Application for determining the modality preference of student learning

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Abstract. Learning modality is the sensory sensitivity of the individual when receiving, storing, and conveying information. Each individual has a personal character and varied sex that influences the type of learning modality. Learning modality consists of four types of visual, auditory, read-write and kinesthetic (VARK). To measure students' learning modalities preference was used VARK Questionnaire 7.1 which contained 16 standard questions through paper media. Paper media is less efficient and effective both in the dissemination and analysis of questionnaires results based on study program and sex, because it made the application of determinants of student-based learning modalities modality using Research and Development (R&D) method with PHP programming language and MySQL database, this application features a percentage analysis of students' learning modalities preference based on study program and sex. This application aims to facilitate the students to know the analysis of modal preference results in accordance with the rules of the limit of the difference of points specified and can display the percentage of overall learning modalities based on sex in accordance with the study program. Based on the results of application acceptance test by students of Faculty of Communication and Informatics Muhammadiyah University of Surakarta known as many as 87% of respondents agreed that the application determinants of learning modalities preference can present information and determine the preferences of learning modalities, easy to use and looks interesting.

1. Introduction
The learning modality is an individual's sensory preference (tendency) or sense sensitivity which is used in conveying, storing and receiving information [1]. [2] also argues that the modality of learning as a condition that is closely related to education where the condition shows how each individual learns.

Transfer of information by lecturers to students can be on target if there is a mismatch between the teaching strategies of the lecturer and the student's learning modalities. While all students are not able to understand learning material that is learned only by standard methods [3], this causes students to be less than optimal in their learning and then becomes quickly bored studying because there is no variation in the right way of learning. Learning modalities can help each individual in improving their learning abilities [4]. In its development each individual does not have the same habits, each individual has differences from each other in many ways, including self-motivation, emotions, likes and dislikes about something, including the modality of learning [5].

[6] as an expert in learning modalities as well as the authors who use the most sensory tendency assessment in learning modalities mentions learning modalities or learning styles divided into four categories. [7] states that categories of learning modalities include visuals; auditory; read-write; kinesthetic (VARK). Visual preferences learn better through viewing visual educational material such
as diagrams, numbers, and pictures accompanied by explanations; auditorial preferences learn better through listening and verbal delivery such as listening to the teacher's explanation in front of the class; read-write preferences learn better through reading and writing, such as writing notes from instructor-explained material, reading material or printed material; Kinesthetic preference for learning is better by doing direct practice or experimental exercises as well as manipulation of objects with physical processes [4]. Each individual's learning modality can be divided into a number of sets, the 1st set is divided into 4 components: unimodal, bimodal, trimodal, quad modal; the second set uses the classification of 5 components namely V, A, R, K and multimodal; the third set uses all classifications of 15 components including V; A; R; K; VA; VR; VK; AR; AK; RK; VAR; VAK; VRK; ARK; VARK [6].

The modality of learning becomes an important influence in the reception and delivery of information, especially during the teaching and learning process, but the modality of individual learning is also influenced by several factors. Factors affecting individual learning modalities include culture, sex, age and educational attainment [8]. According to Fleming [9], variations in the sex of individuals also become an important factor in their effects on individual learning modalities. Sex variations in this study were analyzed as to how it affected the percentage difference in the trend of male and female learning modalities in each study program at the Faculty of Communication and Information, Muhammadiyah University, Surakarta.

One way to determine and measure a student has a certain variation of learning modalities is through filling the VARK questionnaire. [9] used the same questionnaire before and used in this study was adopted from the VARK Questionnaire Version 7.1. The questionnaire contained 16 question instruments containing four answer choices for each question [9]. Students as respondents can choose more than one answer choice on each question to identify the number of trends they have [9]. The results of descriptive analysis by the author based on the distribution of paper media VARK questionnaires targeting 100 students of the Faculty of Communication and Information Technology including 25% men and 25% women majoring in Informatics, 25% men and 25% women majoring in Communication that majoring in Informatics by 36% male students have the highest inclination towards multimodal learning modalities; VARK and female students have the same highest tendency of 40% in VARK learning modalities. Subsequent analysis showed that the Department of Communication 32% of male students had the highest tendency in unimodal learning modalities, namely Auditorial and female students had the same highest trend of 36% in Auditorial learning modalities.

