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Learning Styles and Multiple Intelligence how can implications related to multiple learning styles (Multiple intelligences) be identified in a classroom context with Multimedia BSc students?

Silvio Nocilla

March 2021

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Chapter 1 - Introduction

1.1 Background

Students learn in a variety of ways. Some prefer visual content such as photos, films, and diagrams, while others prefer audio content, written language, or physical activity.

"Jackson (2005) developed a hybrid model of personality and learning, known as the learning styles profiler (LSP) which was designed to span biological, socio-cognitive, and experiential research foci of personality and learning research. The hybrid model argues that functional and dysfunctional learning outcomes can be best understood in terms of how cognitions and experiences control, discipline, and re-express the biologically based scale of sensation-seeking."

(Jackson, et al., 2009)

This research study will approach a similar strategy using two models to combine students' learning patterns and learning styles: the Learning Connections Inventory (LCI) model questionnaire to determine students' learning patterns and the VARK model questionnaire to determine students' learning styles. The findings of this study will combine students' learning styles according to their learning patterns and the implications of teaching materials, instructional methods, and assessment methods.

1.2 VARK and Learning Connections Inventory (LCI)

Neil D. Fleming developed the VARK in 1987. A questionnaire of 16 questions is used in the VARK test to determine personal learning preferences. That denotes the person's preferred learning methods. The VARK model, which stands for Visual, Auditory, Read-write,

Kinesthetic, and Problem-solving is a learning style assessment that identifies a student's dominant learning modality. A learning style is a pattern in the way a person approaches and processes information. The four main learning styles are:

Visual Learners: These people learn best through reading or seeing
Auditory Learners: These people learn best by listening to things or getting verbal instructions. They know that they've learned something when they can repeat it back to you.
Tactile/Kinesthetic Learners: These learners need to be able to touch and manipulate what they're trying to learn about it to be able to remember it.
Individuals who have a strong visual, auditory, and tactile/kinesthetic learning style are called multiple modal learners because these traits all apply strongly for them.

The Learning Connection Inventory is a survey that can be used to identify a student's learning pattern. Dr. Christine Johnston of Rowan University and her research team were looking at the foundations of effective educational leadership in the early 1990s. Understanding how people build their leadership styles, however they realized that this only answered part of their query. The study team had to reassess leadership from a learning perspective after it became evident that how an individual learns is a significant component of leadership.

The Learning Connection Inventory is a free online questionnaire which assists to determine the best learning patterns which are best suited for students. The Let Me Learn (LML) Process

is a comprehensive method to teaching and learning that begins with the administration of the Learning Connections Inventory (LCI), a survey tool that evaluates individual learning styles.

1.3 Research Question

The following research questions have been identified to analyze the learning pattern and learning styles, instructional resources, teaching methods, and evaluation methodologies for BSc Multimedia Software Development (MSD) students.

How can implications related to multiple learning styles (Multiple intelligences) be identified in a classroom context with Multimedia BSc students?

1.4 Aim of the Study

This research study will investigate combining the LCI and VARK models to assess students' learning styles and how they learn. This study will also investigate the implications of teaching materials and resources, as well as assessment methods and teaching methods. Based on the research findings the researcher will provide teaching materials and resources, as well as assessment methods and teaching technique recommendations for different learning styles.

1.5 Objectives

- To identify students' learning patterns using the LCI questionnaire model.
- To Identify students learning style using VARK questionnaire model.
- Identify best teaching resources, teaching method and assessment method for different learning styles

Chapter 2 - Literature Review

Learning has long been acknowledged as a crucial human aspect that influences a student's ability to learn. Previous research has shown that considering students' learning styles can be quite beneficial. One of the lecturers' main responsibilities is to personalize learning content so that it suits the information and learning styles of the students.

Larsen-Freeman and Anderson (2011) state that *"teachers who recognize the multiple intelligences of their students acknowledge that students bring with them specific and unique strengths, which are not taken into consideration by many teachers in the classroom situations, and activities can be categorized and used in the classroom according to students' intelligence."* (Xu, 2020, p. 60)

A lecturer should assess each student's learning difficulties and adapt relevant learning content for them. *"Research have indicated the importance of taking personal preferences and learning habits into account (Hsu, Hwang, & Chang, 2010; Tseng, Chu, Hwang, & Tsai, 2008)"* (Yang, et al., 2012, p. 185)

Identifying students' learning styles and learning patterns is an important cause which prepares the lecturer to understand the model of learning preferred by students. A good planning that approaches adaptive learning creates a motivational learning environment due to better understanding on behalf of the students.

Filippidis & Tsoukalas, (2009) cited in Yang, et al, (2012, p. 186) posits that *"Learning styles have been recognized as being an important factor for better understanding the model of learning and the learning depositions/preferences of students"*

Sternberg & Grigorenko (1997) cited in Yang, et al (2012, p.187) have suggested that *"cognitive styles can be defined as cognition oriented, personality centered, or activity centered in order to deal with the interaction between cognitive and learning styles. moreover, learning style can be perceived as the activity-centered cognitive styles"*

Using two questionnaire models, the VARK model and the LCI, this research will aim to identify the personality cognition centered style and the activity centered cognitive style. The VARK will detect activity-centered cognitive styles, while the LCI will identify personality cognition centered styles.

Identifying students' learning styles avoids labeling students as lazy and uncooperative or told to be not trying hard enough. They may be trying their hardest but failing due to a learning difficulty to put their thoughts on paper. These are students that need to believe in themselves and build up self-confidence. Self-confidence is about believing in your own abilities. The lecturer has the role of discovering students' abilities and encouraging students to express their creativity.

Kolb & Kolb (2013, p. 29) quotes that *"A key aspect of meta-cognitive learning is a person's beliefs about themselves, particularly their views about their ability to learn. At the extreme, if a person does not believe that they can learn they won't."*

Distinguishing learning styles encourages students to work more autonomously, allowing them to customize their learning experiences to meet their specific needs increasing learning effectiveness. This is also supported by Kolb & Kolb, (2013, p. 32) stating that *"An understanding of one's unique learning preferences and capabilities, and the match between these and the demands of learning tasks, can increase learning effectiveness."*

The ability to match student preferences to teacher preferences is critical because will enable the student to reach his full potential. This can help the student get a better understanding of his chosen field of study, improve his exam grades, and ultimately achieve his educational objectives. Learners are not always aware of their learning preferences or how to optimize their learning based on these preferences. This may lead lecturers to teach their personal teaching techniques rather than techniques that are tailored to the students' learning styles.

According to Pashler et al. (2008) cited in Leach-López, et al (2019, p. 153) *"instructors need not match their instruction techniques to students' learning styles but match the instruction to the topic being taught (e.g., lectures, group discussion, and hands-on work)."*

A lecturer must be aware that "*An instructor's job is to make knowledge accessible to the students and to help students understand the material and what that material means."*

(Leach-López, et al., 2019, p. 134).

2.1 VARK

The acronym VARK stands for Visual, Aural, Read/write, and Kinesthetic. VARK focuses on a single preference out of a person's complex mix of preferences that make up their learning style. The VARK questions and their conclusions are concerned with how people want to receive information and how they prefer to communicate what they have learnt.

