



**MASTERS OF SCIENCE IN TECHNICAL EDUCATION
(ELECTRICAL AND ELECTROINC ENGINEERING)**

**Learning Styles of Engineering Students: A Case of Islamic
University of Technology**

KASIITA TAWHEED

STUDENT NO: 181031205

MSC.TE (EEE)

Supervisor: **Prof. Dr. Md. Faruque A. Haolader**

Co-Supervisor: **Mr. Hamisi Ramadhan Mubarak**

DEPARTMENT OF TECHNICAL AND VOCATIONAL EDUCATION
ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
DHAKA-BANGLADESH

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**LEARNING STYLES OF ENGINEERING STUDENTS: A
CASE OF ISLAMIC UNIVERSITY OF TECHNOLOGY**

BY

KASITA TAWHEED
STUDENT NO: 181031205
MScTE (EEE)

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DEPARTMENT OF TECHNICAL AND VOCATIONAL EDUCATION
ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DHAKA-BANGLADESH

FEBRUARY, 2021

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The thesis titled **Learning Styles of Engineering Students: A Case of Islamic University of Technology** submitted by **Kasiita Tawheed** with student No. **181031205** has been found satisfactory and accepted as fulfillment of the requirement for the degree of **Master of Science in Technical Education (M.Sc.T.E.)** with specialization in **Electrical and Electronic Engineering** on 12th February 2021.

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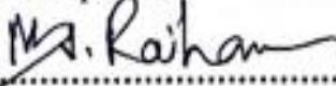
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TVE Department

Supervisor
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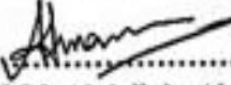
.....
Mr. Hamisi Ramadhan Mubarak
Lecturer,
TVE Department

Co-Supervisor
(Member)



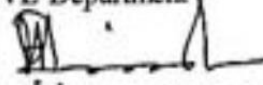
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(Ex-Officio)



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(Member)



.....
Dr. Mohammad Ali Zinnah
Professor, IER ,
Dhaka University

(External Examiner)

Declaration of the author

This is to testify that the work presented in this thesis is my original work. This thesis has neither been submitted nor previously been accepted for the award of any degree in the university or elsewhere. I also declare that the sources used in this thesis were explicitly acknowledged with proper citation and references.

.....

(Signature of the Supervisor)

Prof. Dr. Faruque A. Haolader

Supervisor and Professor

Department of Technical and Vocational
Education (TVE)

Islamic University of Technology (IUT)

Gazipur, Bangladesh

Date:

.....

(Signature of the Co-Supervisor)

Mr. Hamisi Ramadhan Mubarak

Co-Supervisor and Lecturer

Department of Technical and Vocational
Education (TVE)

Islamic University of Technology (IUT)

Gazipur, Bangladesh

Date:

.....

(Signature of the Candidate)

Kasiita Tawheed

181031205

Academic Year 2019

Date:

Dedication

This thesis is wholeheartedly dedicated to my beloved parents who have given me unconditional support throughout my entire life. Their endless love, support and encouragement played a big role in the success of this thesis.

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List of Abbreviation of Technical Symbols and Terms

IUT - Islamic University of Technology

CSE - Computer Science and Engineering

EEE - Electrical and electronic engineering

MPE - Mechanical and Production Engineering

CEE - Civil and Environmental Engineering

TVE - Technical and Vocational Education

VARC - Visual, Aural, Read/Write, Kinesthetic

SPSS - Statistical Product and Service Solutions

GPA - Grade Point Average

ILS - Index of Learning Styles

ANOVA - Analysis of variance

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Abstract

Islamic University of Technology (IUT), admits students from various countries with a diverse educational background. There has also been an effort to recruit female students in the university since 2016/17 whose number increases year by year. This has brought up a further challenge for teachers adopting to various teaching methods that will suit the different learning styles of these students. In addition, IUT offers both undergraduate and postgraduate programmes. Courses at these levels are often taught by same teachers. This diversity of the programme offers teachers a challenge with whether to deploy the same method of teaching in both undergraduate and postgraduate. Therefore, this study aims to enhance the effectiveness of teaching-learning through exploring different learning styles and how they differ among undergraduates and postgraduate engineering students at IUT. A quantitative research approach was employed in conducting the study. The researcher adopted and customized the VARK questionnaire which was administered to 340 students to determine their preferred modes of learning. After analysis of the obtained raw data from the participants, the unimodal learning style was found to be dominant over the multimodal learning style. Among the unimodal learning style, kinesthetic was the most preferred mode of learning. The findings also revealed that there was a difference in learning style preference according to gender. The percentage of the *kinesthetic* scores was much higher in males than in the females whereas in the multimodal learning style, the percentage of the *read/write-kinesthetic* score was much higher in females than in the males. There was no significant difference found between the learning styles of the undergraduate and postgraduate students of IUT.

Key words: *Learning styles, Engineering, undergraduate and postgraduate, IUT*

CHAPTER 1 INTRODUCTION

1.1 Background of the problem

The organization of Islamic cooperation over the years has invested a huge amount of money in its subsidiary Organ, Islamic University of Technology to improve the quality of education. Investing in education is of a great value to the students' future, and a great deal of focus is put on the curriculum and educational values to allow students meet the needs of the industry (JORGE et al., 2020). Students are believed to be academically able to grasp lessons and tasks given to them. Most of them are able to graduate, but the burden falls on academic requirements or teaching techniques for those who are not able to graduate (Shaaidi, 2015). The student's ways of acquiring knowledge and their learning styles are given less attention. Ideally, teachers should match their ways of teaching to students' ways of learning by adopting teaching techniques that suite the students' learning styles (Halif et al., 2020; Papadatou-Pastou et al., 2020).

