A review of determining the learning style preferences by using computer-based questionnaires on undergraduate students

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Abstract. This study aims at identifying student learning styles in the Faculty of Communication and Informatics. Web-based applications are built as a system to determine visual, auditory, read/write, or kinesthetic (VARK) learning styles. The Version 7.1 questionnaire has been applied as a basic instrument. Test data was obtained from a sample of 230 students. System performance is tested by applying black-box testing and testing the validity of alpha-beta on each system module. Meanwhile, the survey method is used to assess the feasibility of application design. Based on a series of observations, tests, and analysis it can be concluded that of 230 students, 27% had visual learning styles, 16% hearing, 14% reading and writing, and 43% kinesthetic. Based on the results of this study, it can be concluded that students have diverse learning style preferences so that educators must adjust learning strategies by providing appropriate learning media and learning instruments in teaching classes.

1. Introduction

There are several definitions of learning styles or learning modalities delivered by many researchers. Learning styles according to [1]–[7] are the most preferred ways for students to understand something. Meanwhile, by [8]–[10] learning styles are defined as learning methods that students feel are most efficient and effective in processing, storing and retrieving something they have learned. Learning style is a different way for each individual in learning [11]–[15] and is a skill and behavior that determines how students conduct the learning process [16], [17], [18]–[20] suggest that learning styles can influence the effectiveness of training both online and in more traditional ways. Learning styles are categorized by [21] into wholist-analysts and verbalizer-imagers. This type of wholist-analysts describes how individual process and understand information. Wholists prefer to study material globally. Instead, analysts emphasize more on the details of information processing. Verbalizer-imagers are descriptions of how individuals reveal information. Verbalizers prefer the presentation of information in the form of words, while imagers tend to prefer the presentation of information in the form of pictures. According to [22], a wholist-analysts is also called a wholist-serialists wherein learning a material takes a path with a global view and then is followed by a more detailed process.
Serialists have a tendency to carry out the learning process step by step. Another statement according to [16], wholists and serialists are known as globalist and sequential, while verbalizers and imager are known as verbalist and visual. Sequential students tend to learn in linear steps which are part of the step by step. Conversely, globalist learners prefer to study material in an irregular way. Learning styles are divided by [23], [24] and [12] into four categories. They argue that learning styles can be classified into visual, auditory, read/write, and kinesthetic (VARK). Related to that, [25] also classifies students into students with visual, auditory, and kinesthetic learning types depending on how they receive and process information. So that means students can at least be categorized into one of three existing learning styles, namely visual, auditory, or kinesthetic. These three ways of learning are known as VAK learning styles. The VAK learning style is related to the sense of human observation, namely vision, hearing, and movement. Visual type students will learn effectively when they see the material. On the other hand, auditory type students prefer learning by relying on hearing, while kinesthetic type students are students who have the best way of learning with practice and practice.

Absorption of information by listening is a way of learning auditory type students. They have the best way to learn by listening to lectures and participating in discussions. When they want to retrieve the information they get, they will remember how they heard it when they received the information. Views in the form of images, tables, charts, and maps are the best media for students in a visual learning style. Viewing and reading are important activities for these visual learners. Kinesthetic learning style students do the best learning with practice or practice. Laboratory activities or field activities are more enjoyed by kinesthetic students than in class. They like the involvement of contacts and physical experiences, such as touch, feeling, holding, doing, and other hand-related experiences in practice.

Each learning style has unique learning instruments and tools. Therefore, knowing the learning style is very important, both for teachers and students. Determination of conventional learning styles usually uses a questionnaire form. Questionnaire version 7.1 has provided several questions that lead to the identification of student personality, skills, and behavior. In this study, the determination of VARK learning styles was carried out with the help of computer programs based on web applications to help determine the type of learning style that students have. The existence of this application is expected to make it easier to find student learning modalities so that teachers can use information about their students’ learning modalities in packaging appropriate learning tools and learning strategies.

2. Methodology

This research was carried out using the Research & Development (R & D) method. The steps of R & D in this study were simplified into four stages, namely the exploration stage, the model development stage, the model testing phase, and the dissemination stage. The exploration phase is carried out by conducting relevant theoretical studies, assessing the quality of the existing models and conducting needs analysis, and making product specifications. The development stage includes modeling based on specification requirements, testing the model design in the field (until said to be qualitative), and finally producing a test result model. The testing and evaluation phase is carried out to test the reliability and effectiveness of the application through a series of experiments with certain test cases.

