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The effectiveness of UPA system to boost the bioinformatics learning process in limited time for pharmacy students at University of Surabaya, Indonesia

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Abstract: Bioinformatics is one of essential fields widely applied to various studies, especially in the exploration studies of the herbal medicine in drugs discovery. However, bioinformatics course at the Faculty of Pharmacy University of Surabaya still needs to be improved. This research aims to develop the efficient teaching system to optimize the bioinformatics course within limited time. The developed learning system: Understanding, Practicing, and Applying (UPA) system, was conducted. This study involved 95 pharmacist students which were given questionnaire I (before the class) and questionnaire II (after the class) to measure the success rate of learning process. UPA system was implemented by instructor through the explanation about basic concept, the guidance for practice, and the demonstration in research. Result showed that 72% student was lacked of knowledge about the bioinformatics in the beginning but they have a strong willingness to learn. It proved by high interest in bioinformatics (78%) and herbal exploration (72%), respectively. In the end, the interest rate of student to bioinformatics was 96%. It was in line with the understanding of the tools usage ratein advance research. UPA system was successfully boosting the interest and skill of student in bioinformatics, as well as the awareness of herbal conservation.

1. Introduction

Bioinformatics is the combination between biology and information technology[1]. It is applied by computational techniques to manage and analyse the biological information[1,2]. It can be used for sequences alignment, macromolecular structure analysis, molecular dynamics analysis[3], molecular modeling[4,5], protein structure prediction, gene expression analysis, drug interactions[6,7], etc. Pharmacy is one branch of science that related to the application of bioinformatics[8,9]. The molecular dynamics, molecular docking, drug discovery, and herbal compound exploration are more easily understood by bioinformatics[4-7]. Therefore, the role of bioinformatics is essential in pharmaceutical science.

Indonesia has high biodiversity of natural resources, including the plant diversity[9]. Various species of plants are known for possessing potential function as herbal medicine. This potential

function is needed to be further explored. In the 1990s, NMR was discovered to identify the herbal compounds. Various databases on phytochemicals have been identified. Bioinformatics has an important role to identify phytochemicals that pharmacological effects[1,2].

University of Surabaya is one of the most substantial private university in Indonesia. The development of medicines is being one of essential issues in the Faculty of Pharmacy University of Surabaya. Drug discovery and herbal compound identification are intensively studied. However, the bioinformatics course in the Faculty of Pharmacy University of Surabaya is still considered to be improved. There are various teaching techniques which can be implemented in the class. Each of techniques has benefit in different depth of learning[10]. Therefore, the development of teaching system is needed to optimize the bioinformatics lecture due to the limited number of lecture or meetings.

The concept of UPA system consisted of three components, such as understanding, practicing, and applying. All students must fill pre-questionnaire before expose UPA system. After that the instructor explained about the concept of various web server and demonstrated the tutorial in term for Understanding system and then the students practice by themselves under the guidance of instructor for Practice system and then the instructor showed and explained about the related research in bioinformatics for Applying system. All students also must fill post-questionnaire after expose UPA system.

Result showed that the application of Understanding, Practicing, and Applying (UPA) system in bioinformatics class improved the interest and skill of pharmacy student at University of Surabaya. It demonstrated by the success learning rate which significantly elevated after UPA system application. Therefore, it suggested that UPA system was successfully boosting both the interest and skill of student in bioinformatics.

2.   Research methods

This research was applying the innovative teaching of bioinformatics course for pharmacy student in the Faculty of Pharmacy, University of Surabaya. It was developed in order to create the optimal course during the limited time. Therefore, the application of UPA system was conducted.

2.1 Participants

Students from faculty of pharmacy at University of Surabaya were addressed as a subject in this research. Students were randomly selected among pharmacist student which never received about bioinformatics. The appropriate sample number for this research was calculated as follow:

$$n = \frac{N}{1+N(d^2)}$$

(1)

N = Number of population
n = Number of sample
d = Significance level 0.05

Based on that formula, the minimum number of participants in this research was 77 students. However, in this case, all student was included 95 students as participants. If the number of population was less than 100 people, all the participants could be involved[11].

