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LEARNING STYLES BASED CHECKLIST FOR INSTRUCTIONAL MATERIAL FEATURES IN E-LEARNING

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Abstract

E-learning is a rapidly growing industry with a large number of users around the globe. The learning process of e-learning mainly depends on different learning techniques of instructional materials provided in the learning environment. Learning materials are the key component of comprehending information in an e-learning environment. Thus, it is vital to develop e-learning learning materials that are beneficial for the target learners. Different learners have different preferences in learning. Several learning style models have proposed over the years to define the different characteristics of different types of learners. This paper describes seven such learning style models and define learner characteristics focused on each of these models. Then the defined characteristics of each learner style in all seven learning style models are tabularized to emphasize the overlaps of learner characteristics focused in different learning style models. As the next step, a list of unique learner characteristics with reference to learning styles was defined using the information in the table with all learner characteristics. This paper also defines features available in e-learning materials. At present, MOOCs (Massive Open Online Course) can be defined as the key pillar of e-learning. Thus, several MOOCs provided by Coursera platform were analyzed to derive features of e-learning materials or e-learning environments. The identified unique learner characteristics of learning styles are then mapped with the list of features in learning materials in an e-learning environment. The final result of this research is a checklist which can be used by e-learning content developers to classify how the instructional materials are effective for the target learners. This checklist defines the satisfied learning styles of all seven learning style models by each identified feature of e-learning instructional materials. It can be used as a guideline for e-learning content developers to determine the features that has to be included in the learning materials to provide an effective learning environment for the target learners.

Keywords: e-learning, learning styles, learner characteristics, instructional materials, instructional materials checklist.

1 INTRODUCTION

Learners have different preferences, styles and characteristics in processing information. A learning material consisting features which are not preferred by a learner may cause that learner to demotivate in following the learning process. In addition, if a learning material is exclusively favoring the learning style of a learner, it might decrease creative thinking of the learner [10]. Over the years there are several learning style models proposed to categorize the preferred way of learning by variety of learners. A well-known categorization of learners is visual form and verbal form.

A comprehensive study on the importance of considering learning styles of e-learning learners is explained in [8] by Doulik, Skoda and Simonova. In this study, authors have further described the relationship of learning styles in traditional learning environment and e-learning environment. According to this study it concludes that there is a difference in preferences of learners in e-learning and traditional learning. It also states that there is a necessity for further research in e-learning learning styles.

Manochehr has conducted a study which concludes the significance of considering the learner's learning style in an e-learning environment [11]. In this study, author has tested the success of traditional leaners and those who have used e-learning by categorizing according to the types of learners defined in Kolb's learning style model. The results of this study concludes that the Assimilator and Converger type learners in Kolb's learning style model had better results in following e-learning materials. This study further claims that it is important to provide several learning opportunities to accommodate the learning requirements of each learner. It also states that a learning material with teaching approaches that matches with the learning style of learners will increase the learner satisfaction and achievements.

Learning styles are proposed as a model to define different ways of learning preferred by different individuals. There are several learning style models proposed over the years [15].

Literature on learning style models

Myers-Briggs Type Indicator

The Myers-Briggs Type Indicator is a learning style model which categorize learners by considering psychological aspects of the learners. Following are the categories of learners defined in this model [5].

- Extravert: Learns by trying out and cooperative learning.
- Introvert: Learns by thinking and individually applying what is learned.
- Sensor: Learns by focusing on procedures and facts.
- Intuitive: Learns by imagining and thinking of the meaning and possibilities.
- Thinker: Learns by considering about the facts, rules and logic.
- Feeler: Learns by considering humanistic and personal aspects.
- Judger: Learns by following an agenda or a plan and try to find closure without adding more information.
- Perceiver: Learns by adapting to changes and trying to add more data to what is learned.

According to this model a learner can be extravert or introvert, sensor or intuitive, thinker or feeler and, judger or perceiver.

Kolb's Learning Style Model

David Kolb has proposed Kolb's Learning Style Model to categorize the types of learning styles. According to this model, Kolb has defined four types of learning styles. Diverging is the type of learners who uses imagination and gather information. These types of learners are ideal for idea generation and they prefer to have group activities rather than individual activities. Assimilating type of learners prefer clear explanation and are more interested in logical theories. These types of learners need time to think and understand and they prefer to learn from lectures and reading. Converging learners are more interested to learn by finding solutions for practical problems. These learners learn by experimenting innovative ideas and practically working with what is learned. Accommodating learners prefer learning through hands-on experience. They are enticed to work according to a plan and accept new challenges [18].