Learning styles can be assessed in different ways, but the most popular approach is focused on ones' preference on the type of sensory modality to assess and make use of new knowledge in a particular learning environment. Fleming (2011) proposed four sensory modalities as visual, auditory, reading and kinesthetic (VARK), and his VARK questionnaire is used to assess the sensory modalities. Learning style plays a crucial role in the influence of diversity of student's academic performance. Therefore, learning style should often be used as a tool to guide educationist towards selection of better and appropriate teaching methods that will improve the quality of student's learning experiences (Asiry, 2016).

Many educationist have also developed a keen interest in exploring students' learning style in engineering education (Gaikwad, 2017). Unlike other educational domain, engineering education deals with teaching students the knowledge and fundamental principles that they will need in practicing engineering as a profession (Palmer et al., 2017). In addition, engineering education brings about an increase in technological and

educational innovations as well as improving the standards and diversity of engineering graduates preparing to join the technical workforce (Pleasants & Olson, 2019). Therefore, investing in engineering education may help in progressing the country's technological status.

Students in engineering have the task of gathering, organizing and thinking the various information provided by their teachers in relation to their fields of specialization. This forces students to develop different learning styles in order to be able to keep up with all the information provided to them. Learning styles differ from one student to another as each student has their own way of taking in new information (Berková et al., 2020). By exploring how students learn and style of learning approaches will guide educationist towards proper selection of teaching tool and appropriate learning materials for their learners.

1.2 Problem statement

In Islamic University of Technology (IUT), students are admitted from various countries with a diverse educational background. Recently, since 2016/ '17 there has also been an effort to recruit female students in the university whose number increases year by year. This has brought up a further challenge for teachers adopting to various teaching methods that will suit the different learning styles of these students.

Like any other higher educational institution, IUT offers both undergraduate and postgraduate programmes. Courses at these levels are often taught by same teachers. This diversity of the programme offers teachers a challenge with whether to deploy the same method of teaching in both undergraduate and postgraduate (Awang et al., 2017). To the best of the researcher's knowledge, literature investigating different learning styles among engineering students, particularly in Bangladesh is scarce. Furthermore, no studies have examined the correlation of gender and graduate level with learning styles in engineering context.

In this research, we investigated the learning styles among the undergraduate students of IUT and how they differ from those of the postgraduate students of IUT. We further

investigated whether gender has an impact on the learning styles of the engineering students.

1.3 Research objectives

Educational institutions have demonstrated a great interest in investigating student's learning styles over the years, as they recognize that students learn and understand things differently (Gaikwad, 2017; Palmer et al., 2017). As a result, this issue caught the attention of the researcher as an educator to know the student's most favored learning styles in IUT. Therefore aim of this study is to enhance the effectiveness of learning-teaching through exploring different learning styles and how they differ among undergraduates and postgraduate engineering students at IUT. To achieve this aim, the following specific objectives were constructed:

- i. To identify the most preferred learning style of the undergraduate students from the six departments of IUT.
- ii. To identify which learning style do the postgraduate students of IUT favor most.
- iii. To identify the most preferred learning styles of students of IUT with respect to gender.
- iv. To determine if there's a significant difference in learning styles between levels of education.

1.4 Research questions

Alternatively, the study will be guided by the following research questions :

1. What learning styles do undergraduate students of IUT prefer most?
2. What learning styles do IUT postgraduate students prefer most?
3. How do the learning styles of the male students in IUT differ from that of female students?
4. Is there any significant difference in the learning styles of the undergraduate and postgraduate students of IUT?

1.5 Hypotheses

Research question 3: *How do the learning styles of the male students in IUT differ from that of female students?*

- Ho: *There is no significant difference in the learning styles of IUT students with respect to gender.*
- **H_{a3}:** *There is a significant difference in the learning styles of IUT students with respect to gender.*

Research question 4: *Is there any significant difference in the learning styles of the undergraduate and postgraduate students of IUT?*

- Ho: *Student's level of education does not significantly influence their preferred style of learning.*
- **H_{a4}:** *Student's level of education significantly influences their preferred style of learning.*

1.6 Significance of the study

IUT has students from diverse background who come with various learning styles that they are familiar with. Its goal is to produce productive competent professionals that can compete in the professional life. To achieve that, a great emphasis is put on the academic excellence of its students. Butt (2020) in his research noted that to achieve great satisfaction in education, educators should empower their students to be familiar with their individual learning styles and in turn teach those students using the methods that match best with the student's individual learning styles. Therefore, by exploring how each student learns and their style of learning approach, will guide educationist towards selection of a proper teaching tools and appropriate learning materials for learners thereby enhancing their academic performance.

1.7 Limitations

The researcher concentrated only on the VARK Learning Styles Model that's made up of Visual, Aural, Read/Write and Kinesthetic sensory modalities instead of all the elementary

six models presented by Reid (1987). Therefore, all the research findings solely focused towards the VARK model. In addition, since the research was limited only to the engineering students of IUT, the findings may not be generalized to the entire engineering education sector of Bangladesh.

