Designing Teachers' Observation Questionnaire based on Curry's Onion Model for Students' Learning Styles Detection

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Abstract: **Every student has his/her learning styles. Understanding students' learning styles is an important factor to improve both learning and teaching. Teachers need to identify students' learning styles to enable them to prepare materials that match their styles of learning. This paper discusses the development of a survey instrument that solicits information on teachers' observations of their students' preferences and behaviors in the classrooms to detect students' learning styles. The instrument solicits observation data from teachers using a survey questionnaire that is developed based on the four layers of Curry's Onion model. We argue that, in a state where clear detection of learners' styles is not available, teachers' observations in the classroom could offer significant contribution to detecting students' learning styles.**

Keywords – **Learning style, VARK model, Curry's onion model, Questionnaires.**

1. Introduction

Research in learning progressively advanced to detecting learning styles of learners for improved learning quality. Learning style has been defined in variety ways by different researchers in the field. Among others, Akkoyunlu & Soylu [1] defined it as the personal ability to receive information and to treat it with the environment. Jensen [2] defined it as the way a student thinks, understands, processes, and solves problems. Nowadays many researchers in

learning styles make great efforts to include adaptive features in learning systems [3, 4, 5]. Most of the research work is focused on learning styles detection to achieve learning adaptation. There are as many kinds of learning materials as there are teaching methods. For teaching, some teachers focus on discussion; some focus on lecture, and others on practical examples [6].

Learning style is considered very important in teaching and learning, as it has a strong impact on students' academic achievements and on the interaction between teachers and their students. Through detecting learning styles we can determine more suitable teaching strategies in the classroom [7]. Dunn et al. [8] raised a very important query: "How will I teach them if I do not know how they learn?" McCombs et al. [9] determined two important points to be considered in learning and teaching operations: learner's characteristics and practices in the teaching. They believe that students learn differently and appreciating their differences will help the instructors teach them better. The challenge is to produce an effective tool for teachers to suggest their students' learning styles. The question now is how does a student learn? We made a proposition that: "It depends on his/her ability and the compatibility of his/her learning styles and the teacher's teaching style". Studies have shown that learning occurs when the teaching style matches the students learning styles than when they are mismatched [10]. Few researchers offer ideas on what teachers think about their students' learning styles. Teachers' opinions could be exploited to detect students' learning styles to subsequently implement adequate teaching strategies. Accurate detection of students' learning styles could be used to design appropriate learning materials, examination's questions and other materials that demand effective delivery [11].

Fleming [12], the creator of the VARK model, summarizes the importance of knowing the learning style for both students and teachers and the effect of this knowledge on the understanding and learning. He proposes that self-knowledge is a start but how

does one get that self-knowledge? He suggests making inventories as a useful method to get this knowledge, but adds hints that detecting learning styles is not a set of scores on some inventory, or a set of alphabetic symbols, or paragraphs of descriptors with labels. A learning style is, rather, a description of a process or of preferences. Although the literature in the learning dimension is large, it offers little help in distinguishing teachers' observations in the classroom and the effectiveness of such observations on the nature of teaching and learning operations. Consequently, there is a need to look for a relation between the teacher's opinions and observations and detecting students' learning styles.