In a research study conducted by (Othman & Amiruddin, 2010, p. 656) defined VARK as follows:

*"**VISUAL** students like to use figures, pictures, and symbolic tools such as graph, flowcharts, hierarchies, models, and arrow which represent printed information. They also are able to explain a concept to others by drawing a figure or picture (Murphy et al. 2004).*

***AURAL** students discuss on answers or by listening to recording over the examination topics (Murphy et al. 2004). Students who learn with this mode are easily interrupted noise (Drago & Wagner 2004). **READ/WRITE** These students like to arrange lecture notes into sketch form, paraphrase classroom notes, and study multiple choice exam questions (Murphy et al. 2004). Besides that, according to Drago and Wagner (2004), these students are note takers.*

*Drago and Wagner (2004) describes the characteristics of predisposing **KINESTHETIC** students as those who emphasize more in experience in learning something and usually, they*

have high energy and prefer to apply touch, movement, and interaction to their environment Zhang (2002) believes that to observe effectiveness and students' acceptance to learning that applies in teaching and learning process depends on students' learning style."

2.2 Learning Connection Inventory (LCI)

While VARK focuses on a particular learning preference, the LCI identifies students' learning patterns providing lectures with the appropriate knowledge of the students' learning design allowing them to communicate to students their learning abilities.

Kolb & Kolb (2013, p. 69) cites, *"Gardner's approach that 'learning styles and multiple intelligence types are different and a learning style could be related to more than one intelligence area'."*

To support Gardner's argument about learning design that encompasses multiple intelligence and distinct learning styles, this research study will integrate LCI and VARK models to focus on learning styles as well as learning patterns.

Dahm & Harvey (2008, p. 3) define LCI learning patterns as follows:

- **Sequence** (organization, planning, order, structure)
- **Precision** (information, details, knowing for the sake of knowing)
- **Technical Reasoning** (hands-on learning, relevance, self-sufficiency)
- **Confluence** (risk, innovation, alternative views, freedom from rules)

The process of VARK and LCI combination yields the function of the Brain and the mind selecting learning patterns and operation of learning modalities.

The diagram below provides a clear vision of how the brain processes the learning modalities, in this case linked to the VARK model and the mind processes the learning patterns in this case linked to the LCI model.

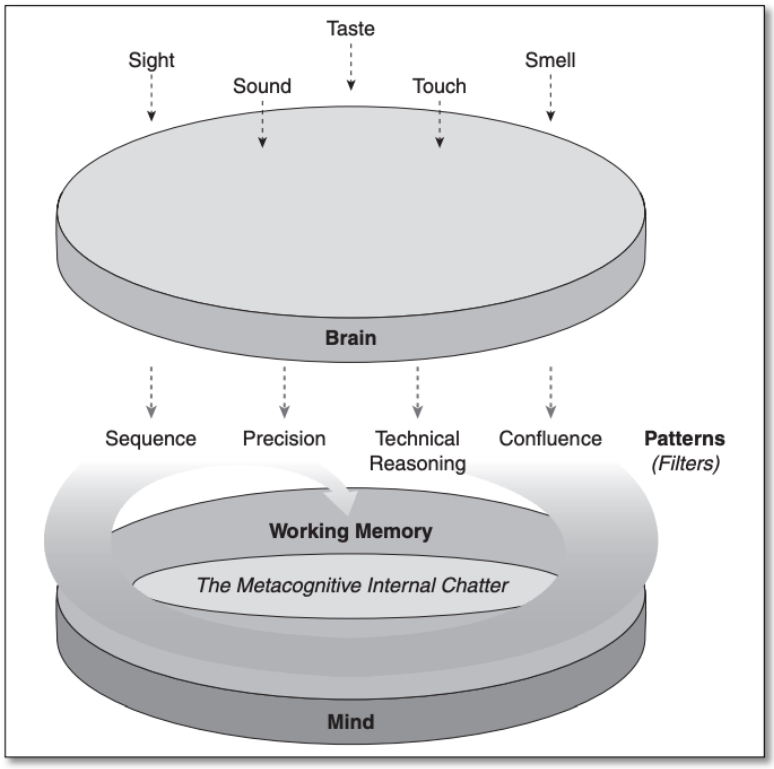


Figure 1: Representation of the Brain-Mind Connection
(Dawkins, et al., 2010)

The diagram above demonstrates clearly that the Brain processes the human senses which also determines the learning modality meaning if it is Visual, Auditory, Read/ write or kinetic. The mind process represents the learning pattern identifying if an individual learns in a sequential, precision, and technical or confluence pattern.

Many practitioners and academics have used these styles and categories to predict individual and group learning results across a variety of knowledge domains. However, few studies have adopted the combination of learning patterns and learning styles approach, focusing on the learner's role in maximizing knowledge acquisition and the available instruments for doing so.

This research study will approach the representation of the Brain - Mind connection to analyze students' modalities and students' learning patterns by applying the VARK and LCI model systems.

Despite the popularity of learning styles and inventories like the VARK and LCI, it's crucial to remember that there's no evidence that matching activities to one's learning style helps learning. In 2009, Psychological Science in the Public Interest commissioned cognitive psychologists Harold Pashler, Mark McDaniel, Doug Rohrer, and Robert Bjork cited in Chick (2010) posits that "*Although the literature on learning styles is enormous," they "found virtually no evidence" supporting the idea that "instruction is best provided in a format that matches the preference of the learner." Many of those studies suffered from weak research design, rendering them far from convincing. Others with an effective experimental design "found results that flatly contradict the popular" assumptions about learning styles (p. 105)*."

2.3 Outcome Expectations

The analytical expectations of this research study are intended to provide a category of learning patterns as well as learning styles for BSc Multimedia Software Development students. Since the unit taught is visual and at the same time technical it is expected that most students' learning patterns will be **Sequential** and or **Technical** after they have completed the LCI questionnaire, and that most students' learning styles will be Visual and Kinetic after they have completed the VARK questionnaire. As a result of the findings, the researcher will be able to look at multimodalities in terms of teaching resources, teaching methodologies, and assessment methods.

Chapter 3 – Research Methodology

3.1 Introduction

The purpose of this study is to investigate various learning patterns and modalities that students have, as well as the implications of developing appropriate modalities for diverse learning styles when it comes to teaching, resources, and assessment.

This study approached a quantitative research method involving first-year BSc Multimedia Software Development students (MSD). As a research instrument the LCI and VARK questionnaire models were used to gather the required data.

3.2 Aims and Objectives

The aims and objectives of this research study are to determine MSD students' learning styles and modalities, as well as to provide recommendations about teaching materials, assessment methodology, and teaching methods based on the findings of this study. As previously explained on page 4 (1.4 Aims of this study).

3.3 Research Philosophy

This research study can be described as a collection of data to examine a specific theme that identifies learning patterns and appropriate learning modalities. The techniques approached in this research study explores and identifies appropriate recommendations that lead to developing learning resources, teaching and assessments methods solutions reflecting students' learning styles and learning modalities. In this case two models LCI and VARK were applied to identify how most of the students learn and which modalities they prefer.

3.4 Validity and Reliability

Notwithstanding its popularity, no systematic attempt has been made to establish the validity of the VARK questionnaire's scores, however, the current study's findings support the use of the VARK by students and teachers as a low-stakes diagnostic tool.

