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# Critical thinking skills of prospective biology teacher on the chromosomal basic of inheritance learning through online discussion forums

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**Abstract.** Critical thinking skill (CTS) are 21st century skills, need to be trained on prospective teachers as stock of life in the future. With online forum discussion apps, prospective teachers apply multifunctional smartphones to help the learning process and practice their critical thinking skills. The role of online discussion forums is studied to investigate students' perceptions of the use of smartphones in supporting the learning process. Nevertheless it is rarely used to investigate the level of CTS of prospective teachers. A quasi experiment study to investigate the level of CTS of students through online discussion forum was conducted on prospective teachers who take Genetics course with 37 prospective teachers selected by purposive sampling a participants. This research focus is implementing online discussion forums through smartphone-assisted applications short message. Problem-based online discussion forums with three different cases are applied on Chromosomal Basic Inheritance Learning. Data acquisition of CTS of prospective teachers is obtained through the participants' responses in responding to problems in the online discussion forum and then analyzed to determine the level of CTS of prospective teachers according to the Facione CTS assessment tool. The prospective teacher's critical thinking skill level increases on the basic of chromosomal inheritance learning properties through online discussion forums.

## 1. Introduction

The quality of teacher education is very important and increasingly influenced by technology applications. To improve the quality of future prospective teachers, innovation is needed in the learning process that can facilitate the educational experience that provides the 21st century skills. The use of technology is not only a useful teaching tool, but also a method that can improve the learning process. One way that technology can improve the learning process is by offering a learning environment (online discussion, e-mail, chat, blog,) [1,2] available outside the classroom where students can continue the learning process to reflect and discuss topics studied without being limited by time and place.

The challenge for educators for prospective teachers uses this technology by learning with high-quality education that promotes CTS, Meanwhile critical thinking is often discussed in terms of other cognitive skills such as logical reasoning, arguments analyzing, hypotheses testing, decisions making, possibilities estimating, and creative thinking [1]. Learning of prospective teachers needs to train various



skills such as communication, critical thinking skills, and problem solving [3,4,5] as a competency that must be possessed.

Learning of the 21st century emphasizes the problems [3,4,5], so that learning for prospective teachers also emphasizes issues to improve their compensation for future life supplies. One of the competencies that should be possessed is critical thinking skills, in which these skills can improve their ability to match problems [3,4,5]. Critical thinking skills (CTS) are a process of thought reconstruction that must be developed in higher-level learning processes [6] especially in the teacher training institute (LPTK).

The use of traditional classroom discussions can contribute to the development of CTS of prospective teachers. However, discussions are often impeded by time, the number of prospective teachers participating in the classroom, and unequal access to interactions (eg, prospective teachers dominating classroom discussions). For this we offer a learning experience that allows more time for discussion. Genetic learning, especially concept of the Chromosomal Basis of Inheritance, is an interesting topic for discussion, since this concept is a concept that contains many cases of genetic abnormalities, so it is appropriate to apply in online discussion forums. Problem solving in genetic learning, can reduce learning difficulties and improve understanding of concept and procedural genetics [6]. Learning by applying online forum discussion methods to prospective teachers can improve CTS [1,7,8], increase affective attitudes in exposing opinions [9,10,11], and increase virtual group learning [8]. For that, it needs to be applied properties online discussion forum on basic chromosomal inheritance learning to improve CTS on prospective teachers.

## 2. Method

In this study, researchers used purposive sampling [12], a group of participants was selected because they met the characteristics specified by the researchers and they also served the purpose of this study. The study participants were third-years of biology prospective teachers who took Genetics courses in one of the LPTK with a population of 145 prospective biology teachers with a total of 37 participants. Genetics learning consists of 14 weeks. From week 2 to week 4 during the study, participants were asked to use online forums to respond to three cases submitted by the instructor. The first week is used to familiarize the online discussion forum with smartphone technology. Implementation of group usage The online forums discussion are quasi experiment on 37 prospective teachers who are members of an online discussion forum group. Data was collected through a problem-based short message submitted through an online discussion forum and then responded by the participants, supported by several sources of reference used by participants in providing feedback. Problem-based short messages have three cases, they are sex chromosome determination, genetic defects of sickle cell anaemia and genetic disorders of thalassemia.