Herrmann Brain Dominance Instrument

Herrmann Brain Dominance Instrument is a model that describes four thinking quadrants as modes of effective learning. These four modes can also be identified as four stages in learning. Initial mode is the external learning, where learning happens when following text books and lecture. The second mode is the internal learning which occurs when the learner thinks and intuitively understand. The third mode is interactive learning where the learning happens through discussions and practical experiments. The fourth mode is procedural learning where the learner practice and test what is taught [19].

Felder-Silverman Learning Style Model

Felder-Silverman Learning Style Model is another most widely used model which was developed by Richard Felder and Linda Silverman. It has eight learner types and four dimensions to categorize a learner. Following are the learner types defined in this model.

- Active: Learns by hands-on experience.
- Reflective: Learns by thinking and understanding.
- Sensing: Learns through clear facts and details. Prefers to follow a well-known procedure.
- Intuitive: Learns through abstract information and try to discover new possibilities.
- Visual: Prefers to learn using visual presentations such as pictures, graphs, animations etc.
- Verbal: Prefers to learn by listening and reading.
- Sequential: Learns step by step in an organized environment.
- Global: Prefers to learn randomly in a creative manner.

According to Felder-Silverman Learning Style Model the four dimensions are Processing which has Active or Reflective styles, Perception which has Sensing or Intuitive styles, presenting which has Visual or Verbal styles and Understanding which has Sequential or Global styles. These dimensions are defined by considering different scales in learning [30]. A learner is categorized into one type in each dimension. i.e. a learner can be Active or Reflective, Sensing or Intuitive, Visual or Verbal and Sequential or Global.

Honey Mumford Learning Style Model

Peter Honey and Alan Mumford developed the Honey Mumford Learning Styles Model, which defines four preferred styles of learners. Activist is the type of learners who prefers to learn by practically applying what is learned. They are more towards team work, problem solving and new experiences than listening to a lecture or reading. Reflectors prefer to listen and observe in learning. They are often thinking of the all possible situations and considered as thoughtful and cautious learners. Theorists prefer to learn from facts, models and concepts. They learn well in an organized environment and with a clear purpose. Pragmatist learners prefer to learn by trying out innovative ideas and practically trying what was learned. They are more attracted to content which has practical benefits with clear guideline on how to perform them [14].

4MAT's Learning Styles

4MAT's Learning Styles is another model that defines the types of learners. In this model there are four types of learners. First type is known as the learner who has a higher concern on feeling and reflecting. This type of learners prefers to learn through short explanations. They favor to learn through group activities. Learner who prefer to learn by thinking and reflecting is the second type in this model. These learners prefer to learn by lectures, reading, individual activities and discussions. The third type of learners prefer to learn by thinking and doing. They prefer to learn from demonstration and learn in a well structured environment. They prefer to have clear choices and restricted academic tasks. Those who prefer in acting and creating is the fourth type of learners in this model. This type of learners prefer independent learning environments and flexible knowledge areas [13].

VARK Learning Style Model

The VARK (Visual, Audio, Reading, Kinesthetic) learning style model is another famous way of categorizing learners which was developed by Neil Fleming [15]. According this model there are four learner types namely, Visual, Audio, Reading and Kinesthetic. According to the categorization of this model, Visual learners are the ones who prefer to learn through visual content such as symbols, graphics and videos. Audio type learners are those who prefer to learn through listening. Reading type learners are those who learn well by reading and writing. They prefer to have key areas listed down in point form for better understanding. Kinesthetic learners prefer to learn by practically experiencing [29].

2 METHODOLOGY

The Qualitative Research Methodology Content Analysis was used to extract learner characteristics presented in Table 1. It was also used to identify different types of the instructional materials found in several MOOCS, covering all knowledge areas provided in the Coursera environment. Content analysis is a research methodology that enables a researcher to systematically evaluate data which is usually in the form of textual format and make valid inferences by interpreting and coding the data [17]. Bengtsson, Erlington and Brysiewicz describe in detail how to make inferences from different sources of data using context analysis [9] , [4].