Leite, et al (2010, p. 14) states that "*The preliminary evidence of validity of the VARK scores with respect to dimensionality and reliability found in the current study support the use of the VARK as a low-stakes diagnostic tool by students and teachers. Therefore, those who wish to use the instrument as a way of helping students identify their preferences should feel comfortable in this use."*

The University of Malta believes that all variations of the LCI, are reliable tools for use with children, adolescents, and adults.

"Malta is one of the countries among many others that have participated in the studies aimed at confirming the reliability and validity of this instrument over the years. Based upon studies completed to date and the theoretical base of consistent learning pattern operation, we believe that all forms of the LCI constitute instruments which are reliable for use with children, adolescents and adults."

(UOM, 2020)

The American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, (1999). Cited in Leite, et al (2010) argues that *"the validity of the scores of a learning styles instrument should be supported by multiple sources of evidence, such as test content, response processes, internal structure, relationships with other variables, and consequences of testing".*

In the case of this research study, two sources have been applied to support each other, the LCI model and the VARK model. Results have been combined using two separate variables

for the same context, to validate students learning requirements based on multiple resources to improve the reliability of this research study.

3.5 Research Limitations

Learning patterns and learning modalities, rarely provide learning theories that look at the varying complications associated with learning disabilities which add new dimensions to the learning theories. This study's findings may lead to solutions that are biased toward average students and therefore individual students with learning difficulties needs are not being met because there are limited possibilities for them. It should be emphasized, however, that 3% of the participants in this study have different abilities and provided answers for the VARK and LCI questionnaires, allowing this study to examine learning requirements accordingly. Another limitation of this research study was the limited sample size. As a result, these findings cannot be generalized to all the students.

3.6 Conceptual Framework

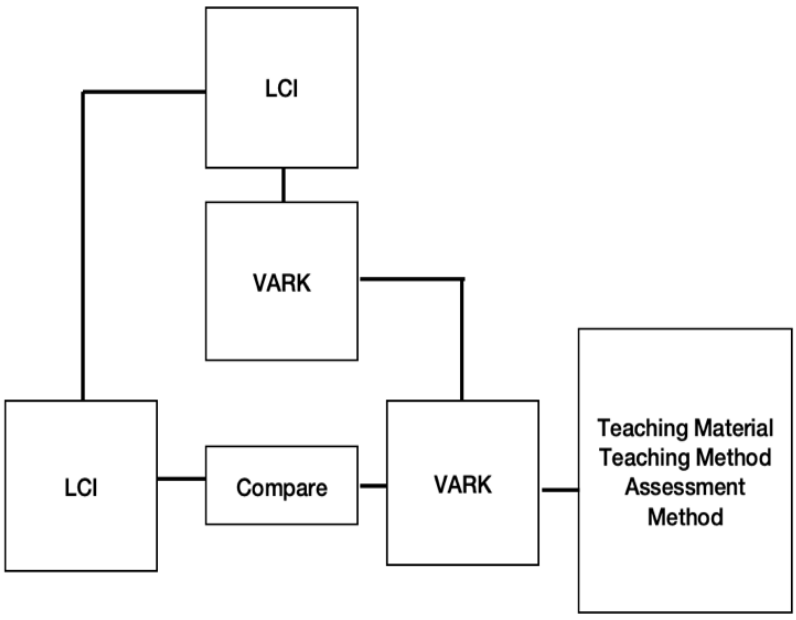


Figure 2: Conceptual Framework

The LCI questionnaire model was used to gather data about students' learning patterns investigating the following variables:

- Sequential learning pattern
- Precise learning pattern
- Technical learning pattern
- Confluence learning pattern

The VARK questionnaire model was used to gather data about students learning modalities, measuring the following variables:

- Visual modality
- Auditory modality
- Read/write modality
- Kinetic modality

Data from the LCI and VARK models were compared to determine the combination of learning patterns and learning modalities, and the data was analyzed to provide teaching resources, teaching techniques, and assessments recommendations.

3.7 Data Collection

Data was gathered via two questionnaires.

Questionnaire one - LCI model to gather data about students' learning style.

Sequential (Learner looks for order, planning & organization) - Precise (Learner looks for accuracy, detail & information) - Technical (Learner looks for problem solving, relevance & autonomy)

Confluence (Learner looks for ideas, uniqueness & expression)

Questionnaire two – VARK model to gather students learning modalities

Visual Modality - Auditory Modality - Read/Write Modality - Kinetic Modality

N=23 students were involved. Participants were first-year BSc MSD students with an average age of 18 years. The sample size has a male prevalence of 80%, 20% of females of

which 3% foreigners (English speaking) and 3% students with different abilities. Participants were purposely selected because the unit they are reading requires visual and logical skills; this will determine how students adjust to visual and logical thinking, as well as the challenges they face, based on their learning style and learning modalities.
Understanding students' diverse learning styles preferences and their impact in achieving academic success is becoming increasingly important in the educational sector. As a result, this research study applied VARK and LCI questionnaires to identify the learning styles and modalities preferences of first-year BSc MSD students. The students' preferences for the various VARK and LCI components, as well as their preferences for various teaching-learning approaches, are analyzed using descriptive statistics based on the VARK and LCI scores. The VARK and LCI scores are compared using the students' answers to the questionnaires.

3.8 Ethical Procedures

No names or other personal information were requested to safeguard the participants' privacy. The participant and institute director were explicitly informed about the research study and its aim. No data was revealed, and any data that was not used for the research was destroyed, to respect the privacy of information and personal details. This study did not include any religious or cultural research. The subject of this research study, "Students' learning styles and modalities" was the focus of the investigation.

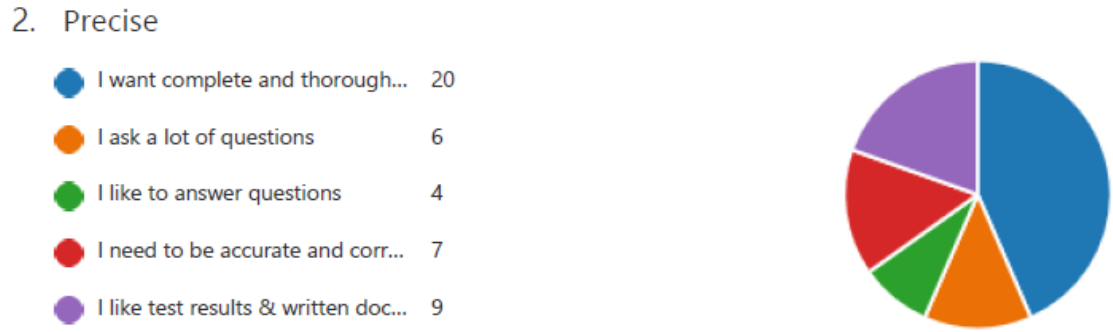
Chapter 4 - Discussion of Analysis

Following the completion of the VARK and LCI questionnaires, it was discovered that students learning style is balanced between sequential and technical learning patterns and a preference to visual modality. Even though students demonstrated a sequential/technical learning style approach. Data gathered demonstrates that students require a complete thorough explanation (Precise learning pattern), they want to figure out things how they work (Technical Learning pattern) and enjoy taking risks (Confluence learning pattern). The study demonstrates the relationship between students' distinct learning styles and their abilities to think chronologically, interpret and voice an opinion.