The following case settings in the online discussion forums are implemented;

### Case 1: Chromosomal Basis of Sex

A true story, there is a woman call Starla, she is 21 years old and has not experienced menstruation. Besides, she also has her mammary gland not fully developed. She had been sexually lit, but she had no interest in men at all. Do you think it's true that she's a woman? Is there a possibility that she was mistaken for a gender because her secondary sex organs did not develop even her internal sex organs such as ovary and uterus did not have?

### Case 2: Genetic Abnormalities: Sickle cell anaemia

Genetic disorders based on alleles can be differentiated into several causes. Sickle cell anemia is a genetic disorder caused by abnormalities in one of the alleles possessed by the patient. Do you think that sickle cell anemia disorder is caused by what alleles? Also mention some of the causes of the origin of alleles that are the cause of genetic disorders. Let's put you down some of the possibilities of parents who degenerates sickle cell anaemia.

**Case 3: Genetic Disorder: Thalassemia major**

There was a child who died when he was 3 years old because of major thalassemia. He in a certain time interval must transfuse blood. Only one doctor's recommendation at that time, the bone marrow transplant. 1) What is thalassemia? What chromosomal abnormalities cause thalassemia? 2) If she is suffering from major thalassemia disorders, explain how the genotypes are likely from both parents and how likely are the genotypes of their other brothers? and 3) Why does the doctor recommend a bone marrow transplant?

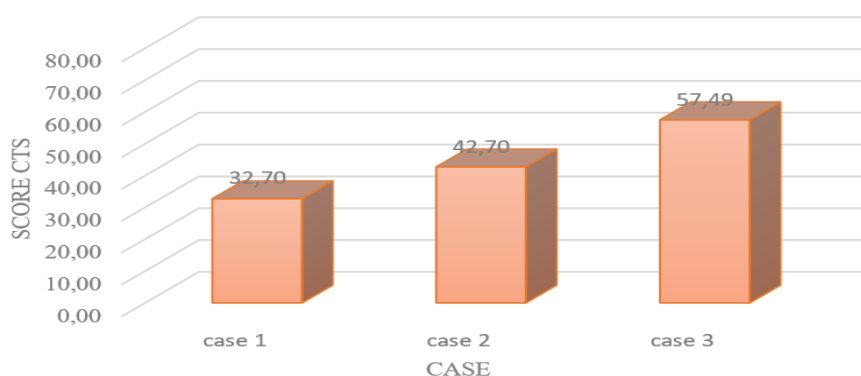
Class members who participate in online discussion forums are committed to participant by responding to the ciphers messages provided by the structure. The participants 'responses were then scanned using the students' critical thinking skill instruments with the Facione framework [13], consisting of five indicators, they are interpretation, analysis, evaluation, inference and explanation. The data were analyzed qualitatively to determine the prospective teachers CTS level.

**Table 1.** CTS according to the Facione Framework [13].

Indicator	Definition	Subskill
Interpretation	ability to understand and express the meaning or intent of an experience, situation, data, events, decisions, conventions, beliefs, rules, procedures or criteria.	Categorize, encode data, clarify meaning
Analysis	The ability to identify ideas or arguments to express trust, decisions, experiences, reasons, information or opinions.	Testing ideas, identifying arguments, analyzing arguments
Evaluation	The ability to judge the credibility of statements or other representations by assessing or describing a person's perceptions, experiences, situations, decisions, beliefs.	Assess the credibility of claims, assess the quality of arguments that have been made with inductive and deductive reasoning.
Inference	The ability to identify and select the elements necessary to form a reasonable conclusion or to form a hypothesis with regard to relevant information.	Questioning statements, thinking of alternatives, drawing conclusions
Explanation	The ability to state the outcome of a person's reasoning process, the ability to justify that reason based on evidence, concepts, methodology, a certain criterion and reasonable judgment.	Declare the results, explain the method, put forward the argument

**3. Result and Discussion**

Participants' responses were short messages in online discussion forums on three cases given by the instructor and assessed on the basis of CTS instruments with the Facione framework described in Figure 1.