Website-based learning style identification application is equipped with the features for analyzing and percentage calculation of learning styles based on study program and student's gender. This application is built with PHP programming language and MySQL databases.

This learning style determinant application contains 16 standard Indonesian language questions in which the content is related to the characteristics of several learning styles that refer to the VARK Version 7.1 questionnaire. This computer-based questionnaire provides four answer choices for each problem where respondents can choose more than one answer for each question. The standard questionnaire instrument was adopted from the vark-learn.com website. Examples of VARK questionnaire instruments Version 7.1 that is used in this study are illustrated in the following Table 1.
Table 1. Sample questionnaire instrument

| No | Question                                                   | Answer                                                                 |
|----|------------------------------------------------------------|------------------------------------------------------------------------|
| 1  | Anda harus membuat sebuah pidato penting di sebuah konferensi atau acara penting. Anda akan melakukannya dengan: | Membuat diagram atau grafik untuk menjelaskan sesuatu.                 |
|    |                                                             | Menulis beberapa kata kunci dan berlatih mengucapkan pidato anda secara berulang-ulang. |
|    |                                                             | Menulis pidato anda dan mempelajari dengan membaca beberapa kali.      |
|    |                                                             | Menggabungkan banyak contoh dan cerita untuk membuat pembicaraan menjadi nyata melalui praktek. |

The data required in this study include student identity data and habits in learning something. Student identity data is obtained from the personal data input filled by students when they first enter the application. While the data of students’ learning habits is determined from the value of the weighting of answers to questionnaire questions which can only be accessed after students complete filling in student data at the beginning of the application.

The data used in this study of learning style preferences is the answer to the list of questions in the VARK questionnaire version 7.1 which was sampled from 230 students of the Faculty of Communication and Informatics.

To determine the type of learning style, two categories are used: 1) unimodal, if the difference in the first and second learning style trend points exceeds the specified tolerance limit; and 2) multimodal, when the difference between the first and second ways of learning style is smaller or equal to the specified tolerance limit [26]. The results of the questionnaire analysis are calculated manually based on the tolerance limit below. [27] established a tolerance limit for scoring answers to the VARK questionnaire as described in Table 2 below.

Table 2. Limit tolerance of differences in VARK questionnaire points

| No | Rule of margin difference of points |
|----|-------------------------------------|
| 1  | If the total points of respondents answer amounted to 16 to 21, then the tolerance limit of the point of each maximal modality is 1. |
| 2  | If the total points of respondents answer amounted to 22 to 27, then the tolerance limit of the point of each maximal modality is 2. |
| 3  | If the total points of respondents answer amounted to 28 to 32, then the tolerance limit of the point of each maximal modality is 3. |
| 4  | If the total points of respondents answer amounted to 29 and above, then the tolerance limit of the points of each maximum modality is 4. |

3. Result and Discussion

3.1 Display of application

This study produced a web-based learning style identification application. This application is used to help students determine their learning style trends which are also accompanied by information about the right learning solutions. In addition, the most important thing is the result of student learning style categorization analysis of this application can help teachers to know the tendency of student learning styles in both male and female students. The existence of this learning style information is expected to guide teachers in developing better and more appropriate learning strategies. The existence of this web-based application has also increased time efficiency in the implementation of questionnaires to determine student learning style preferences when compared to paper-based questionnaires. In Figure 1a the questionnaire questions are based on VARK Version 7.1. Visitors (students) are then asked to
complete at least 12 questions and may choose more than one answer from the available answer options. After the student has finished answering a number of questions, the filling results can only be processed after clicking "Save" to instruct the application to begin the process of analyzing the learning style as shown in Figure 1b below.

![Figure 1](image1.png)

**Figure 1.** Questionnaire question page (1a), 'Save' button to start processing (1b)

On the results page is displayed the results of weighting answers. Furthermore, the categorization of learning styles is calculated based on the limits of the tolerance points specified in the system. In Figure 2a the complete biodata of visitors is displayed, points for each type of learning style preferences, and trends in learning style types. If the learning style button is clicked, the learning solution will be presented

![Figure 2](image2.png)

**Figure 2.** Result of analysis page determining learning style preferences (2a) and learning solution given (2b)

Figure 2b above shows an overview of how a student with a predetermined learning style can receive, store, and communicate information well. This also simultaneously proposes the right learning strategy to be used by the learning style owner.