1.8 Conclusion

The background of the study, problem statement, research objectives and questions, hypotheses, significance and limitations of the study are discussed in this chapter. The importance of learning styles to the administrators and teachers is explained. The research will help the teachers select appropriate teaching techniques along with proper materials to suite to learning styles of students. This research would also support the administration as it will provide them with valuable knowledge to build a favorable learning atmosphere.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

The academic as well as administrative communities have taken a keen interest in learning styles and interests of students. Over the years, many educationists have also developed a keen interest in exploring students' learning style in engineering education (Gaikwad, 2017). This chapter discusses learning style definitions, models and previous literature related to this study.

2.2 Definitions of Learning Styles

Learning can be described as life-induced changes in behavior (Barron et al., 2015). Experiential learning theory defines learning as a process by which knowledge is generated by transforming experience (A. Y. Kolb & Kolb, 2017). Knowing the student's learning behavior can help facilitate the process of learning (Studies et al., 2020). The idea of learning styles has therefore become a common focal point in recent literature with several learning style theories developed to simplify the complex learning process (A. Y. Kolb & Kolb, 2017). Learning styles are the various specific ways a person absorbs, processes, understands and retains knowledge and skills (Ilçin et al., 2018). They have been defined in many ways over the past couple of years. Nja et al. (2019) describes learning styles as a student's specific technique of attaining new information so as to excel when it comes to undertakings that are in line with their individual preferences.

2.3 Learning style models

To assess individual variations in learning styles, a variety of techniques have been largely used with each technique providing a somewhat different view of expectations for learning styles. Some of the models of learning styles that can be used in assessing learning styles of students are discussed in this chapter. All of these learning styles are valid and very efficient in their own right. These learning styles may vary among students and teachers should also adopt teaching methodology that are in line with students learning styles.

2.3.1 Kolb's learning styles and experiential learning model.

This learning styles model was developed by psychologist David A. Kolb (2007). He claimed that each individual's learning style is as a result of their genetics, the experiences in their life and their current environment demands (D. A. Kolb, 2007). Kolb's learning styles incorporate four expressions for effective learning:

- **Reflective observation:** learners prefer observing and watching others to in turn establish surveillances of their own experiences.
- **Active experimentation:** making decisions and solving problems using theories is the major characteristic of the learners.
- **Concrete experience:** learners are made aware of new information through practical experience.
- **Abstract conceptualization:** involves constructing concepts or theories by learners in order for them to explain the observation.

2.3.2 VAK/VARK model

Neil Fleming's VARK questionnaire is one of the commonly used technique in determining these variations in learning styles (da Silva et al., 2020; Espinoza-Poves et al., 2019; Fatimah, 2018; Zhu et al., 2018). There are four sensory modalities that he describes i.e. Visual, Aural, Read/Write and Kinesthetic (Fleming, 2011).

- For the **visual** learners, they tend to use symbolic tools representing printed information as a means of learning new information. These tools could be flow charts, diagrams or models.
- The **auditory** learners on the other hand like content that's read to them and therefore learn more through seminars, tutorials, group discussions and even communication with themselves about the reading material.
- The **read/write** learners prefer acquiring new information through written words and texts. Such learners are inclined towards materials like lecture notes, text books and handouts.

- Finally, **kinesthetic** learning uses a combination of sensory functions, the learners need to live the experience to be able to learn from it.

2.3.3 Gregorc Mind Styles Model

This learning style model explains various learning styles based on how people receive and process new information. It consists of two ordering abilities; sequential and random and two perceptual attributes; abstract and concrete (Etikan & Babatope, 2019; Hawk & Shah, 2007). Gregorc further initiated combinations from the above characteristics that make up the four types of learning styles of this model (Hawk & Shah, 2007). They are as follows:

- **Concrete sequential:** These type of learners like logical presentations, systematic instructions, practical experiences and following directions. They prefer a structured setting or environment and pragmatically applying ideas. They find difficulty in group works, working in an unorganized setting and having to deal with abstract ideas,
- **Abstract sequential:** these learners like acquiring new information through reading assignments, lectures and listening to audio tapes. They also like applying logic and analysis when solving problems and prefer working alone at times or in environments that are stimulating. They find difficulty in expressing their personal emotions and having to work with individuals having different views as compared to theirs.
- **Concrete random:** these type of learners like addressing problems independently, finding solutions through experimenting and are found of taking risks since they work independently. They find it hard to keep detailed records, having to deal with restrictions and following routines.
- **Abstract random:** these learners in most cases are emotionally sensitive. They tend to keep friendly relationships with others. They also prefer not working in a restricted environment. In addition, they usually don't like competition.

2.3.4 Dunn and Dunn Learning Styles Inventory Model

Based on several years of research, professors Rita and Kenneth Dunn actively studied and developed this learning style model to improve student learning in New York that ended up being beneficial worldwide (Dunn, 1990). This model is structured and designed centered on the principle that students individually learn best in various ways. Therefore, recognizing the various ways in which each student learns best individually yield productive teaching and learning approach (Dunn et al., 2010). The model is based on the assumptions that;

- The individual preferences of students in acquiring knowledge can be identified.
- Modifying the teaching environment as well as using different teaching procedures to match the students' preferences is possible.