**Figure 1.** Graph Improved CTS of prospective teachers in online discussion forums.

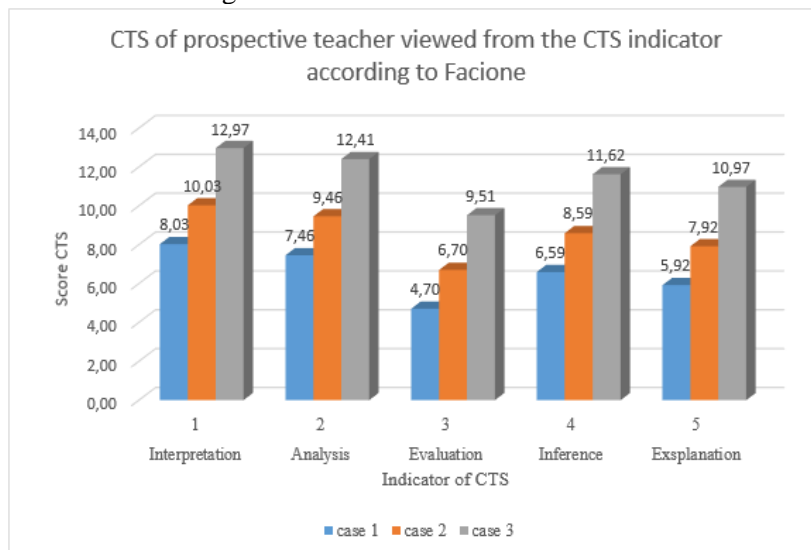
CTS with Facione framework consists of five indicators, namely interpretation, analysis, evaluation, inference and explanation. CTS of prospective teachers based on indicators of CTS are described in Table 2 below.

**Table 2.** CTS of students are reviewed CTS indicators according to Facione.

Case via online forum discussion message	Interpretation	Analysis	Evaluation	Inference	Explanation	Total Score rate
	1	2	3	4	5	
case 1	8,03	7,46	4,70	6,59	5,92	32,70
case 2	10,03	9,46	6,70	8,59	7,92	42,70
case 3	12,97	12,41	9,51	11,62	10,97	57,49
average	10,34	9,77	6,97	8,94	8,27	44,30

Figure 1 show that problem-based online discussion forums can improve the CTS of prospective teachers on the Chromosomal Basic of Inheritance concept with an increase from the first case of sex chromosome determination with a score of 32.70 increased in the second case of genetic defects of sickle cell anaemia with a score of 42.70 and again increased in cases third is the genetic disorder of thalassemia major with score 57.49. Data score CTS in online discussion forums can be seen in Figure 1. CTS with Facione framework consists of interpretation, analysis, evaluation, inference and explanation in online discussion forums in three cases there is an increase from the first case to the third case. This suggests that online discussion forums can improve CTS [1,8,9] prospective teachers on the Chromosomal Basic of Inheritance concept in genetic learning.

Increasing each indicator of CTS with the Facione framework in three cases in an online discussion forum is described in Figure 2 below.



**Figure 2.** CTS of prospective teachers reviewed CTS according to Facione.

Implementation of online discussion forum on the Chromosomal Basic of Inheritance concept, prospective teachers have CTS with indicator 1) interpretation; categorize, encode data and clarify meaning, 2) analysis; test ideas, identify arguments, and analyze arguments, 3) evaluation; assess the credibility of claims, assess the quality of arguments made with inductive and deductive reasoning, 4) inference; questioning statements, thinking of alternatives and drawing conclusions, and 5) explanations; states the results, explains the method, and puts forward the argument [13]. It is clear how prospective teachers respond to the problems given by the instructor with three different cases in online discussion forums.

Critical thinking and problem solving are thinking skills that require cognitive processes. The central point of thinking skills is problem solving and decision making. Problem solving is thought critically and produces a solution by processing information. Prospective teachers collect and encode case-related data, explain the problem by decreasing inheritance of genomic nature in each case, formulating a solution plan, using knowledge and principles, and evaluating solutions that may require cognitive processes. This is in line with the disposition of CTS as analytical, systematic and open-minded, possessing cognitive maturity, curiosity and confidence, and seeking the truth. Analyticity is the preparation for problems that may arise, identify causes and use the data needed for troubleshooting purposes. Systematics must be focused, firm, organized and planned when solving problems. Open-minded is about being open to different views, approaches and views, and evaluating the views of others in the decision-making phase. Cognitive maturity is described as seeing the complexity of problems and acting rationally. The activity of seeking truth in the thought process can be defined as having intellectual determination, respecting different ideas, trying to reach the right information, seeking reason and evidence of truth, and acting objectively against different ideas [11,13].

