition of female prospective teacher is better than male in composite inquisitiveness (mean = 60.53), and maturity (mean = 57.50), while male are better on the self-confidence component (mean = 3.0330) and open-mindedness (mean = 2.9230).
Correlations between each component of male and female critical thinking disposition and the correlation of the disposition of all samples were also analyzed to determine which disposition components interacted with each other. The disposition of analyticity becomes the most positively correlated component with other disposition components both from gender review (Table 3) and generally (Table 4).

**Table 3.** Correlation of students’ critical thinking disposition component based on Gender

| Dispositions | Gender | N   | p     | Annotation |
|--------------|--------|-----|-------|------------|
| Inquisitiveness (I) | Male   | 50  | .013\(^A\), .025\(^M\) | .001\(^A\), .017\(^M\) | 50\(^{IAM}\) |
|               | Female | 50  | .040\(^T\), .000\(^T\), .012\(^A\), .017\(^M\) | .021\(^M\) | 50\(^{IM}\) |
| Self-Confidence (C) | Male   | 50  | .040\(^T\), .024\(^T\), .002\(^M\) | .001\(^A\), .000\(^M\), .033\(^A\) | 50\(^{IAM}\) |
|               | Female | 50  | .006\(^T\) | .005\(^S\) | 50\(^{S}\) |
| Truth-Seeking (T) | Male   | 50  | .006\(^T\), .024\(^T\), .033\(^T\), .001\(^O\), .001\(^M\) | .001\(^A\) | 50\(^{ICTOM}\) |
| Open-Mindedness (O) | Male   | 50  | .005\(^S\) | .025\(^S\) , .021\(^C\) | 50\(^{IC}\) |
|               | Female | 50  | .017\(^A\), .002\(^O\), .001\(^A\) | .001\(^A\) | 50\(^{ICA}\) |
| Analyticity (A) | Male   | 50  | .013\(^T\), .006\(^T\) | .012\(^T\), .024\(^T\), .033\(^T\), .001\(^O\), .001\(^M\) | 50\(^{ICTOM}\) |
| Systematicity (S) | Male   | 100 | .006\(^A\), .022\(^S\) | .001\(^T\), .045\(^S\), .002\(^M\) | 100\(^{AS}\) |
| Maturity (M)    | Male   | 100 | .001\(^T\), .038\(^A\), .001\(^O\), .001\(^M\) | .006\(^O\), .006\(^M\) | 100\(^{ICTOM}\) |
|               | Female | 50  | .045\(^S\), .022\(^O\) | .017\(^A\), .002\(^O\), .013\(^T\), .006\(^A\) | 100\(^{IACA}\) |

Critical thinking is the process of seeking, producing, evaluating, analysing, synthesizing and conceptualizing information as a guide to the development of one’s thinking skills with the awareness and the ability to use that information creatively [23]. The critical thinking disposition is the realm of one’s consciousness to think critically [36]. The results showed that female prospective teacher was better than male in composite inquisitiveness (mean = 60.53), and maturity (mean = 57.50), while male was better on self-confidence components (mean = 3.0330) and open-mindedness (mean = 2.9230). Different results are presented [23] which suggest that males are superior in inquisitiveness and systematics components than female. In line with the results of the study, [31] stated that male in thinking are more analytical and flexible than female, while female is less skilled in abstract and logical thinking [32]. Male are better at logical thinking than female but are better at controlling emotions [37] so that in accordance with the results of the female is superior in the maturity component. Critical thinking that requires precise, objective, and reflective attributes [38] [39] [40] requires good emotional control in order to make good decisions.

Critical thinking disposition components such as truth-seeking (p = .118), analyticity (p = .800), and systematics (p = .663) were not significantly different between male and female. In general, prospective teachers’ critical thinking disposition of both male and female are categorized as neither strength nor weakness (3.1 ≤ X ≤ 3.9) so it is necessary to be developed. People can have abilities but are sometimes not used [38] [3]. In this stage of the abilities, disposition plays an important role, because to be a successful critical thinker, the critical thinking skills that constitute cognitive skills are insufficient and require the development of a critical thinking disposition. The development of critical thinking and other high-level thinking require good plan through the learning process by applying various models that are appropriate to students’ conditions and the material being studied [41] [42].
4. Conclusion
The prospective science teachers’ critical thinking disposition generally should improve. The critical thinking disposition of female and male prospective teachers varies in several components, namely inquisitiveness, maturity, self-confidence, and open-mindedness. The female prospective teacher was better than male in composite inquisitiveness and maturity, while male was better on self-confidence and open-mindedness components. The disposition component of Analyticity has a dominant correlation in all components of critical thinking disposition of male and female so it is important to be learned or integrated into the learning process in the classroom.

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