2.2 Procedure

The concept of UPA system consisted of three components, such as understanding, practicing, and applying. All students would be handed with two kinds of questionnaire, including questionnaire I (questionnaire for pre-UPA system) and questionnaire II (questionnaire for post-UPA system).

Students were asked to fill the questionnaire I before the class started to measure the basic knowledge of the student. Furthermore, students were taught by instructor for the introduction of bioinformatics by using UPA system. The instructor explained about the concept of various web

server and demonstrated the tutorial in term for Understanding system. After that, the Practice system was applied by allowing students to practice by themselves under the guidance of instructor. Furthermore, instructor also showed and explained about the related research in bioinformatics as a part of Applying system. Moreover, students were handed with the questionnaire II as the tool to measure the success rate of learning after the application of UPA system. All the obtained data was analyzed by statistical analysis.

2.3 Measurement

Each of questionnaire I and II was contained of five questions in each. Both questionnaires had a similar question, including closed and open question. Closed question allowed students to answer with Yes and No answer, whilst the open questions were encouraged the students to describe the reason of their answer in closed question. Each of student was handed with questionnaire before and after the workshop in order to measure the success rate of learning process. Furthermore, the answer of open questions was also summarized.

Table 1. Questions in questionnaire I and II

Indonesian	English
a) Apakah anda mengerti kata Bioinformatika? **(Ya/Tidak)** b) Jika **Ya**, menurut anda apakah bioinformatika itu?	a) Do you know about Bioinformatics? **(Yes/No)** b) If Yes, what is Bioinformatics according to your opinion?
a) Apakah topik Bioinformatika menurut anda menarik? **(Ya/Tidak)** b) Jika **Ya**, mengapa? Jika **Tidak**, mengapa?	a) Whether topic of Bioinformatics is interested? **(Yes/No)** b) If **Yes**, why is that? If **No**, why is that?
a) Menurut anda, apakah topik Bioinformatika penting untuk dipelajari? **(Ya/Tidak)** b) Jika **Ya**, mengapa? Jika **Tidak**, mengapa?	a) Whether topic of bioinformatics is important to be learned? **(Yes/No)** b) If **Yes**, why is that? If **No**, why is that?
Coba sebutkan beberapa software atau webserver Bioinformatika yang anda ketahui.	Please mention about several software or webserver which you know.
Apakah tumbuhan herbal menarik untuk dipelajari dan dilestarikan? **(Ya/Tidak)**	Whether medicinal plant is interested to be learned and preserved? **(Yes/No)**

This research contained of independent and dependent variable. The UPA system was determined as independent variable, whilst the knowledge about bioinformatics, interest level, and awareness of the importance on bioinformatics to be learned were considered as dependent variable.

2.4 Validity test

All collected data were analyzed by validity test to measure the relevancy the measure tool which was in this case is the questions within questionnaire. It was conducted by calculating the r value and compare to the r table. If the r calculation > r table so that it was defined valid. The r table for 95 participants was 0.202 with 5% significance level.

2.5 Reliability test

The reliability test was conducted to identify the consistency of the measurement if it was applied within few times. There were many kinds of techniques which could be used. However, Kuder-Richardson (KR-20) was used in this research. It was designed for question with two possible answer only. The formula was demonstrated as follow:

$$KR-20 = \left(\frac{n}{n-1}\right)\left(\frac{s_t^2 - \Sigma pq}{s_t^2}\right)$$ (2)

n = Number of valid questions
s_t^2 = Variance
p = Number of people in the sample who answer correctly
q = Number of people in the sample who do not answer correctly