Online discussion forums can improve the CTS of prospective teachers [1,7,8,9,10]. Implementation of online discussion in learning is not limited by place and time is a mobile learning, where the use of mobile technology and based on information technology is a characteristic of learning in mobile [14]. Information technology applied in mobile learning process not only facilitate discussion forum, so according to researcher, it is necessary to develop next mobile learning in genetics learning, which use many facilities embedded in information technology such as send file, send video, send picture and send the website link as a reference source of learning materials. The rapid and widely available online development of research on genetics is virtual data that can be used as a source of mobile genetic learning materials, and this has not been used as a material for genetic learning.

#### 4. Conclusion

Online discussion forums can improve the CTS of prospective biology teachers on the basic concept of chromosomal inheritance properties in genetic learning. Where the prospective teacher has the ability 1) interpretation; categorize, encode data and clarify meaning, 2) analysis; test ideas, identify arguments, and analyze arguments, 3) evaluation; assess the credibility of claims, assess the quality of arguments made with inductive and deductive reasoning, 4) inference; questioning statements, thinking of alternatives and drawing conclusions, and 5) explanations; states the results, explains the method, and puts forward the argument. Implementation of online discussion in learning and based on information technology is a characteristic of mobile learning. Mobile application development is needed in genetic learning using virtual data subject matter and using smartphone technology to improve 21st century skills, especially critical thinking skills.

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#### References

- [1] Szabo Z and Jonathan S 2011 Learning methods for teacher education: the use of online discussions to improve critical thinking *Technology Pedagogy and Education*
- [2] Yildiz A 2017 The Factors Affecting Techno-Pedagogical Competencies and Critical Thinking Skills of Preservice Mathematics Teachers *Malaysian Online Journal of Educational Sciences*
- [3] Carlgren T 2013 Communication, Critical Thinking Skill, Problem Solving A Suggested Course for All High School Students in The 21<sup>st</sup> Century *Interchange*
- [4] Temel S 2014 The Effects of Problem-based Learning on Pre-Service Teachers' Critical Thinking Dispositions and Perceptions of Problem-Solving ability *South African Journal of Education*
- [5] Abdillah, Toto N, Subanji, Hery S and Abadyo 2016 The Students Decision Making in Solving Discount Problem. *International Education Studies Canadian Center of Science and*

*Education*

- [6] Minter M K 2010 Critical Thinking Concept Reconstructed. *Contemporary Issues In Education Research Educational Consultant USA*
- [7] Chung L.S, Raymond, C, Wing S and Hew K.F 2011 Critical Thinking in Asynchronous Online Discussion: An Investigation of Student Facilitation Techniques *National Institute of Education Singapore*
- [8] Beckmann J and Peter Weber 2015 Cognitive Presence in Virtual Collaborative Learning: Assesing and Improving Critical Thinking in online Discussion Forums *International Conference e-Learning*
- [9] Ebrahimi A, Esmail F and Moghaddam M D 2016 Student perceptions of effective discussion in online forums: a case study of pre-service teachers *Innovations in Education and Teaching International*
- [10] Condy J, Agnes C, Daniela G and Eunice I 2012 Pre-service Students Perceptions and Experiences of Digital Storytelling in Diverse Classrooms. *TOJET: The Turkish Online Journal of Educational Technology*
- [11] Facione, P., Facione, N and Giancarlo, C 1996 *The motivation to think in working and learning* In E. Jones (Ed.), *Defining Expectations for Student Learning* (San Francisco, CA: Jossey-Bass Inc.)
- [12] Cohen L and Manion L 1989 *Research Methods in Education* (3rd ed.) (London: Routledge)
- [13] Facione N C and Facione P A 1996 Externalizing the critical thinking in clinical judgment *Nursing Outlook*
- [14] Aubusson P, Sandy S and Kevin B 2009 Mobile learning for teacher professional learning: benefits, obstacles and issues. *ALT-J*