4.1 LCI Descriptive analysis

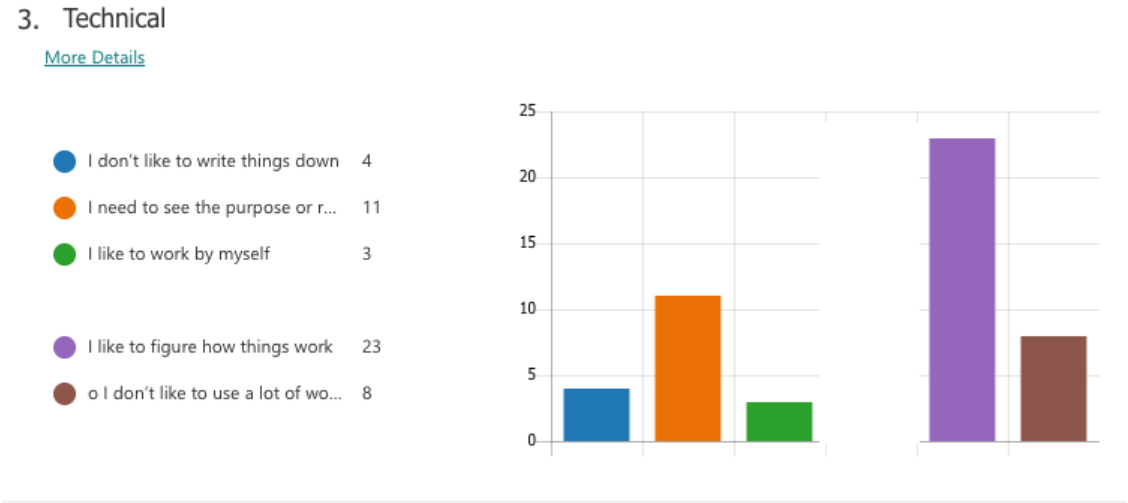
23% of the students want clear directions
23% need-step-by-step directions
17% want time to do their work neatly
17% dislike unplanned work
20% want to know if they are meeting expectations

The data revealed in the sequential pattern shows an equilibrium distribution. This indicates that students' learning patterns approaches a sequential learning style. This learning pattern necessitates a scaffolding design instruction based on a methodical and well-organized framework. This also indicates that students prefer to learn in a chronological and or thematic order. As supported by (Dahm & Harvey, 2008, p. 3) defining sequence learning pattern as organization, planning, order and structure.



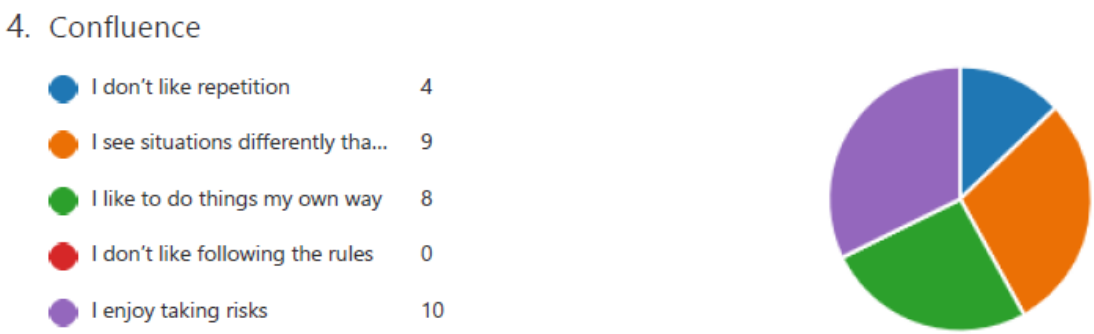
43% of the students want a complete thorough explanation
23% ask a lot of questions
9% like to answer questions
15% need to be accurate and correct
20% like test results and written documents

The results above demonstrates that when it comes to the Precise learning pattern the prevalence is that students want a complete thorough explanation of the lesson. The results above demonstrates that most students do not approach a precise learning style pattern; yet, students' demand for a complete and thorough explanation that complements the sequential learning pattern's methodical framework.



Learn (2020) defines technical students as students that are interested in problem-solving, dislikes writing out solutions, and prefers to learn via experience. The results above show another balance distribution when compared with the sequential results even though is less segmented. The response of the students 23/23 "*I like to figure how things work"* supports the definition provided by (Learn, 2020) stating that technical students are interested in problem-solving approach. At this stage research demonstrates that students are mainly sequential with a tendency to technical learning pattern preferring problem-solving exercises.

4 students don't Like to write things down
11 students need to see the purpose or relevance
3 students like to work on their own
23 students like to figure out how things work
8 students don't like to use a lot of words



13% of the students don't like repetitions
29% of the students see things differently than others
26% of the students like to do things on their own way
32% of the students enjoy taking risks

Learn (2020) posits that confluence students tend to avoid traditional methods and search out new ways to complete their assignments, often they start before hearing all the instructions. This learning pattern contrasts the Technical and Sequential style. Comparing the confluence outcome data to the Technical and Sequential data demonstrates that first-year MSD students prefer the Sequential and Technical learning patterns, however 32% of the students responded that they are willing to take risks. The element of taking risk can be related to the fact that students want to figure out how things work and take the risk to create something innovative with the risk of providing different assignment results.

Wucker (2021) argues that *"Some of the links between creativity and risk are pretty self-evident. Creativity is all about trying something new, exploring the unknown, and accepting uncertainty and the possibility of failure."*

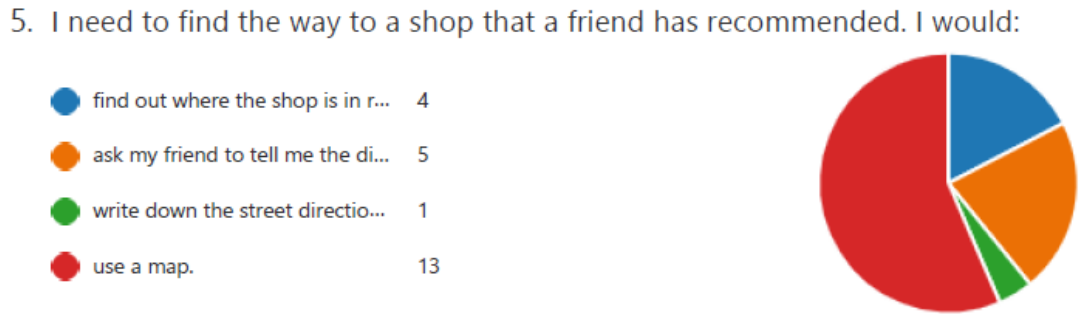
4.2 VARK Descriptive Analysis

The VARK model provides a scoring chart as a guideline to identify the learning modality of the student/s involved according to their responses (refer to appendices for scoring chart sheet). Following the scoring chart provided by the VARK model research demonstrates that students learning modality tends to be kinesthetic

Referring to literature review Drago and Wagner (2004) describes kinesthetic students characteristics *"as students who emphasize more in experience in learning something and usually, they have high energy and prefer to apply touch, movement, and interaction to their environment."*

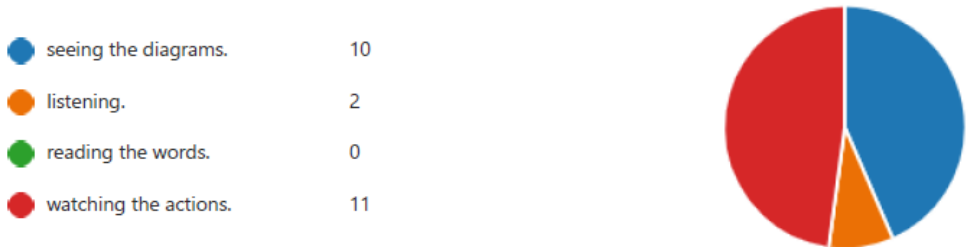
The results below are the overall responses of the students out of 16 questions related to four different learning modalities: Visual, Auditory, Read/Write and Kinesthetic.