Several major principles have been distinguished by the model for administrators and teachers to follow committedly (Dunn, 1990):

- The educational environment, tools and methods respond to the strengths of diversified learning styles,
- Strengths vary from one person to another,
- Each instructor has their preferred way of instructing and it can be reliably measured,
- Majority of the people are capable of learning,
- Teachers can learn how to use learning styles as a foundation of their teaching,
- Students are likely to obtain statistically greater achievement and attitude test marks in matched as compared to mismatched management, provided an adequate environment, facilities and methods,
- When focusing on challenging academic content, plenty of students may learn to take advantage of the strengths of their learning style.

2.4 Other researchers' opinions on learning styles and their impact on education

There has been a rise in discussions about the relationship between the learning styles of students and the corresponding education they obtain particularly when it comes to the second language learners (Atika, 2020; Dantas & Cunha, 2020; Roohani et al., 2020). It was suggested that learning style awareness would be beneficial for both teachers and students, enabling teachers to tailor pedagogy to fit with student learning styles (Dantas & Cunha, 2020; Newble & Entwistle, 1986). Also when teaching a diverse group of students, the most effective approach is to build a course using various learning styles (Atika, 2020; Tanner & Allen, 2004). Through this approach, teachers are able to consider students' needs and in this way, students are able to learn more effectively.

Likewise, students that are aware of their learning styles may be encouraged to recognize and use the methods of learning better suited to their particular styles, thereby improving on their quality of education. Additionally, learning style also helps student to identify and choose the correct direction for their learning, carrier and educational goals (Antelm-Lanzat et al., 2020).

Students' preferred learning style is taken into account in mathematics and science education making the process of acquiring knowledge more affordable and efficient while also providing the teachers a chance to deliver skills and concepts to their students more effectively as compared to the traditional teaching style (Altun & Serin, 2019).

According to Nja (2019), students seem to struggle in obtaining sufficient academic grades due to the fact that they are unaware of their individual learning styles. Therefore, a focus on the student's learning styles would yield greater results. Through identifying the learning styles of students, the teaching process can be modified by implementing policies, methods and techniques according to the preferences of the students as well as using the required teaching tools (Studies et al., 2020). In the process of acquiring knowledge, the student's learning style is a significant factor since it's the way of obtaining new information and perceiving realism individually (Studies et al., 2020).

Therefore, awareness of learning styles can be beneficial in the process of acquiring new information.

Educators use learning styles to better understand a student's preferred method of acquiring information, their comprehending skills and motivation so as to enhance the academic performance of that very student (Wege & Keil, 2020).

Butt (2020) in his research noted that to achieve great satisfaction in education, educators should empower their students to be familiar with their individual learning styles and in turn teach those students using the methods that match best with the student's individual learning styles.

2.5 Learning styles in engineering education programs

In engineering programs, teachers have begun to have a greater interest in the learning styles of students so as to enhance the success of the students, and also guide these teachers in discovering the best methods of instruction (Jamila, 2021). Jamali and Mohamad (2017) stated that engineering students have different learning styles and that a mismatch in their learning styles usually brings about poor performance in class. They recommended that providing learning materials and resources basing the students' preferred ways of learning will have a positive impact on the teaching and learning process.

According to a study in Saudi Arabia (2013) inspecting the gender differences in learning styles and academic performance of medical students, multimodal was the dominant learning style preference of the students (Nuzhat et al., 2013). Also compared with unimodal learners, multimodal learners had higher cumulative GPAs. Kinesthetic and Aural preferences prevailed for males and females among students who favored unimodal preference. In addition, female students had more diverse preferences compared to the male students (Nuzhat et al., 2013).

In the Universiti Tun Hussein Onn Malaysia, a study on identifying learning styles among Engineering students was conducted using a survey questionnaire by Felder and Silverman (1988) based on the Index of Learning Styles (ILS) and it scaled learners basing on four dimensions with each dimension having two sub-scales; process (active-

reflective), understanding (sequential-global), input (visual-verbal) and perceive (sensing-intuitive) (Jamali & Mohamad, 2017). The data obtained revealed that 54.54% were sensing learners and 45.45%, reflective learners in the perceive dimension; 57.11% of the participants were active learners, while 42.86% were reflective learners in the process dimension; 52.96% were sequential learners and 47.03%, global learners in the understanding dimension and 76.87% were visual learners and 23.12%, verbal learners in the input dimension (Jamali & Mohamad, 2017).

A distinct study that utilized the VARK questionnaire on Iranian undergraduate students concluded that 36.6% of the engineering students within the sample used favored read/write as their learning style, and 26.6% recognized aural as their favored learning style, 20% were visual and 18.3% kinesthetic (Moayyeri, 2015).

In a descriptive-analytical cross-sectional study conducted at the Zahedan University of Medical Sciences on all the dentistry students, results after being analyzed using the ANOVA and chi-square test with a significant value less than 0.5 showed that 82% of the students were unimodal learners (Honarmand et al., 2020). The aural style of learning was dominant with a frequency of 43.32%. Aural-read/write was the most preferred method with a frequency of 6.8% when it came to the multimodal styles (Honarmand et al., 2020). In addition, there was no significant relationship between the variables being tested and the learning styles ($p \geq 0.05$).

2.6 Conclusion

Looking at the available literature on learning styles in engineering education, there are not studies that have examined different learning styles between undergraduates and postgraduates through the engineering students' lens. Most importantly, the context of the previous studied were based in Europe and Middle East, which may not necessarily be generalized and adopted in engineering education of Asian sub-continent. Asian Sub-continent has a different educational system and teaching methodology that have a unique cultural aspect. Therefore, in this study, the researcher examined the correlation between the learning styles of undergraduates and postgraduate programmes in engineering. We also identified different learning style as adopted by IUT engineering students.