The filling out of the questionnaire previously carried out using paper media will take a lot of time in distributing questionnaires, in analyzing the results of learning modality trends based on study programs and sex, as well as an inefficient use of paper media itself. One way to facilitate the distribution and management of questionnaire results is to use the system. In a previous study of the design of diagnoses of children's abnormal behavioral disorders using the dumpster-Shafer method, [10] argues that by using the system it can speed up users in knowing the types of disorders diagnosed by children without having to come face to face with psychiatrists.

Therefore, based on research and problems above, the authors make a solution in the form of applications determining the modality of student learning preferences based on websites along with an analysis feature that generates a percentage of modalities based on the study program and sex of students, this application uses the Research and Development (R&D) method and is made with PHP programming language and MySQL database. With this application, students are expected to be able to determine their own learning modality preferences, lecturers can utilize their student learning modality information to develop appropriate learning strategies and students can understand learning modalities according to their character, their learning abilities can increase and their learning outcomes are maximized.

2. Research Method

The research method applied in this research is the Research and Development method or it can be called the R&D method. [11] believes the R&D method is a research method to produce a certain product and
test how effective the product is when used. The R&D method has four stages namely introduction, development, validation and implementation in the order of preparation in Figure 1. [11].

![Figure 1. The stage of the R&D method](image)

2.1. Preliminary

Inaccurate target delivery of information between lecturer learning strategies and student learning modalities causes student learning outcomes to be less than optimal and results in students becoming bored and stressed during the teaching and learning process because of the unknown tendency and lack of understanding of learning modality by students as well as lecturers. The difference in the character of each student is very influential on the tendency of learning modalities. To find out the calculation of learning modality preferences, the spread of VARK questionnaires using paper media is less effective and efficient because it slows the data collection and calculation of data from questionnaires that are still manual.

Based on the review of the problem above, the authors conducted a study on the determination of learning modality preferences and made an application in determining the learning modality preferences according to the character of students with the objects of the Faculty of Communication and Information Technology students accompanied by an analysis of categorizing learning modalities along with features of calculating differences in trends based on study programs and sex. The research methodology used in this study is arranged in the diagram in Figure 2.

![Figure 2. Stages of research methodology](image)

This application contains 16 standard questions related to learning modalities in the form of VARK questionnaire Version 7.1 with four answer choices where respondents can choose more than one answer for each question. The standard questionnaire instrument was adopted from the vark-learn.com website. Example of the VARK questionnaire instrument Version 7.1 in Table 1 [6].

That way students are expected to be able to recognize their learning modalities through the application and be able to improve their learning abilities. In addition, lecturers can utilize the results of the determination of the learning modality of the application as a basis for designing more appropriate learning plans and can fairly evaluate each individual student.
Table 1. Example of the VARK questionnaire instrument Version 7.1

| No. | Question                                      | Answer                                                                 |
|-----|-----------------------------------------------|------------------------------------------------------------------------|
| 1.  | You will cook something for a special treat. You will do this by: | a. See ideas on the internet or in some cooking books from the pictures. |
|     |                                               | b. Ask a friend to input.                                              |
|     |                                               | c. Look at a cooking book where you know there is a good recipe.        |
|     |                                               | d. Cook something you know without the need for guidance                |

2.2. Development
At this stage, the data collection and analysis will be used in the system for the application of student learning modalities sourced from the study of book literature, theses, websites, and journals. The data used are VARK questionnaire data and descriptive analysis results from the distribution of VARK questionnaires to 100 students of the Faculty of Communication and Information UMS.

To determine the type of modality there are two categories, namely unimodal: if the difference between the points of tendency of the first and second learning modalities exceeds the specified tolerance limit; and multimodal: if the difference between the tendency points of the first and second learning modalities is smaller or equal to the specified tolerance limit [12]. The results of the questionnaire analysis are calculated manually based on the tolerance limits below. [13] suggests the tolerance limit of the difference in VARK questionnaire scores which is explained in Table 2.