Nauert [13] says about a new way to decide about anyone, "there are aspects of personality that others know about us that we do not know ourselves and vice-versa". As part of this quest, we have developed a multi-agent system framework to detect a learner's learning styles that include important factors ignored by others researchers [14]. Figure 1. depicts the framework which consists of different social individuals that mingle with the learner (e.g., family, friends and teachers). The framework proposes to exploit the words used by learners that could provide additional resources of learner's information preferences and behaviors while using the Internet. Our framework offers the potential of taking into considerations the opinions of others about learners, to discover learners' personalities and characters by inventorying results as associated factors to detect learners' personality traits such as learning styles. These inventories exploit the relationships of the closest persons with the learners, who could be parents, friends, and teachers. We term such persons as the learners' *social surrounding factor*. In our work, we cover the social surrounding factor that relates to the learners and considers their opinions in our attempt to detect students' learning styles.
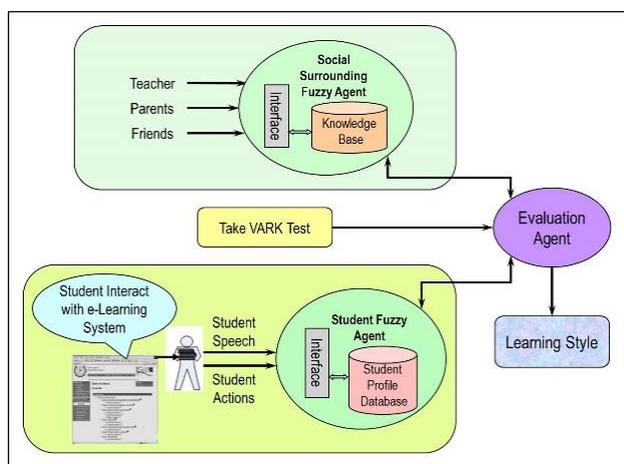

Figure 1.: Learning Style Detection Framework Proposed in [14].

As shown in Figure 1., our motivation to formulate an effective learning style detection system considers other resources such as the three social surrounding components (teachers, parents, and friends). We start by analyzing teacher's observations through a questionnaire developed via Curry's Onion model [15, 16, 17, 18]. In this paper, we focus on the teachers, their observations in the classroom and their perceptions about learners' attitudes and then present our approach to solicit teachers' opinions of their students. We consider teachers' observations of their students' preferences and behaviors as one of the information resources that could be exploited to detect learning styles. Thus we develop a questionnaire that requests teachers to provide data that relates to their students' learning styles. The idea comes from believing that teachers are important sources of information on their students' behaviors in the classrooms.

The rest of the paper is organized as follows. In Section 2, we present the review of current research in learning styles' detection that includes the VARK and Curry's Onion Models. Section 3 discusses the development of the teachers' observation questionnaire. Section 4 concludes the paper.

2. The VARK Model

The VARK model questionnaire developed by Fleming [19] is based on the Neuro-Linguistic Programming (NLP) concept. It is a test with 16 questions, the responses to which are used to classify learning styles as: Visual, Auditory, Read/Write and Kinesthetic. We outline below the kinds of each learning style based on VARK and the associated patterns for each dimension.

- **Visual [V]:** The first dimension of the VARK deals with the Visual mode. Learners with a visual learning style prefer to receive and give information through their eyes and like to learn information which is explained as charts, graphs and diagrams, using their imagination as a primary storage.
- **Auditory [A]:** The second dimension of the VARK is the auditory mode. Auditory learners prefer to learn by hearing carefully, receive spoken information, focus on discussion and enjoy listening. They can understand lecture without much effort and may read aloud to themselves. They often avoid eye contact with their teachers to focus on hearing.
- **Read/Write [R/W]:** This represents a preference for reading and writing information. But rather than just come up with big chunks of texts, learners learn best from discussion with teacher and friends. They can easily understand lectures and tutorials.

• **Kinesthetic [K]:** Learners of this category take information by using all senses, including sight, touch, smell, hearing and taste. They usually learn by doing things using their hands. They prefer learning by touching things and enjoy laboratory sessions and physical experiences.

Table 1. provides an abstract of the patterns per dimension.