CHAPTER 3 METHODOLOGY

3.1 Introduction

Knowledge on student's learning styles is particularly very useful to the administrators and teachers. From this knowledge, teachers can be able to select appropriate teaching techniques along with proper learning materials to suite the learning styles of students (Atika, 2020). Student's learning styles awareness will also be beneficial to the administration as it will provide them with valuable knowledge to build a favorable learning atmosphere (Antelm-Lanzat et al., 2020). Therefore, in this study, we attempt to answer the research questions listed in chapter one. This chapter discusses the research design consisting of the sample size, population, the instrument used to collect data, procedures of data collection and data analysis.

3.2 Research design

A quantitative research approach was employed in conducting the study and a representation of its research design is shown in the Figure 3.1. The population box briefly talks about the target population which in this case is the students of IUT in Bangladesh. The sample and sampling technique box presents the sample size and the technique of sampling used to select the sample size. The students were selected from all the six departments of the university. The instrument box elaborates the use of a particular questionnaire to collect data from the target population. In the data collection procedure box, the researcher briefly shows that the data was collected remotely with the help of Google forms in a specific period of time. Finally, the data analysis box shows the use of SPSS to analyze the collected data.

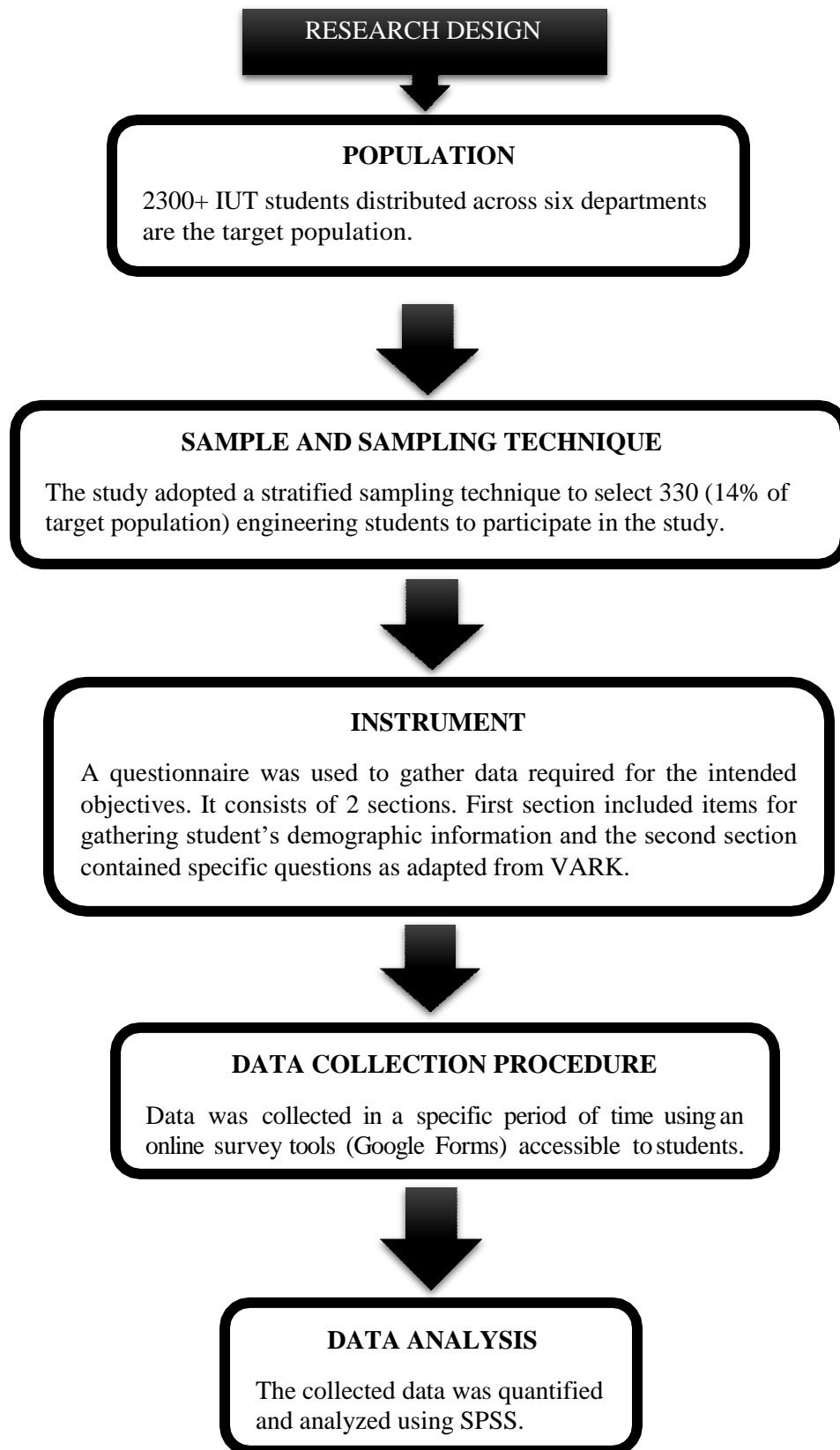


Figure 3.1: Research Methodology

In this study, the researcher analyses the learning styles among the undergraduate and postgraduate students of Islamic university of technology. The study adopted the survey research because this approach provides greater accuracy and reliability of research findings (Creswell, 2012, p.376). Creswell (2012) describes a survey as an empirical strategy which investigates and provides possible information with respect to the population in focus and enables data collection from individuals on their intelligence, sentiments, views, health, social, financial and educational background. A survey questionnaire was used to gather learning styles of engineering students in IUT. In a quantitative research, the researcher is expected to use methods to ensure that the findings are not influenced by his or her personal beliefs and prejudices (Creswell, 2012, p.13). Also in quantitative research, researchers often look to develop and prove equations or sometimes theories usually mathematical that can be used in predicting or describing the findings obtained through qualitative measures (Creswell, 2012, p.14). Therefore, the researcher effectively uses quantitative research methods to collect primary data with the help of a questionnaire administered to the students.