Visual	4 /16
Auditory	3/16
Read/Write	0/16
Kinesthetic	9/16



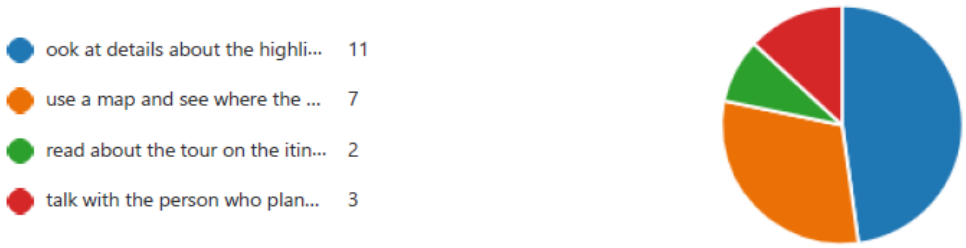
57% of the students responded that they prefer to use a map. According to the VARK model this answer represents Visual Modality.

6. A website has a video showing how to make a special graph or chart. There is a person speaking,
some lists and words describing what to do and some diagrams. I would learn most from:



48% of the students answered that they prefer watching actions. According to VARK model represents Kinesthetic modality, however, it is to be noted that 43% of the students also responded that they prefer seeing diagrams which represents the Visual Modality.

7. I want to find out more about a tour that I am going on. I would:

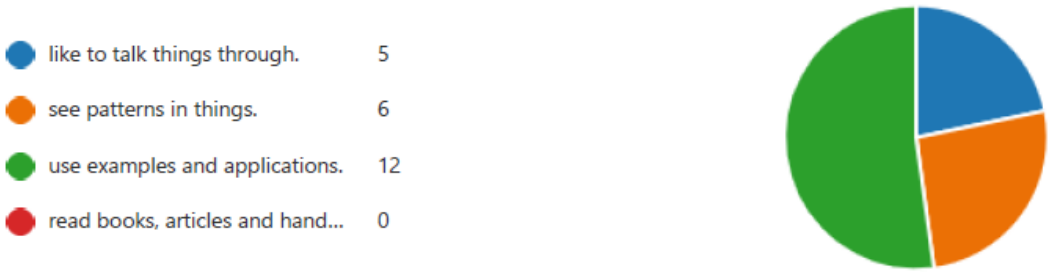


49% of the students preferred to answer, “look at details about the highlights and activities on the tour”. The answer to this question also reflects the Kinesthetic Modality of the students. It is to be noted that 30% of the students said they would "use a map to see where the places are," indicating that they would employ the Visual Modality.

8. When choosing a career or area of study, these are important for me:

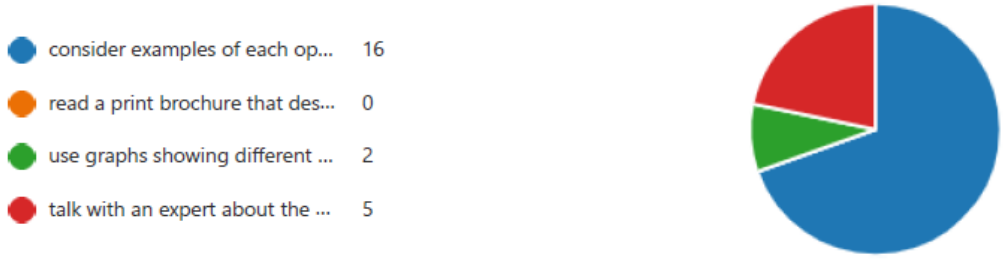
79% of the students stated that they prefer to use their knowledge in real-life circumstances. This response is also a Kinesthetic learning approach.

9. When I am learning I:



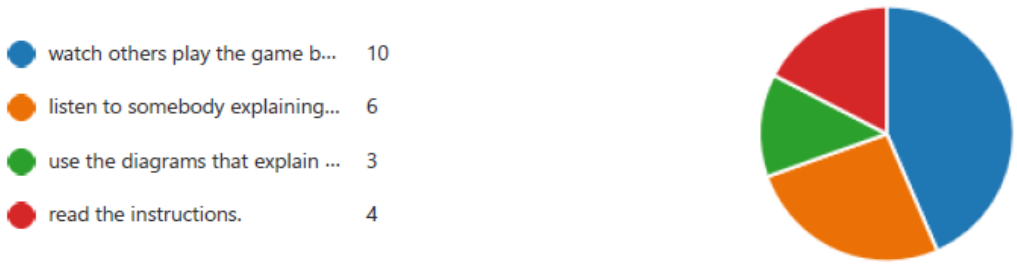
In this case 52% of the students answered that they prefer examples and applications. Once again this is a Kinesthetic learning modality.

10. I want to save more money and to decide between a range of options. I would:



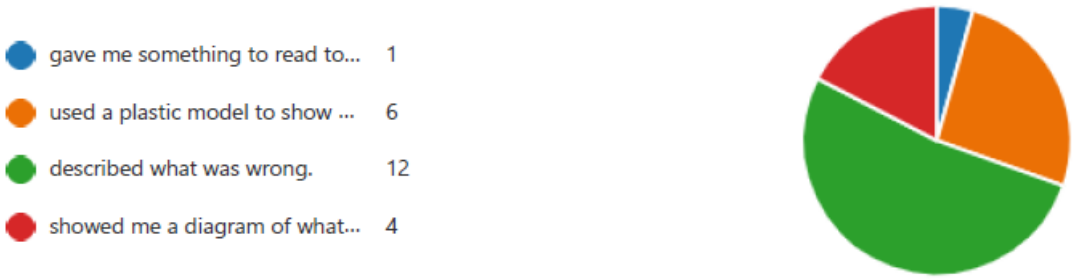
69 % of students prefer to think about scenarios based on their own financial data. Once again, a Kinesthetic learning approach is confirmed.

11. I want to learn how to play a new board game or card game. I would:



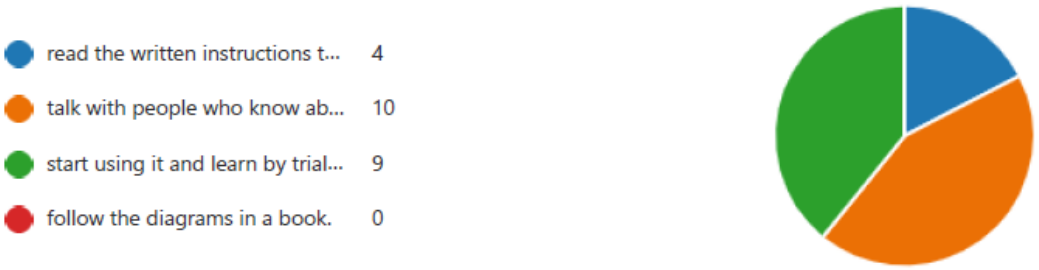
43% of students said they would rather observe others play the game before joining, while 26% said they would rather listen to someone explain the game and ask questions. Showing that 43 percent of the students learn by Kinesthetic Modality and 26% through Auditory Modality. Kinesthetic learning style still prevails, as seen by these findings.