3.   Result and discussion

3.1 UPA system enhanced the understanding and interest level of pharmacist student to the bioinformatics study

Based on the analysis of validity for closed question (question number 1,2,3, and 5), it showed that all questions within questionnaire I and II are valid. Within questionnaire I, the r calculation for questions 1 until 4 was 0.6242084, 0.74041925, 0.54423133, 0.57000732, respectively. Then, it was compared to the r table for 95 students, that is 0.202. The comparation result showed that r calculation was higher that r table so that all the question was valid. However, within questionnaire II, questions 1 until 4 demonstrated t calculation about 0.98449, 0.98449, 0.98449, 0.90186, respectively. Therefore, all the questions were also valid.

Moreover, the reliability test was carried out for the questionnaire I and II by using Kuder-Richardson (KR-20) formula. Result showed that, questionnaire I and II had score 0.386 and 0.973, respectively. Based on the level of KR-20 score, it demonstrated that questionnaire I had low reliability while questionnaire II had high reliability.

Furthermore, all the data from questionnaire were collected. Regarding to the questionnaire I, it showed that most of students had lack of knowledge about bioinformatics. It demonstrated by 68 of students choose "No" for question number 1 which asked about the basic knowledge of bioinformatics. Whilst, there are 27 students already had the basic knowledge about bioinformatics. Moreover, only 75 students who interested to study bioinformatics in the beginning. However, most of them believe that bioinformatics is essential. It showed by 91 students who answer "Yes" for question number 3.

UPA system was started by demonstrated the basic concept of the bioinformatics related to herbal research. The instructor explained the basic concept by using file presentation with two-ways interaction to students. Furthermore, the instructor also demonstrated about several database and web service. Students were introduced how to obtain data from database then analyze it by using certain web service regarding to the individual purpose. After that, students were introduced to the several journals based on the bioinformatics analysis. It aimed to build the mind mapping of the students regarding to the in silico-based research.

After UPA system were applied, students were allowed to fill the questionnaire II. Interesting result showed that, the basic knowledge, interest level, and awareness of importance of bioinformatics

were highly increased. About 93 students had better understanding about basic knowledge of bioinformatics which demonstrated by ability to answer the verbal question and mention several names of database and web server. Moreover, 93 students found that bioinformatics study was interesting and important for the development of pharmacy study. Furthermore, it also enhanced the awareness of student regarding to plant conservation since students have already understand about the function and benefit in each plant.

3.2 Students have better understanding towards bioinformatics after UPA system application

The questionnaires I were handed to student before the class. In several questions, students were asked to write a feedback. Result showed that students looked confused to provide a definition of bioinformatics since they are not familiar with the bioinformatics. Most students interpreted the bioinformatics as biological information about organism. However, there are some students who once hear about bioinformatics and mentioned about several well-known software or web service. Furthermore, most students were attracted to bioinformatics since this new knowledge can support Pharmacy studies, so that they feel challenged and interested in learning process. On the other hand, there are a small number of students who are less interested in bioinformatics since they assumed that bioinformatics was difficult to understand.

Result of questionnaire II after applying the UPA system showed that all students have better understanding related to bioinformatics. They also have ability to explain the benefits of studying bioinformatics, weaknesses, and strengths of bioinformatics. According to them, bioinformatics is interesting since the computer tools can find out the activity of active compounds contained in herbal plant, interaction between compounds, pathway, and potential mechanism of action. Those functions are closely related to pharmaceutical studies. Moreover, all students were able to mention about the Bioinformatics software and web server which taught by UPA system.

4. Conclusion

Bioinformatics is an advanced technology which essentially needed for pharmacy student in University of Surabaya, especially for herbal medicine exploration. However, the bioinformatics course still needed to be improved. UPA system which stands for Understanding-Practicing-Applying is successfully boosting the basic knowledge and interest level of student about bioinformatics. Moreover, it is also improving the skill of student within bioinformatics application. This application enhances the students about awareness of herbal conservation.

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