The learning styles considered in this research are the Myers-Briggs, Kolb's Model, Hermann Brain Dominance, Felder Silverman, Honey Mumford, VARK model and the 4MAT's learning models. The initial step of this study was to identify learner characteristics considered in each learning style of all learner models explained in the literature review (section 1). As the next step, identified learner characteristics were tabularized along with the learning style and learning style model. A learner characteristic was codified based on the description provided in the research papers for each learning style. Table 1 provides a summary of learner characteristics focused in learning styles of each learning models. It further demonstrates how majority of these characteristics are overlapped among different learning style models.

The following five steps were used in Table 1;

1. Select a learning style of a learning style model.

2. Identify learner characteristics which defines a learner of the selected learning style according to the literature in Section 2.

3.Check whether the identified learner characteristics are already available in the table.

4. If a learner characteristic is already available, then add the learning style along with the learner model and merge it with existing record that has the same learner characteristic.

5. If a learner characteristic is not available, then add a new record with learner model, learning style and new learner characteristic.

These five steps were carried out for each learning style in all seven learning style models.

3 RESULTS

3.1. Classifying unique learner characteristics

Table 1: Summary of learner characteristics focused in learning styles

Learning Style Model	Learning Style	Learner Characteristic
Myers-Briggs	Extravert	Learn by trying out (practically applying) the things.
Kolb's Model	Converging	
Kolb's Model	Accommodating	
Herrmann Brain Dominance	Interactive	
Felder - Silverman	Active	
Honey Mumford	Activist	
VARK Model	Kinesthetic	
Myers-Briggs	Extravert	Learn by cooperative learning. (via group discussions)
Kolb's Model	Diverging	
Herrmann Brain Dominance	Interactive	
Honey Mumford	Activist	
4MAT's	Feeling and reflecting	
Myers-Briggs	Introvert	Learn by individually applying what is learned.
4MAT's	Thinking and reflecting	
4MAT's	Acting and doing	
Myers-Briggs	Sensor	Learn by mainly focusing on procedures and facts.
Myers-Briggs	Intuitive	Learn by imagining and thinking of further possibilities and meaning.

Learning Style Model	Learning Style	Learner Characteristic
Kolb's Model	Diverging	
Herrmann Brain Dominance	Internal	
Felder - Silverman	Reflective	
Honey Mumford	Activist	
Myers-Briggs	Thinker	Learn by considering about facts, rules and logic.
Kolb's Model	Assimilating	
Felder - Silverman	Sensing	
Honey Mumford	Theorist	
Myers-Briggs	Feeler	Learn by considering humanistic and personal aspects.
Myers-Briggs	Judger	Learn by following an agenda. (Learn by following defined steps)
Kolb's Model	Accommodating	
Felder - Silverman	Sequential	
Honey Mumford	Pragmatist	
4MAT's	Thinking and doing	
Myers-Briggs	Judger	Learn by abstract information without going on to details.
Felder - Silverman	Intuitive	
4MAT's	Feeling and reflecting	
Myers-Briggs	Judger	Learn by adding closure.
Myers-Briggs	Perceiver	Learn by adapting changes.
Kolb's Model	Accommodating	
4MAT's	Acting and creating	
Myers-Briggs	Perceiver	Learn by adding more details.
4MAT's	Acting and creating	
Felder - Silverman	Sensing	
Felder - Silverman	Intuitive	Learn by discovering new possibilities.
4MAT's	Acting and creating	
Kolb's Model	Assimilating	Learn by taking time to think and understand.
Honey Mumford	Reflector	
Kolb's Model	Assimilating	Learn by reading.
Herrmann Brain Dominance	External	

Learning Style Model	Learning Style	Learner Characteristic
Felder - Silverman	Verbal	
4MAT's	Thinking and reflecting	
VARK Model	Reading	
Herrmann Brain Dominance	Procedural	Learn by testing the things learned.
Felder - Silverman	Visual	Learn by using visual presentations such as pictures, graphs, animations etc.
VARK Model	Visual	
Felder - Silverman	Verbal	Learn by listening.
Honey Mumford	Reflector	
VARK Model	Audio	
Felder - Silverman	Global	Learn by random learning environment.
4MAT's	Thinking and doing	Learns by demonstrations.

Final outcome of this step was a list of unique learner characteristics which were addressed in the seven learning style models found in the literature.

3.2. Mapping identified learner characteristics with features of e-learning materials

There are several methods to transfer knowledge to learners in an e-learning environment, and different types of learners are leveraged in different characteristics of these methods. Thus, developing an effective learning material aimed at multiple learners is a challenging task.