Table 2. Tolerance limits on the difference in VARK questionnaire points

| No. | Points Difference Rules                                      |
|-----|--------------------------------------------------------------|
| 1.  | If the total points of respondent's answers are 16 to 21, then the tolerance limit of the difference in points for each maximum modality is 1. |
| 2.  | If the total points of respondent's answers are 22 to 27, then the tolerance limit of the difference in points for each maximum modality is 2. |
| 3.  | If the total points of the respondent's answers amount to 28 to 32, then the tolerance limit of the difference in points for each maximum modality is 3. |
| 4.  | If the total number of respondent's answer points is 29 and above, the tolerance limit of the difference in points for each maximum modality is 4. |

After the data collection and analysis are completed then at this stage the application of the modality of learning modality is determined using a MySQL database. This website-based application uses the PHP programming language to design the system interface to be more easily used by users.

Then the application that has been completed will enter the black box test phase where one by one checking the function of its features is carried out to determine whether there are still bugs/errors, if there are still errors then it is followed up with application improvements.

2.3. Validation
Validation of testing is needed to measure how high the level of trust in the application[14]. Validation is done by testing applications by 20 respondents, students of the Faculty of Communication and Information UMS. After testing the application is complete, then filling out the questionnaire by students of the Faculty of Communication and Information UMS to provide an assessment and suggestions on application performance and assessment of the overall appearance of the application.

2.4. Implementation
The final stage is the implementation, at this stage, the application approach is made to the wider community, especially its use in the world of education. The important thing in this stage is that
socializing also communicates applications that have been made by the writer either in the form of research seminars or journal publications [11].

3. Results and Discussions
This study produced a web-based application that assists students in determining the tendency of learning styles or learning modality is accompanied by the presentation of information learning solutions appropriate to the character of the students who analyzed through answers to questions in the application. In addition, the analysis of the results of categorizing student modalities in this application can help lecturers know the trend of student learning modalities, both male and female students, and with that lecturers can develop more appropriate learning strategies, this application also streamlines time in the use and distribution of questionnaires that were originally with paper media. The following are the results of this study.

3.1. User Interface
Main Page. The main page has a home menu, VARK profiles, and a login menu that can be seen in Figure 3. Log in menu only can be accessed by the admin, VARK profiles menu displays brief information about each learning modality, home menu is used to return to the main page of the application.

![Figure 3. The main page of the application](image)

Visitor registration form page

![Figure 4. Visitor registration form page](image)
The feature for visitor registration in Figure 4 will appear when clicking on the "start" button, visitors are required to fill in all identities on the form completely, after clicking "save" then visitors can open the question page.

3.1.1. The Question Page. The questions page in Figure 5 contains 16 standard VARK Versi 7.1 questionnaires. Visitors are required to fill at least 12 questions and visitors are free to choose more than one answer in the answer choices that exist on each question by means of checking the box selection. Once finished answering the question then click "Save" to begin the process of learning modality analysis in Figure 6.

**Figure 5. Questionnaire page**

**Figure 6. End of the questionnaire there is a 'Save' button**
3.1.2. Results Page. The results page displays analysis of visitors answer calculations, and the categorization of modalities is calculated in accordance with the tolerance limits of points difference that has been predetermined in the system, the results page in Figure 7 displays the complete biodata of visitors, points of each type of modality and the tendency of the type of learning modality. If the modality type button is clicked, visitors will enter the learning solution page.

3.1.3. Learning Solution Page. The learning solutions page in Figure 8 displays a description of how visitors with a predetermined learning modality can receive, store, and convey information properly. In addition, a learning strategy or learning solution that is appropriate for the owner of this type of modality is displayed. There is a "Go back" button to return to the results page.

3.1.4. Sort Diagram Page. This page is a menu contained in the admin page. Figure 9 presents the percentage diagram according to the color of the learning modality category, Figure 10 presents the percentage of total learning modality tendencies that can be categorized in two terms at once based on the study program and sex. The equation used to calculate the percentage of learning modalities tendency by sorting according to faculty is explained in Equation 1.

\[
\text{Percentage of learning modality types Y in study program Z with sex X (A\%)} = \frac{\text{Number of students with gender X and learning modality Y in study program Z}}{\text{The number of students with the type of gender X in the study program Z}} \times 100\%
\]
3.2. Blackbox Testing

Blackbox test has the main objective for the analysis of functional specifications of the software where the testers are able to define the conditions of the input the testers were able to define the input conditions and can test a functional specification program.