3.2.1 Population and Sampling technique

In this study we shall target the students of Islamic university of technology (IUT) in Bangladesh whose population is 2300+. The researcher adopted a finite population formula, to generate an appropriate and adequate sample size that will minimize the sampling error or biasness of the study (Etikan & Babatope, 2019). The formula is given below (Equation 1) and it is a commonly used formula for computing or estimating the sample size in a survey study.

Equation 1: Sample Size Equation

$$\frac{Z^2 \cdot p(1-p)}{1 + \left(\frac{Z^2 \cdot p(1-p)}{e^2 N} \right)}$$

From equation 1, the appropriate sample size calculated was 330 for our population of 2300+ at a confidence level of 95%. The population proportion (p) was 0.5, margin of

error (e) was 0.04 and the Z-score at a 95% confidence level was 1.96. The researcher went on and obtained 340 students to participate in the study which is slightly above the calculated sample size adding more accuracy. This 340 represents about 14% of the university's population. That is within the acceptable range of sample size (Creswell & Guetterman, 2019). The participants were selected from Computer Science and Engineering (CSE), Electrical and Electronics Engineering (EEE), Technical and Vocational Education (TVE), Civil and Environmental Engineering (CEE), Business and Technology Management (BTM) and Mechanical and Production Engineering (MPE) departments. After the approximation of sample size (equation q1), the researcher adopted two sampling techniques in the study, i.e. stratified sampling and simple random sampling (Creswell, 2012, p.144). Stratified sampling is a sampling method that involves the dividing of the target population into smaller identical sub-groups identified as strata to increase the accuracy of the sample by lowering sampling error (Atika, 2020). These sub-groups/strata are formed on the basis of the common attributes or features of members. Simple random sampling is one in which every member of the target population has an equal and independent opportunity to be chosen. Therefore, in this case, the researcher used stratified sampling technique to divide the population into departments and then a simple random sampling technique was used to choose participants of each sub-group. The Table 4.1 below shows the distribution of the students selected from the six departments.

Table 4.1: Sample Distribution

DEPARTMENT	SAMPLE
Electrical and Electronics Engineering (EEE)	61
Mechanical and Production Engineering (MPE)	62
Computer Science and Engineering (CSE)	84
Technical and Vocational Education (TVE)	73
Business and Technology Management (BTM)	23
Civil and Environmental Engineering (CEE)	37
	TOTAL= 340

3.2.2 The instrument/ questionnaire design

Diverse instruments are used to collect data of a particular study depending on the type of the data one intends to collect (Shaaidi, 2015). In this study, the researcher adopted and customized the VARK questionnaire and administered it to the 340 students to determine their preferred modes of learning. It consists of two sections. The first section (Section A) includes the items for gathering student's demographic information. The second section (Section B) contains specific questions adopted from VARK (Leite et al., 2010) which determines student's preferred learning styles. Section B consists of 16 multiple-choice questions with four answer possibilities to select from. Each possibility constitutes one of the four modes of perception. A student may select more than one answer which is important to recognize the poly modal modes of recognition and learning.

The validity of VARK questionnaire has been tested by Leite (2010) who found effective in measuring student's learning styles. Findings from a study conducted by Fitkov-Norris and Yeghiazarian (2015) supported the suitability and reliability of VARK questionnaire as a tool for determining a learner's preferences for receiving and processing information in Auditory, Visual, Read/Write and Kinesthetic ways.

3.2.3 Data collection procedure

With a view of adhering to the social distancing guidelines as provided by local government and implemented by IUT, the data was collected through an online survey tools (Google Forms) that was accessed by all the students involved. The questionnaires were remotely distributed to the students, independently or through their teachers. Before distributing the questionnaires, ethical considerations were maintained by the researcher towards the students and the teachers in charge of distributing the questionnaires. In addition, the researcher guaranteed the students that their answers were to be kept confidential and will be used only for the purpose of this research.

3.2.4 Data analysis

The collected data was quantified and analyzed using a Statistical Product and Service Solutions (SPSS) to estimate numbers and means clearly as well as to explain the discrepancy between the responses. SPSS software is the most recommended and widely

used modern software to analyze scientific data related with the social science research that adapt a survey questionnaire (Creswell & Guetterman, 2019, p.398). SPSS was used mainly because of its ability to analyze in details the essential characteristics of the collected data (Norusis, 2008).