12. I have a problem with my heart. I would prefer that the doctor:



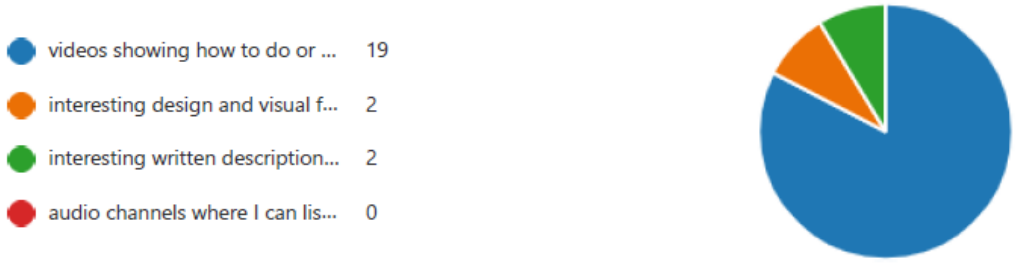
In this case students approach an Auditory approach. 52% of the students prefer a description of what was wrong.

13. I want to learn to do something new on a computer. I would:



The answer to this question is virtually evenly split, with 40% of students preferring to speak with persons who are familiar with the topic and 39% preferring to start using the computer and learn through trial and error. According to the VARK model, 40% of the students learn by Auditory Modality, whereas 39% learn through Kinesthetic Modality.

14. When learning from the Internet I like:

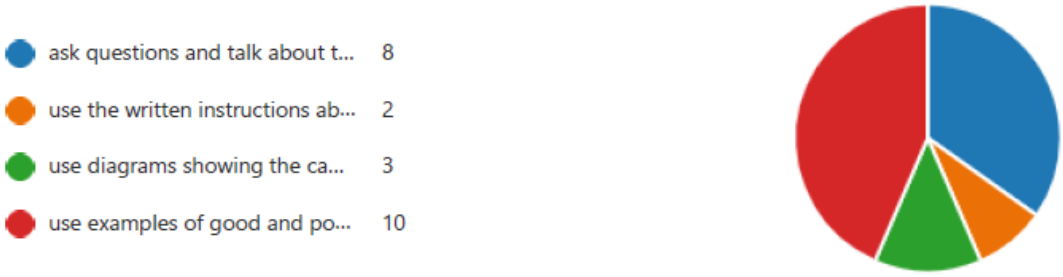


To understand how things are done, 83% of the students prefer to watch videos. This is interpreted as kinesthetic modality by the VARK model. This result demonstrates that most of the students prefer a Kinesthetic learning style.

15. I want to learn about a new project. I would ask for:

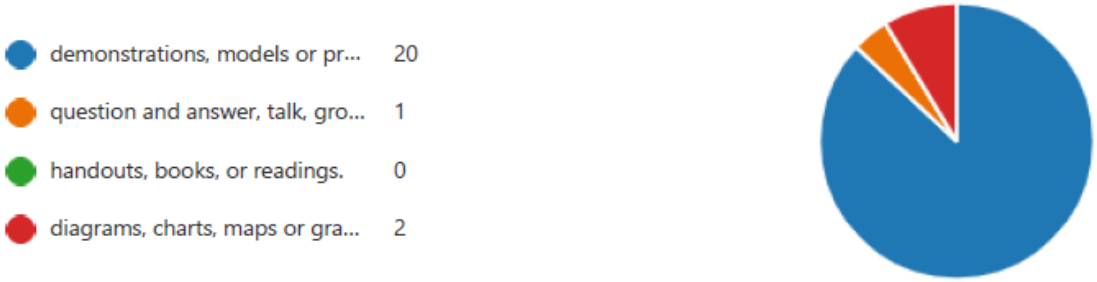
To show the stages of a project, 39% of students indicated they prefer to use diagrams and charts. This question has a well-balanced response. In this scenario, most of the students choose the Visual Modality, but 26% choose the Auditory Modality, stating that this could be an opportunity to debate the topic.

16. I want to learn how to take better photos. I would:



To improve their images, 48% of students prefer to use examples of good and bad photos. This is a Kinesthetic Modality, however 37% of the students would rather ask questions, talk about the camera, and discuss its characteristics, which is an Auditory Modality approach.

17. I prefer a presenter or a teacher who uses:

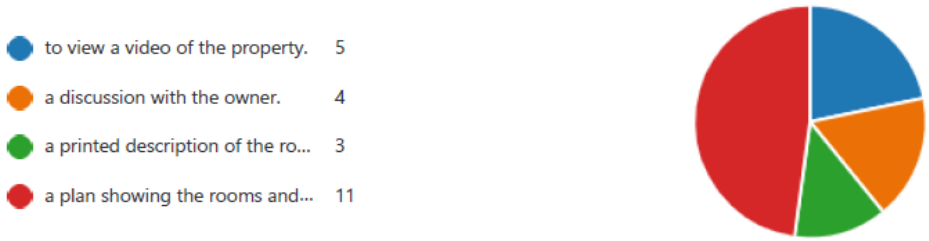


84 % of the students prefer demonstrations or hands-on activities. Most of the students prefer demonstrations and practical sessions; hence this is a Kinesthetic Modality approach.

18. I have finished a competition or test and I would like some feedback. I would like to have feedback:

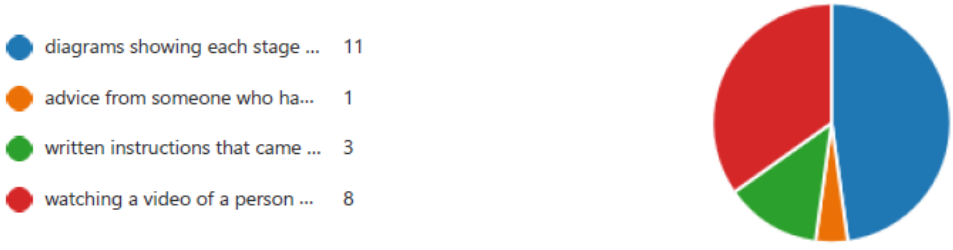
The Auditory Modality is represented by the answer to this question, with 52% of the students preferring that the feedback be discussed in detail by someone to them.

19. I want to find out about a house or an apartment. Before visiting it I would want:



In this scenario, 48% of students respond that they prefer to view a plan that depicts the rooms as well as a map of the area approaching a Visual Modality.

20. I want to assemble a wooden table that came in parts (kitset). I would learn best from:



48 % of students prefer to learn how to assemble a hardwood table by following a schematic that shows each step. This response shows that most of the students prefer Visual Modality.

The data analyses revealed that first-year BSc MSD students approach two different learning patterns, Sequential and Technical learning patterns with a slight preference to Sequential learning pattern. The preferred modality for MSD students is Kinesthetic modality following Visual Modality.