The results of the black-box test show every feature on learning modality preferences determinant application can run properly or there are errors described in Table 3.

Table 3. Blackbox test

| Input                | Testing Section       | Function                                      | Output                                      | Result |
|----------------------|-----------------------|-----------------------------------------------|---------------------------------------------|--------|
| Home Menu            | Home Button           | Enter the main page                           | Displays the main page of the application.  | valid  |
|                      | Start Button          | Enter the visitor registration form.          | Displays the visitor registration form.     | valid  |
| VARK Profiles Menu   | VARK Profiles         | Enter the VARK learning modality description page. | Displays a description of the VARK learning modality | valid  |
| Log In Menu          | Log In Button         | Enter the admin login page.                   | Displays the admin login page.              | valid  |
| Dashboard Menu       | Dashboard Button      | Enter the admin home page.                    | Displays the admin home page.               | valid  |
| Visitor Biodata Menu | Add Data Button       | Enter the form add visitor data.              | Display the form add visitor data.          | valid  |
|                      | Save Button           | Saving visitor data added.                    | Displays a table of results from added visitor data. | valid  |
| Data Modality Menu   | Add Data Button       | Enter the form add modality data.             | Display the form add modality data.         | valid  |
|                      | Save Button           | Saving modality data added.                   | Displays a table of results from added modality data. | valid  |
| Question Data Menu   | Add Data Button       | Enter the form add visitor data.              | Display the form add visitor data.          | valid  |
|                      | Save Button           | Saving question data added.                   | Displays a table of results from added question data. | valid  |
3.3. Validation
In the validation phase, carried out a comparative analysis through the percentage of learning modality preferences based on the study program and sex, from the results of the VARK questionnaire test using paper media with using application media. Student learning modality applications that are made are equipped with a sorting feature based on sex and study program in accordance with the predetermined point’s difference. The percentage ratio of the two media is shown in Table 4.

3.4. Test Application Acceptance Level By Prospective Users
After the black box test is complete, the respondent fills in the questionnaire. There were 20 respondents from the Faculty of Communication and Informatics. They first try this application to find out every feature that is presented. The calculation of the questionnaire answers percentage using Equation 2.

\[
\text{Percentage of Answer (X\%)} = \frac{\text{Total Score Question } X}{\text{Total Score Max}} \times 100\% \quad (2)
\]

Based on the above equation the maximum score of all respondents is 80, it can be seen the results of the application acceptance percentage rates by respondents in Table 5.

| Sex   | Paper Media | Application Media | Explanation |
|-------|-------------|-------------------|-------------|
|       | Informatics| Communications    | Informatics| Communications|
| Male  | VARK 36%   | A 32%             | VARK 36%   | A 32%     | valid |
| Female| VARK 40%   | A 36%             | VARK 40%   | A 36%     | valid |

| Table 5. Results of the percentage of application acceptance rates |
|---------------------------|-----------------|--------|--------|--------|
| CODE | Question | SA (4) | A (3) | D (2) | SD (1) | Score | Percentage |
|-----|---------|--------|--------|--------|--------|------|------------|
| Q 1 | Is the application determining the modality of learning preferences easy to understand and easy to use? Can the application determining the modality of learning preferences provide information about learning modalities? Is the application determining the modality of learning preferences can help you more quickly determine your learning modality? Is the application display determinant of learning modality preferences attractive? | 8 12 - - 68 | 85% |
Average Percentage of Answers 87%

Explanation:
SA = Strongly Agree
A = Agree
D = Disagree
SD = Strongly Disagree

After obtaining the total score and percentage of each question filled by the respondent then proceed to look for the average percentage. The average percentage obtained was 87% of respondents agreed that the application for determining modality preferences for learning was easy to understand and easy to use. Applications can provide information about learning modalities, help visitors more quickly and easily determine the modality of learning and have an attractive user interface. The graph of the application acceptance level by respondents based on the percentage calculations in table 5 is explained in Figure 11.