3.2 Data analysis

3.2.1 Analysis Based on Types of Learning Style Preferences.

The equation used to calculate the percentage of learning style outcomes based on the study program is shown in Equation 1 below.

\[
Y_{z,x} = \frac{\sum (X,Y)_z}{\sum X_z} \times 100\%
\]  

(1)
where $Y_{Z,X}$ presents percentage of learning modalities $y$ in study program $z$ with gender $x$, $\sum (X,Y)_z$ is the number of students with gender $x$ and learning modality $y$ in study program $z$, and $\sum X_z$ states the number of students with gender $x$ in study program $z$. Students of Informatics Study Program have a tendency of learning style from the largest to the smaller percentage, namely AKRV-K-A=AK-AKR, where A: auditory, K: kinesthetic, V: visual, R: read/write. In Figure 3a the percentage of the results is presented.

![Figure 3a](image1.png) ![Figure 3b](image2.png)

**Figure 3.** Percentage of student’s learning style preferences of Informatics (3a) and Communication Study Program (3b)

Furthermore, students of Communications Study Program have a tendency of learning style from the largest to the smallest percentage, namely A-K-AKR-AV=AK=AR, where A: auditory, K: kinesthetic, V: visual, R: read/write. In Figure 3b above the percentage of the results is presented.

3.2.2 Learning style preferences analysis based on gender

Male students of Informatics Study Program have a tendency of learning style from the largest to the smaller percentage, namely AKRV-A-K=AK-AKR=ARV=A, where A: auditory, K: kinesthetic, V: visual, R: read/write. In Figure 4a below the percentage of the results is presented.

![Figure 4a](image3.png) ![Figure 4b](image4.png)

**Figure 4.** Percentage of students learning style preferences of the Informatics Study Program for male (4a) and female (4b)

Conversely, female students learning of Informatics Study Program have a tendency of learning style from the largest to the smallest percentage, namely AKRV-K-AK=AK-AKR=ARV=A, where A: auditory, K: kinesthetic, V: visual, R: read/write. The percentage of the results is presented in Figure 4b above.

Meanwhile, male students of the Communication Studies Program have a percentage of the tendency of learning styles from the largest to the smallest percentage, namely A-K-ARV=AKV, where A: auditory, K: kinesthetic, V: visual, R: read/write. In Figure 5 the percentage of results is presented.
Female students of Communications Study Program have a tendency of learning style from the largest to the smallest percentage, namely A-K-AKR-AK, where A: auditory, K: kinesthetic, V: visual, R: read/write. In Figure 5b above the percentage of the results is presented.

3.3 Validation stage
After the black-box test was completed, it was followed by filling in the questionnaire by the respondents, namely 20 respondents from the Faculty of Communication and Informatics to assess each feature presented. The formula used to calculate the percentage of questionnaire answers using Equation 2 below.

\[
\text{Answer}_X = \frac{\sum \text{Score}_X}{\sum \text{MaxScore}} \times 100\%
\]  

(2)

where Answer$_X$ states percentage of answer, \(\sum \text{Score}_X\) is the number of x question score, \(\sum \text{MaxScore}\) presents the number of maksimum score.

After getting scores and percentages for each answer, continued by calculating the average percentage. The average percentage received is 87% of respondents agree that the application of learning styles is easy to understand and easy to use, applications can provide information about learning styles, applications can help visitors faster and easier in determining their learning style. The results are shown in Figure 6.

In Figure 5 above, there is a horizontal axis which includes Q1, Q2, Q3, and Q4. Each of these Q represents different questions, namely:
Q1: Is the application easy to understand and use?
Q2: Can the application provide information about learning styles?
Q3: Can the application help faster in determining learning styles?
Q4: Is the application look attractive

4. Conclusion

This paper proposes an application model to determine student learning style preferences in the learning process. The application created can determine the percentage of student learning style trends according to set-point limitation rules and may also indicate the percentage of overall learning styles based on gender in accordance with the study programs in the Faculty of Communication and Informatics. Based on the results of the questionnaire on the respondents in the Faculty of Communication and Informatics, it can be concluded that as many as 87% of respondents agreed to the application of student learning style preferences that are made with the results of the application assessment is easy to use, can provide information on determining learning styles, and looks attractive. An additional conclusion is that based on the results obtained from the application, the instructor should be aware that students have different learning style preferences so that teachers need to develop and organize appropriate teaching strategies when implementing learning.

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