3.3 Ethical considerations

The respondents' participation in this research was entirely voluntary. All of them had a choice to be or not to be a part of the study. Furthermore, the respondents, who willingly accepted to participate in this research, had the right to withdraw from it at any given time without owing any explanation to the researcher as to why they withdrew. Also, before distributing the questionnaires, the main aim and objectives of this research were briefly clarified by the researcher to the students and the teachers in charge of distributing the questionnaires. In addition, the researcher assured the students that their answers were to be kept confidential and will be used only for the purpose of this research. According to Westfall (2017), researchers are not supposed to obtain identifying information from participants of a particular study unless if it is critical for the procedure of that study. In the design of the questionnaire, the use of insulting, discriminatory and any other inappropriate language was avoided by the researcher. Finally, acknowledgement of studies conducted by other researchers was done by adding references of their work.

3.4 Conclusion

This chapter discusses the research design which consists of the population and sampling technique, the instrument/questionnaire design, data collection procedure and data analysis. It elaborates the use of VARK questionnaire to collect raw data from the students. In addition, it discusses the use of SPSS software to calculate the collected data and present it in pie charts, graphs and tables.

CHAPTER 4 DATA ANALYSIS AND RESULTS

4.0 Introduction

The results of analyzed data obtained from the evaluation of the questionnaire given to the students of IUT are presented in this chapter. The first section (Section A) indicates the student's demographic information and the second section (Section B) indicates the results obtained from the analysis of sixteen questions adopted from the VARK questionnaire to determine the students learning styles.

4.1 Data presentation

4.1.1. Gender Representation

Figure 4.2 shows that 340 students that participated in this study, 288 were boys which represents about 85% of the sample size and the remaining 52 were girls which represents about 15% of the sample size chosen.

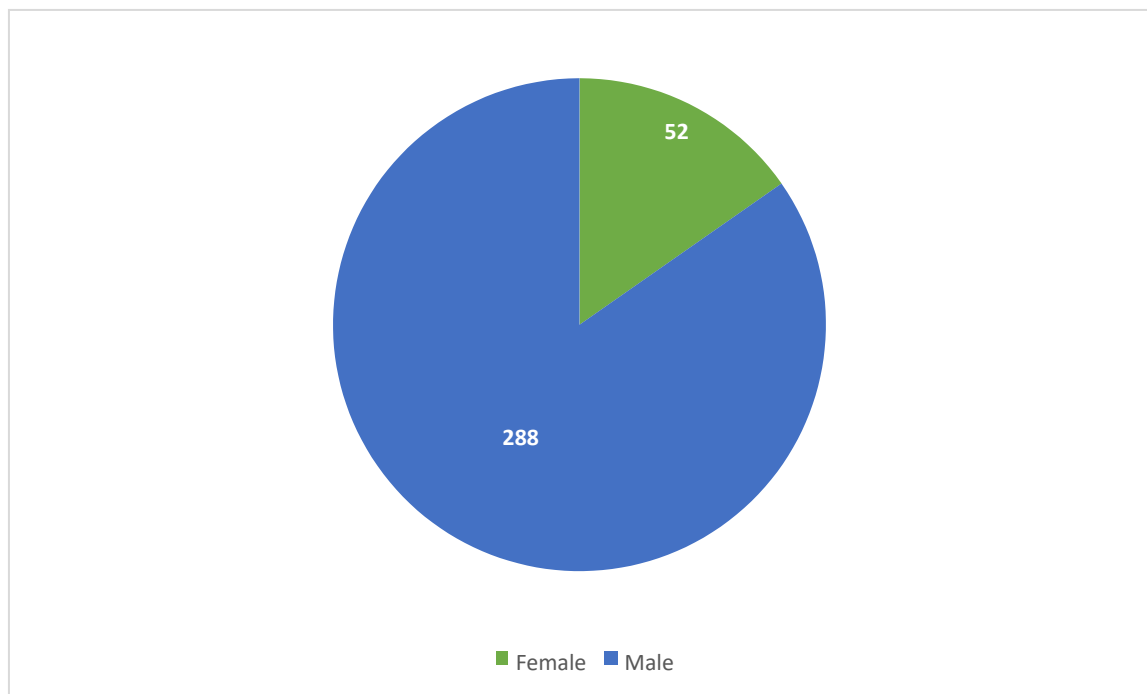


Figure 4.2: Gender Representation

4.12 Representation of education level

Figure 4.3 below indicates that the undergraduate students outnumbered the postgraduate students with 316 undergraduates compared to 24 postgraduates which means that 93% of the sample size were undergraduates while the remaining 7% were postgraduates.