Kinesthetic characteristics are defined by (Drago & Wagner, 2004) as students who prefer to utilize touch, movement, and interaction, and visual modality characteristics are defined by Othman & Admiruddin (2010, p.656) students who like to use figures, drawings, graphs, and flowcharts.

Dawkins, et al (2010) diagram supports the findings of this research study. Dawkins, et al (2010) digram distinguish the functions of the Brain and the Mind, linking the Mind to learning patterns and the Brian to modalities. When learning patterns (LCI) and learning modalities (VARK) results are combined, the study finds that sequential learners prefer pictures, charts and diagrams(Visual), whereas technical learners prefer touch and interaction (Kinesthetic). The findings of this study confirm the theory of (Dawkins, et al., 2010), demonstrating that MSD students' learning patterns are Sequential and Technical, with Kinesthetic and Visual modalities being favoured.

Chapter 5 - Recommendations and Conclusion

This study has further shown the importance of learning styles and learning modalities. Identifying learning patterns and learning modalities leads to motivate students during their learning journey and to approach the correct method of teaching and evaluation.

This study verifies and supports (Dawkins, et al., 2010) hypothesis of separating mind and brain activity as it relates to learning styles and patterns, demonstrating the efficacy on students' motivation and stimulation to learn.

When a lecturer identifies and interprets the input of students' learning patterns and inputs of students' learning modalities, the lecturer may recognise and decode the problems students face, being able to balance and apply their learning style to overcome their learning difficulties. To be effective in any activity, a lecturer must first understand and be able to identify students' learning styles and patterns, as well as the methods he uses for teaching, the teaching materials he provides , and assessment methods applied. Furthermore, the data revealed that Visual-spatial, bodily-kinesthetic, and logical are the three types of learning styles that ranks first based on the outcome results of this research study.

The findings lead us to adopt a modular delivery strategy and a continuous assessment plan that provides students with visual and practical lessons that include visual, interactive, and practical materials. Students prefer problem-solving practical classes with frequent assignments and feedback to evaluate their learning.

Rushton, 2005 cited in Dejene (2019, p.4) posits that *"The practice of modularized curriculum in higher education institution: Active learning and continuous assessment combined with regular feedback, it will improve students' learning"*

Based on the outcomes of this research study and literature review it is recommended to apply the following strategy for students who have a sequential/technical learning pattern:

Teaching method: Delivering lessons through visual and practical examples, demonstrating to students how to solve problems in practical situations. During lessons, allow students to discover and solve problems (independent learning).

Resources: Learning by doing is almost always more effective for kinesthetic learners. Research revealed that for kinesthetic learners, projects, labs, note-taking, and other activities that allow participation and a hands-on approach are paramount. Students should have access to interactive activities and learning strategies that enhance their skills.
Research also revealed that sequential learners tend to approach visual modalities. Visual learners prefer to learn by seeing things. A visual learner's education toolkit should include pictures, diagrams, concept maps, symbolism, films, and other visual presentations, to name a few.

Assessment: it is recommended a continuous assessment planning including Time Constraint Assignments (TCA) not in a form of a test but to allow students to express their understanding.
Example:
Students are assigned the task of creating an interactive website as a home project. The TCA should be designed in such a way that students have the opportunity and ability to

demonstrate the work they have done at home. A TCA should not put students under any pressure, but rather enable them to write down their explanations and knowledge gained during the development of their project.

The continuous assessment must be divided into small modules or units that are independent, and typically short in duration or adapted according to the assignment requirements. This way students will accumulate grades for each module or unit and lead them to the the final grade of the assignment. This evaluation design enables lecturers to make changes to their teaching and learning in response to assessment. This also aids students in receiving feedback on their learning as well as guidelines on how to improve and instruct them how they can do to improve their situation.

Strategic diagram for sequential / technical students

It is to be noted that the strategic plan in figure 3 is currently in practice providing positive results.

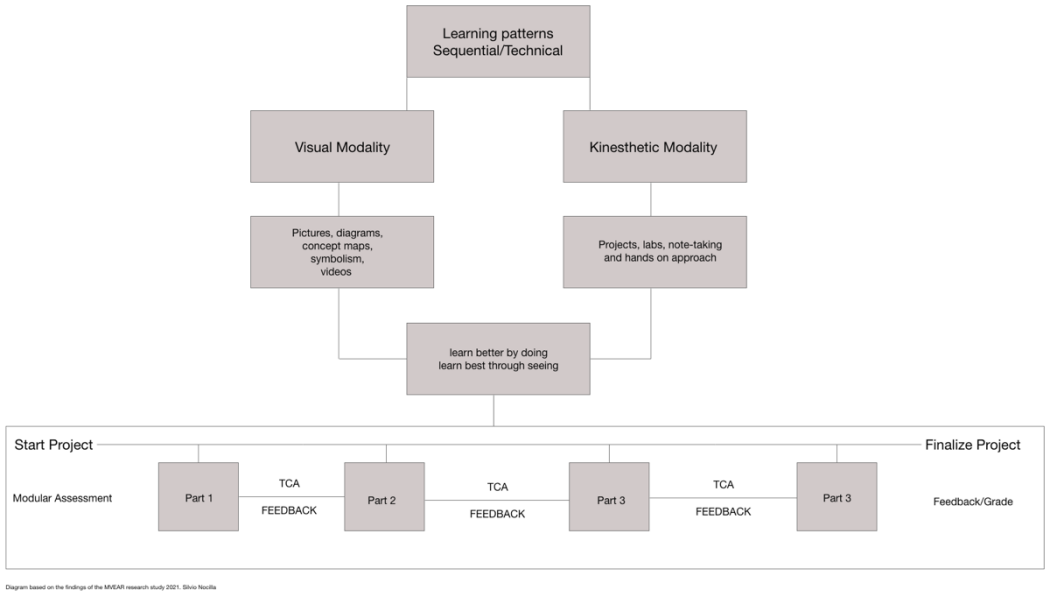


Figure 3 Strategic Plan

A lecturer's motivation to understand how his students learn and what type of delivery and resources they require to develop a positive relationship with them, create more conducive learning settings, and fulfill their developmental, emotional, and academic needs. It is suggested that lecturers focus not only on the professional delivery of the lesson, but also on how the lesson should be delivered in relation to the students in the classroom, including treating students with respect, having high expectations for all students, and maximizing success for each student. Positive teacher-student interactions increase student receptivity to instruction.

5.1 Conclusion

Knowing the learning styles of the students will help the lecturer to create and develop more effective teaching materials and assessment procedures. Learning styles can help students understand topics more quickly and readily if they are integrated into the course design. There are no right or incorrect methods to learn; rather, there are new ways to learn. It's critical to remember that everyone learns in their own unique way. Lecturers sometimes make the mistake of believing that their students learn at the same rate that they do, but this is not always the case. Research revealed that students that follow ICT design and development frequently require visual and kinesthetic learning methods. When it comes to supporting our students, we do not have to be concerned to try new things.

Learning is a complicated construct that is influenced by several elements, the most important of which is the interaction between lecturers and students during the teaching and learning process. Understanding how students learn and what factors influence their academic success is critical knowledge for class preparation and evaluation, as well as maximizing students' learning potential and outcomes. How successfully we blend our experiences, reflections,

conceptualizations, and planning to produce improvements determines our ability to constructively put students in a position to identify their abilities, skills and knowledge.