MOOC or Massive Open Online Courses are the key pillar of e-learning at present. Coursera is one of the most popular MOOC providers among online learners at present [6]. Online courses available in this platform are categorized into eleven categories (Data Science, Business, Computer Science, Personal Development, Information Technology, Language Learning, Health, Math and Logic, Social Sciences, Physical Science and Engineering, Arts and Humanities) [7]. As the next step of this research, different features of instructional materials were identified through a content analysis of randomly selected online courses (Machine Learning by Andrew Ng [1], Python Basics by Paul Resnick, Steve Oney and Jaclyn Cohen [16], Learning to Teach Online by Simon McIntyre and Dr Negin Mirriahi [22], Semiconductor Physics by Wounjhang Park [28], Positive Psychology by Dr. Barbara L. Fredrickson [3], Geopolitics of Europe by Sylvain Kahn, Thomas Raineau and Philippe Perchoc [23], Business Analytics Capstone by Wharton Teaching Staff [26], Leading Change in Health Informatics by Ashwini S. Davison, M.D [2], Market Analytics by Rajkumar Venkatesan [25], The Science of Well-Being by Laurie Santos [20], Internet Connection by Telethia Willis [27], Tricky English Grammar by Tamy Chapman, Brad Gilpin and Helen Nam [24], Discrete Mathematics by Dominik Scheder [21], Modern Art & Ideas by Lisa Mazzola [12]) covering all the categories in Cousera platform. Then these identified features of instructional materials were mapped with previously defined learner characteristics. Table 2 provides the result of this mapping.

Table 2: Mapping of learner characteristics and identified features of instructional materials in an e-learning environment.

	Learner Characteristic	Features of an e-learning Instructional Material or Learning environment
1	Learn by trying out (practically applying) the things.	Learning materials include quizzes and activities for learner to try out things.
2	Learn by cooperative learning. (via group discussions)	Learning environment provide facility to collaborate and learn via groups chats, forums etc.
3	Learn by individually applying what is learned.	Learning materials include quizzes and activities for learner to try out things. *(Same as 1)*
4	Learn by mainly focusing on procedures and facts.	Learning materials are organized as procedures and knowledge is represented as facts.
5	Learn by imagining and thinking of further possibilities and meaning.	Not applicable
6	Learn by considering about facts, rules and logic.	Learning materials are organized as procedures and knowledge is represented as facts. *(Same as 4)*
7	Learn by considering humanistic and personal aspects.	Not applicable
8	Learn by following an agenda. (Learn by following defined steps)	Learning environment provides a clear process of how the learning will happen.
9	Learn by abstract information without going on to details.	Learning materials does not include in detail information. Knowledge is represented in an abstract manner.
10	Learn by adding closure.	Learning materials provide a summary or conclusion of the knowledge at the end.
11	Learn by adapting changes.	Not applicable
12	Learn by adding more details.	Learning environment provides additional resources which will further enhance the knowledge of learner.
13	Learn by discovering new possibilities.	Learning environment provides additional resources which will further enhance the knowledge of learner. *(Same as 12)*
14	Learn by taking time to think and understand.	Learning environment provides self-paced learning.
15	Learn by reading.	Majority of the learning happens via reading materials.
16	Learn by testing the things learned.	Learning materials include quizzes and activities for learner to try out things. *(Same as 1)*
17	Learn by using visual presentations such as pictures, graphs, animations etc.	Majority of the learning happens via instructional videos and visual aids.

	Learner Characteristic	Features of an e-learning Instructional Material or Learning environment
18	Learn by listening.	Majority of the learning happens via audio materials.
19	Learn by random learning environment.	Not applicable
20	Learns by demonstrations.	Learning materials are enriched with demonstrations of the content.

4.3. Checklist of e-learning content features and target learner styles

The final outcome of this research is a check list (see Table 3), which describes how the features of e-learning materials satisfy different types of learners (learning styles) proposed in aforementioned learning style models. Outcomes of each step in the methodology section were integrated to develop this check list.

Chauhan and Goel has also conducted a study and proposed a checklist for features in instructional videos from learner's perspective [6]. In this study, authors have derived a feature list for instructional videos by analyzing courses in Cousera, Udacity and edX MOOC providers. The identified features in this study were specific for instructional videos and these features are mostly relating to the technical factors such as enabling full screen, option to on or off caption, change caption format, change video player etc. The checklist provided from this study has not considered learning styles of learners to classify the learner preferences.