![Graph of application acceptance level](image)

**Figure 11.** Graph of application acceptance level

4. Conclusion
The application determinant of learning modality preferences that are made can determine the percentage of student learning modality tendencies in accordance with the rules of the different points specified. The application also can display the overall percentage of learning modality based on sex according to the study program in the Faculty of Communication and Informatics that is Informatics and Communication. From the questionnaire respondent’s results of the Faculty of Communication and Information Technology, Universitas Muhammadiyah Surakarta students, 87% of respondents agreed that the application of determining the student learning preferences modalities is easy to use, informative and can present the modality of learning, and its user interface is interesting.

References
[1] Guryay, B. (2016, April). The relationship between learning modalities and perceived self-regulation levels. *Procedia Social Behavior Sciences*, 232, 389 – 395. doi: 10.1016/j.sbspro.2016.10.054.

[2] Asiry, A.M. (2016). Learning styles of dental student. *The Saudi Journal for Dental Research*, 7, 13–17. http://dx.doi.org/10.1016/j.sjdr.2015.02.002.

[3] DePorter, B., & Hernacki, M. (1992). *Quantum learning: Membiasakan belajar nyaman dan menyenangkan* (Alwiyyah Abdurrahman, Penerjemah.). Bandung: Kaifa, h. 110.

[4] Sarabi, A., Jafari, M., Sadeghifar, J., Tofiqhi, S., Zaboli, R., Peyman, H., Salimi, M., & Shams, L. (2015). The relationship between learning style preference and sex, educational major and status in first year medical students: A survey study from Iran. *Iran Red Crescent Med Journal*, 17(1), 1-6. doi: 10.5812/rcmj.18250.
[5] Shah, J., & Gathoo, V. (2017). Learning styles and academic achievement of children with and without hearing impairment in primary inclusive classrooms in Mumbai. *Journal of Disability Management & Special Education*, 1(1), 1-9.

[6] Dobson, J.L. (2010). A comparison between learning style preferences and sex, status, and course performance. *Advances in Physiology Education*, 34, 197–204. doi:10.1152/adven.00078.2010.

[7] Wibowo, N. (2016). Upaya peningkatan keaktifan siswa melalui pembelajaran berdasarkan gaya belajar di sma negeri 1 saptosari. *Jurnal Electronics, Informatics, and Vocational Education (ELINVO)*, 1(2), 128-139.

[8] Vaseghi, R., Ramezani, A.F., Gholami, R. (2012). Language learning style preferences: a theoretical and empirical study. *Asian Social Science (AASS)*, 2(2), 441-45.

[9] Shetty, S. (2016). *Influence of sex in learning style preference in undergraduate medical students*. pada Proceedings of ASAR-IJIEEE International Conference, Mysore, India. ISBN: 978-93-86291-33-2. 1-2.

[10] Kurniawan, Y.I ., & Dwiyatmika, W. (2017). Aplikasi Diagnosa Retardasi Mental Pada Anak. *Prosiding Semnas Penguatan Individu di Era Revolusi Informasi*. ISBN: 978-602-361-068-6.

[11] Haryati, S. (2012, September 5). Research and development (R&D) sebagai salah satu model penelitian dalam bidang pendidikan. *Majalah Ilmiah Dinamika*. 37(1), 11-26.

[12] Pujasari, R.M.S. (2015). Perbedaan Preferensi Gaya Belajar Mahasiswa Antara Mahasiswa Kelas Reguler 1 dan Kelas Reguler 2 Fakultas Psikologi Universitas Mercubuana. Skripsi, Universitas Mercubuana.

[13] Widanengsih, S. (2011). Pengajaran Remidual Berdasarkan Gaya Belajar Siswa Pada Konsep Sistem Gerak Manusia. Skripsi, Universitas Pendidikan Indonesia.

[14] Kurniawan, Y. I., Soviana, E., & Yuliana, I. (2018, June). Merging Pearson Correlation and TAN-ELR algorithm in recommender system. In AIP Conference Proceedings (Vol. 1977, No. 1, p. 040028). AIP Publishing.