Table 1: VARK Model Preferences

Styles	Semantic groups
Visual	Prefer picture, graphs and flowchart
Audio	Prefer Audio tapes, music, drama
Read/Write	Prefer Books, Texts, Reading, Essays
Kinesthetic	Prefer Real-Life Examples, Examples and Constructing, Working Models

2.1 VARK Multimodal and Questions

VARK model [11, 12, 19, 20] categorizes learners by their interaction mode preferences with others and their receiving and giving information. There is no student that has only one learning style, but there are one or two dominant styles, i.e. multimodal learners. About 60% of the population is multimodal. A learner tends to adapt his/her learning preference to from other learners around him/her and from the medium he/she is presented with. It is also possible for a learner's learning preferences to change according to his/her life experience. Figure 2. maps the possible multimodal characteristics of learners when each mode overlaps.
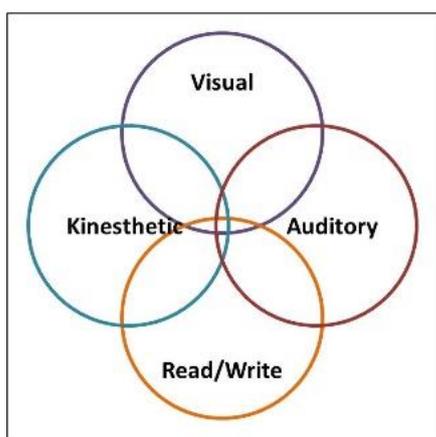

Figure 2.: The VARK Multimodal

2.2 Curry's Onion Model

Curry's Onion model has been developed to detect learning styles. Figure 3. explains the model that can be viewed as a framework for classifying learning styles. The four layers are represented by layers of an onion, hence the model's name.

• **Layer A:** Basic personality traits. This layer represents the cognitive processes and can be detected by special techniques.
• **Layer B:** Assimilating information. This layer describes the way a student assimilates and processes information.
• **Layer C:** Social interaction. This layer includes a student's interactions in the classroom, classifying the student as avoidant/participative, competitive/collaborative and dependent/independent learner depending on his/her behavior with his/her friends in the classroom and his/her teacher.
• **Layer D:** Preferred learning techniques/environment. This layer describes the preferences of a student for different learning techniques or environment such as small group or lectures.
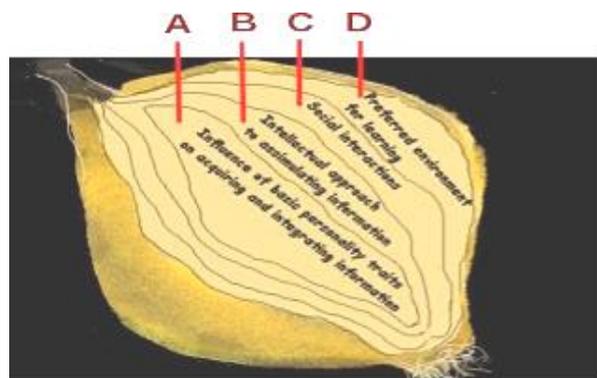

Figure 3.: Curry's Onion Model with the Four Layers of Differences in Learning Styles [21]

2.3 Related Work in Learning Styles Detection

Felder-Silverman Learning Style Model (FSLSM) is also a popular learning style model [22, 23, 24, 25]. In [24], Christou et al. collected data for all courses using the questionnaire of FSLSM and gather information about learner's examinations results and their favorite subjects. They found that the comparisons between students' learning styles and behaviors are important to predict their performance. On the other hand, Graf et al. [25] examined the relationship between the cognitive traits and learning styles. Darwesh et al. [22] produced an automatic system that detects learning styles based on analyzing learner's preferences in Web pages. In a similar manner, Vidal [23] created an automatic tool (social bookmarking service) that displays the attitude of learners when browsing a website. Both Dekson et al. [3] and Alghamdi [4] utilized VARK learning style model to detect learning styles of learners. In [4], Alghamdi integrated two models of

learning style; VARK and Honey & Mumford. VARK focuses on how students recognize the learning operation, while Honey & Mumford [26, 27] check the students' interest to learn a subject. Dekson [3] developed new system architecture utilizing the VARK model to detect and deliver appropriate materials to students depending on their learning needs. After a learner selects one of the topics in the system, the system detects the learner's preference and suggests appropriate materials to him/her. Botsios et al. [5], used the Kolb's [28] Learning Style Inventory to collect data about students. In their work, they developed a simple expert system application using Bayesian Networks.