The checklist proposed in this paper (see Table 3) has identified features of instructional materials or e-learning environment through an analysis of several courses in Coursera platform. Thus, the features identified in this checklist are not limited for instructional videos. In addition, the checklist given in this paper defines the learners who will be benefited by the instructional material features by considering the learning styles of seven standard learning style models.

The proposed checklist (see Table 3) is designed to assist e-learning content developers to evaluate the effectiveness of learning materials. An e-learning course typically contain different types of learning materials. These learning materials consist of different instructional features and some of these instructional features may not meet the preferred learning style of a learner. Classifying learner preferences of the audience of an e-learning course is usually a challenging task. Thus, developing a course with multiple instructional features that are preferred by different types of learners will help the content developers to attract variety of learners. The check list proposed in this study (see Table 3) can be used to evaluate the types of learning styles satisfied by a e-learning course.

In addition, this checklist can also be used by the course developers to determine whether the same content has to be delivered using different instructional features, for it to be more effective for majority of the learners.

This checklist is exceedingly beneficial if the content developers have an idea of preferences of their target audience. In such conditions, content developers can evaluate the effectiveness of their learning materials by considering the number of instructional features included which are preferred by the target learners.

In the checklist in Table 3, Myers-Briggs's intuitive and Felder-Silverman's reflective learning styles are not mapped with identified instructional material features, since these learning styles describe learner characteristics which are related to the personal aspects of the learner such as the ability of thinking and understanding.

In order to develop this checklist, unique features of instructional materials were selected and identified the learner characteristic(s) satisfied by the instructional material feature (see Table 2). Then, learning styles are mapped with the instructional material features by considering the learning styles of identified unique learner characteristics. This research has identified twelve unique features of e-learning instructional material and these are included as items of the check list (see Table 3).

Table 4: e-learning features and the target learning styles checklist

Features of an e-learning Instructional Material or Learning environment	Myers-Briggs								Kolb's				HBDI				Felder-Silverman								HMLS				4MAT's				VARK			
	Extravert	Introvert	Sensor	Intuitive	Thinker	Feeler	Judger	Perceiver	Diverging	Assimilating	Converging	Accommodating	External	Internal	Interactive	Procedural	Active	Reflective	Sensing	Intuitive	Visual	Verbal	Sequential	Global	Activist	Reflector	Theorist	Pragmatist	Feel and Reflect	Think and Reflect	Think and Do	Act and Create	Visual	Audio	Reading	Kinesthetic
Learning materials include quizzes and activities for learner to try out things.	X	X									X	X			X	X	X								X					X		X				X
Learning environment provide facility to collaborate and learn via groups chats, forums etc.	X								X						X										X				X							
Learning materials are organized as procedures and knowledge is represented as facts.			X		X					X									X								X								
Learning environment provides a clear process of how the learning will happen.							X					X											X						X							
Learning materials does not include in detail information. Knowledge is represented in an abstract manner.							X													X									X							
Learning materials provide a summary or conclusion of the knowledge at the end.							X																													
Learning environment provides additional resources which will further enhance the knowledge of learner.								X											X	X												X				
Learning environment provides self-paced learning.										X																X										
Majority of the learning happens via reading materials.										X			X									X								X					X	
Majority of the learning happens via instructional videos and visual aids.																					X											X				
Majority of the learning happens via audio materials.																						X				X							X			
Learning materials are enriched with demonstrations of the content.																															X					

4 CONCLUSIONS

Learning material in an e-learning environment plays an important role in learning process. Thus, it is important to provide appropriate materials for the target audience. Learners may prefer different approaches in learning, which makes the preparation of an effective learning material a challenging task. Final result of this study will provide a methodical approach to identify the type of learners who will be benefited from an instructional material or a learning environment by considering the features available in the instructional material or the learning environment. Instructional material developers can use this checklist to determine whether the instructional material or the learning environment is effective for majority of its target learners. This study was conducted by identifying features of instructional materials via analyzing courses available in Coursera platform. Results of this study can be further improved by identifying features of instructional materials in several other e-learning platforms. In addition, results of this study can be enhanced by validating the mapping of learner characteristics with instructional material features (see Table 2).

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