Identifying the proper form of teaching for our students can be a difficult task but knowing how to combine learning patterns and learning modalities can help us to reach teaching efficacy by providing appropriate pedagogy to our students. Studying learning preferences can provide us with a wealth of useful information. We may improve the effectiveness of our courses by focusing on numerous modalities and delivering training that caters to a variety of learning styles.

Gaining a better understanding of how our students learns and absorbs information will assist us help them be and achieve their best both inside and outside the classroom. Despite the fact that many students have a mix of learning styles, most of the students have a favorite technique of learning. While each learning method has advantages and disadvantages, we can see that there are numerous ways to learn and improve.

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Appendices

Multiple Intelligences Questionnaire

You are being invited to participate in a research study about learning styles and learning Modalities. This study is being conducted by *Silvio Nocilla* Lecturer at IICT MCAST.
The study is conducted as part of an undergraduate project, by
MCAST.
This survey is anonymous no names will be divulged and or published and after the reserach study is completed all data will be erased and destroyed. Your participation in this study is voluntary. You are free to decline to answer any
particular question you do not wish to answer for any reason.

* Required

* This form will record your name, please fill your name.

1. Sequential *

- [ ] I want clear directions
- [ ] I need step-by-step directions
- [ ] I want time to do my work neatly
- [ ] I dislike unplanned changes
- [ ] I want to know if I am meeting expectations

11/15/2021

2. Precise *

- [ ] I want complete and thorough explanations
- [ ] I ask a lot of questions
- [ ] I like to answer questions
- [ ] I need to be accurate and correct
- [ ] I like test results & written documents

3. Technical *

- [ ] I don't like to write things down
- [ ] I need to see the purpose or relevance
- [ ] I like to work by myself
- [ ] I like to figure how things work
- [ ] I like to figure how things work
- [ ] o I don't like to use a lot of words

4. Confluence *

- [ ] I don't like repetition
- [ ] I see situations differently than others
- [ ] I like to do things my own way
- [ ] I don't like following the rules
- [ ] I enjoy taking risks

5. I need to find the way to a shop that a friend has recommended. I would: *

- ◯ find out where the shop is in relation to somewhere I know.
- ◯ ask my friend to tell me the directions.
- ◯ write down the street directions I need to remember.
- ◯ use a map.

6. A website has a video showing how to make a special graph or chart. There is a person speaking,
some lists and words describing what to do and some diagrams. I would learn most from: *

- ◯ seeing the diagrams.
- ◯ listening.
- ◯ reading the words.
- ◯ watching the actions.

7. I want to find out more about a tour that I am going on. I would: *

- ◯ ook at details about the highlights and activities on the tour.
- ◯ use a map and see where the places are.
- ◯ read about the tour on the itinerary.
- ◯ talk with the person who planned the tour or others who are going on the tour.

8. When choosing a career or area of study, these are important for me: *

- ◯ Applying my knowledge in real situations.
- ◯ Communicating with others through discussion.
- ◯ Working with designs, maps or charts.
- ◯ Using words well in written communications.

9. When I am learning I: *

- ○ like to talk things through.
- ○ see patterns in things.
- ○ use examples and applications.
- ○ read books, articles and handouts.

10. I want to save more money and to decide between a range of options. I would: *

- ○ consider examples of each option using my financial information.
- ○ read a print brochure that describes the options in detail.
- ○ use graphs showing different options for different time periods.
- ○ talk with an expert about the options.

11. I want to learn how to play a new board game or card game. I would: *

- ○ watch others play the game before joining in.
- ○ listen to somebody explaining it and ask questions.
- ○ use the diagrams that explain the various stages, moves and strategies in the game.
- ○ read the instructions.

12. I have a problem with my heart. I would prefer that the doctor: *

- ○ gave me something to read to explain what was wrong.
- ○ used a plastic model to show me what was wrong.
- ○ described what was wrong.
- ○ showed me a diagram of what was wrong.

13. I want to learn to do something new on a computer. I would: *

- ◯ read the written instructions that came with the program.
- ◯ talk with people who know about the program.
- ◯ start using it and learn by trial and error.
- ◯ follow the diagrams in a book.

14. When learning from the Internet I like: *

- ◯ videos showing how to do or make things.
- ◯ interesting design and visual features.
- ◯ interesting written descriptions, lists and explanations.
- ◯ audio channels where I can listen to podcasts or interviews.

15. I want to learn about a new project. I would ask for: *

- ◯ diagrams to show the project stages with charts of benefits and costs.
- ◯ a written report describing the main features of the project.
- ◯ an opportunity to discuss the project.
- ◯ examples where the project has been used successfully.

16. I want to learn how to take better photos. I would: *

- ◯ ask questions and talk about the camera and its features.
- ◯ use the written instructions about what to do.
- ◯ use diagrams showing the camera and what each part does.
- ◯ use examples of good and poor photos showing how to improve them.

17. I prefer a presenter or a teacher who uses: *

- ◯ demonstrations, models or practical sessions.
- ◯ question and answer, talk, group discussion, or guest speakers.
- ◯ handouts, books, or readings.
- ◯ diagrams, charts, maps or graphs.

18. I have finished a competition or test and I would like some feedback. I would like to have feedback: *

- ◯ using examples from what I have done.
- ◯ using a written description of my results.
- ◯ from somebody who talks it through with me.
- ◯ using graphs showing what I achieved.

19. I want to find out about a house or an apartment. Before visiting it I would want: *

- ◯ to view a video of the property.
- ◯ a discussion with the owner.
- ◯ a printed description of the rooms and features.
- ◯ a plan showing the rooms and a map of the area.

20. I want to assemble a wooden table that came in parts (kitset). I would learn best from: *

- ◯ diagrams showing each stage of the assembly.
- ◯ advice from someone who has done it before.
- ◯ written instructions that came with the parts for the table.
- ◯ watching a video of a person assembling a similar table.

visual * aural * read/write * kinesthetic

VARK®

a guide to learning styles

The VARK Questionnaire – Scoring Chart

Use the following scoring chart to find the VARK category that each of your answers corresponds to. Circle the letters that correspond to your answers.

e.g. If you answered b and c for question 3, circle V and R in the question 3 row:

Question	a category	b category	c category	d category
3	K	V	R	A

Scoring Chart

Question	a category	b category	c category	d category
1	K	A	R	V
2	V	A	R	K
3	K	V	R	A
4	K	A	V	R
5	A	V	K	R
6	K	R	V	A
7	K	A	V	R
8	R	K	A	V
9	R	A	K	V
10	K	V	R	A
11	V	R	A	K
12	A	R	V	K
13	K	A	R	V
14	K	R	A	V
15	K	A	R	V
16	V	A	R	K

Calculating Your Scores

Count the number of each of the VARK letters you have circled to get your score for each category:

Total number of **V**s circled =	
Total number of **A**s circled =	
Total number of **R**s circled =	
Total number of **K**s circled =	

Fill in the questionnaire online at http://vark-learn.com/the-vark-questionnaire/ to find out your VARK learning preference.

This document must not be published on the Internet – instead please suggest people download the latest version from the vark-learn.com website.

 http://vark-learn.com

Figure 1.3 Sample Items From the LCI Form II