Table 2. summarizes the related work associated with learning styles detection. The review shows that all proposed research consider learners' responses to a specific questionnaire and detects learning styles from the behaviors and actions of learners. One drawback of this approach is that student's survey and student's behaviors are limited to the student only without considering his/her social surrounding opinions in the detection method. Our work attempts to provide a different perspective in the context of learning style detection.

Table 2.: Related Work

Work Ref.	Learning Style Model	Source of Information
[3] Dekson, D.E., Suresh, E.S.M., 2011.	VARK	Learner's preference
[4] Alghamdi, A.A., 2010.	VARK and Honey & Mumford	Student's profile
[5] Botsios, S., Georgiou, D., & Safouris, N., 2008.	Kolb	Answer questions
[22] Darwesh *et al.*, 2011.	FSLS	Webpage of the learner
[23] Vidal, Jos´e M., 2011.	FSLS	Learner's favourite Webpages
[24] Christou, N., Dinov, I.D., 2010.	FSLS	Students' performance
[25] Sabine Graf , Kinshuk, 2010.	FSLS	Detecting patterns of behaviour

3. Teacher's Observation Questionnaire Development

Learners who are able to identify their own learning styles support them to use appropriate ways for studying [29]. On the other hand, teachers who possess knowledge about their students' learning styles help them to give supporting ideas in

explaining the learning materials. When there is a gap between teaching and learning styles, students may feel tired, ignorant, and score lower grades. As a reaction to these circumstances, teachers also tend to become negative and unhappy in teaching. For these reasons, teachers should have ideas about students' learning styles, and how to use multiple learning strategies [30].

Our overall approach of detecting teacher's opinion in discovering learner's learning styles uses a two-step method: (1) Conduct the Standard VARK learner's questionnaire and analyze the responses [14], and (2) Develop a teacher's questionnaire based on Curry's Onion Model, and analyze the responses. Figure 4. shows the main components of the proposed research framework. We use Curry's Onion model to create the teacher's observation questionnaire that offers an alternative source of learner's information. The evaluation of students' behaviors in the classroom motivates the teachers' awareness on their ability to observe their students' preferences and characteristics in learning. The VARK model is exploited for two main purposes: to examine learner's learning styles directly from the standard VARK questionnaire, and to compare them with the teacher's responses developed based on Curry's Onion model. The results of this comparison will eventually be used to determine the students' learning styles.
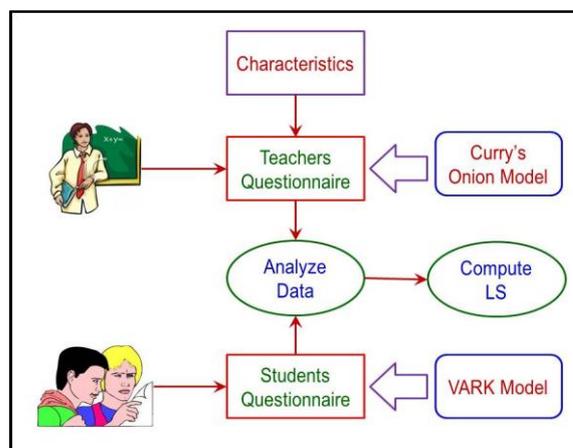

Figure 4.: Questionnaire Development within the Research Framework

The framework for computing the students learning styles is based on the following processes:

- **Information Resource Identification**: We identified two information resources: students' responses to the VARK model questionnaire, and teachers' observations.
- **Questionnaire Model Identification**: We have two kinds of questionnaire models: the standard VARK model questions, and the questions developed based on Curry's Onion model.

- **Data Collection**: Data collection involves identifying a group of students and their corresponding teachers. Students are required to attempt the VARK questionnaire, while the teachers are requested to attempt the Teachers Observation questionnaire.
- **Data Analysis:** Two sets of data obtained from the students' responses and the teachers' responses are compared and analysed. The output is then computed to produce the learning styles.

In the second process, we create eight questions, each two questions corresponds to one layer of Curry's Onion model. For each corresponding layer we determine the students' characteristics that match the layer's topic, as shown in Table 3.

Table 3.: The Proposed Questions Mapping to Curry's Onion Layers

Onion Layer	Question No.	Students' Characteristics
Basic Personality Trait	1, 2	Source of distraction, skills
Assimilating Information	3, 4	Explaining ideas
Social Interaction	5, 6	Behaviors during lecture
Preferred Learning Techniques	7, 8	Learning methods, Examination result

The questionnaire is created based on teachers' observations of learner's preferences and behaviors in the classroom. The first two questions are based on the first layer of the Onion model, i.e. the **Basic Personality Trait**. The first question focuses on the sources of disturbance on the learners while the second question focuses on some specification of the learners, e.g. his/her skills. The next two questions are developed based on the second Onion model's layer, **Processing Information**. We include two

queries about how learners explain their ideas and the learners' discernment. The fifth and the sixth questions are related to the third Onion model's layer, **Social Interactions**, for which we query about learners' social behaviors in lecture sessions. The last two questions are based on **Preferred Learning Techniques,** the fourth Onion model's layer that deal with the learner's learning preferences. These questions are derived from the learning methods that learners can understand better than others.

Based on such approach, we develop the eight questions for the Teachers Observation Questionnaire as shown in Table 4. The proposed questions offer a new dimension on the judgment of learners' styles. In a state where clear detection of learners' styles is not available, teachers' observations in the classroom could offer significant contribution to detecting learners' styles.

4. Conclusion and Future Work

This paper discusses the development of an instrument for detecting students' learning style via teachers' observation in classrooms. The instrument, which is a questionnaire, was developed using Curry's Onion model. We argue that such evaluation and assessment of teachers' and students' inventories as developed by our approach is a novel method to learning styles detection. As a means to validate the model, we will conduct a statistical analysis of the responses from both the standard VARK questionnaire and the teachers' observation questionnaire developed from this work. Our further studies would proceed in the direction of developing new instruments to solicit similar information from other learners' social surrounding (family and friends), and then compute the responses using a social surrounding fuzzy agent as presented in Figure 1.

Table 4: The Proposed Teacher's Observation Questionnaire based on the Curry's Onion Model

No.	Questions	Visual	Audio	Read/Write	Kinesthetic
1	He/She gets distracted easily if:	No visual guides or aids included in lecture.	No audio explanations.	Nothing written about the object.	No experiential and practical examples.
2	He/She	Likes colors and fashion	Reads slowly.	Have great handwriting	Does not have great handwriting.
3	He/She explains his/her ideas by:	Using flowcharts or diagrams.	Explaining and discussion about it.	Writing a paragraph and explaining it.	Representing the ideas as models.
4	He/She is: .	Good at spelling but forgets names.	Good at explaining.	Good at writing	Is not good at spelling
5	During lectures, he/she:	Focuses on the face of the lecturer and need to see the teacher's body language and facial expression to fully understand the content of a lesson.	Often avoids eye contacts with the teacher to concentrate.	Emphasizes text-based input and output and try to write some notes.	Is fidgety during lectures.
6	During lectures, he/she:	Prefers sitting at the front of the classroom to avoid visual obstructions.	Often benefit from reading texts aloud.	Follow each word displayed on the board.	Could not stay in the same place for long time.
7	He/She learns from:	Seeing information such as pictures, diagrams, graphs, flow charts and hierarchies.	Hearing the information spoken from lectures, group discussion and talking things through.	Extensive reading and writing the learned things in order to memorize it.	Demonstrations, simulations of "real" things, case studies, practice and applications, exploring the physical world around them.
8	He/She gets a high score in questions that focus on:	Diagrams.	Discussion about the subject.	Write explanations.	Practical representations.

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