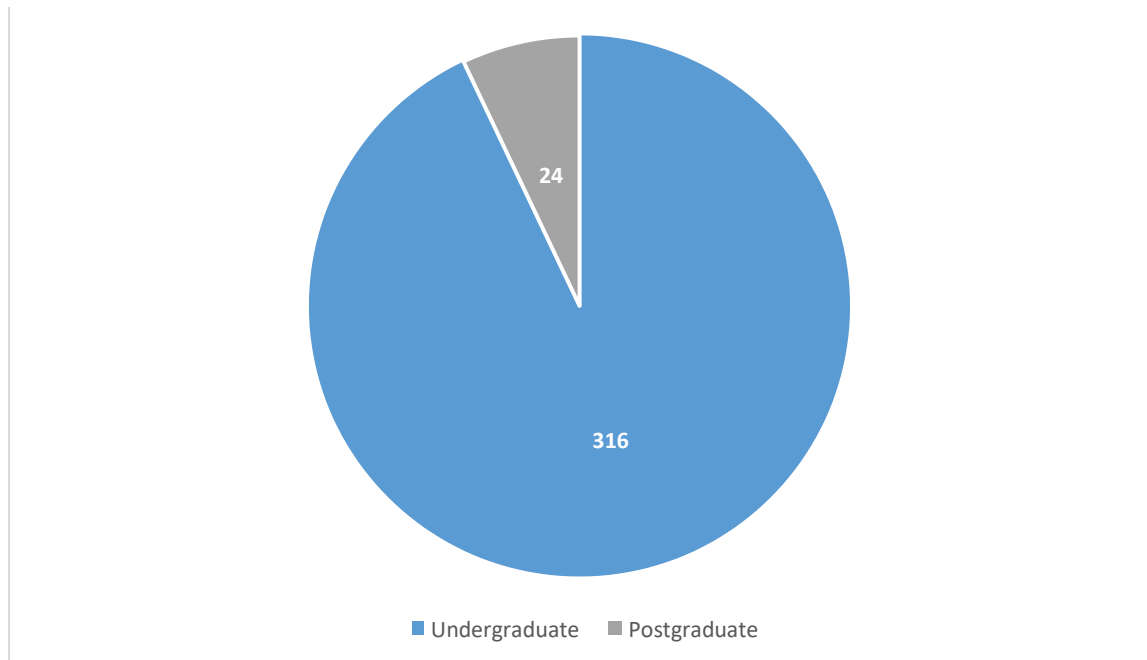


Figure 4.3: Representation of education level

4.13 Students' participation from different departments

In figure 4.4, 84 of the respondents were from the CSE department, 73 from the TVE department, 62 from the MPE department, 61 from the EEE department, 67 from the CEE department and 23 from the BTM department.

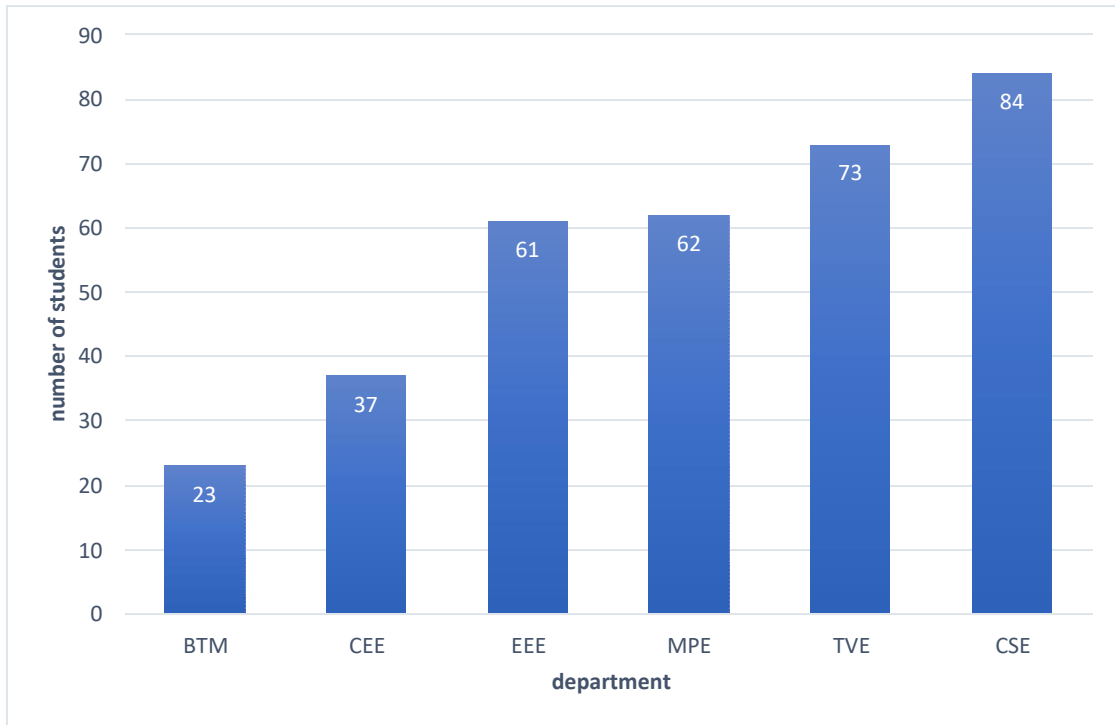


Figure 4.4: Students number per department

4.2 Data presentation according to research Questions.

Research Question 1:

What learning styles do undergraduate students of IUT prefer most?

Table 4.2 shows the distribution of the data collected from undergraduates and their level of preferences basing on the *Visual, Aural, Read/Write and Kinesthetic* learning styles. The unimodal learning style was dominant over the multimodal learning style with a percentage of 61.3% over 38.7% for multimodal. Among the unimodal learning styles, *kinesthetic* (26%) was the most preferred learning style followed by *Aural* (14%) learning style, *Visual* (12%) learning style and finally the *Read/Write* (9%) learning style. Among the multimodal learning styles, the combination of *Aural* and *Kinesthetic* (8%) was the most preferred learning style.

Table 4.2: Undergraduate VARK scores

Learning Style	Category		VARK score	% of VARK score
Unimodal Learning Styles		V	601	12%
		A	710	14%
		R	456	9%
		K	1330	26%
Multimodal Learning Styles	Bimodal	VA	225	4%
		VR	83	2%
		VK	335	7%
		AR	126	2%
		AK	419	8%
		RK	252	5%
	Trimodal	VAR	45	1%
		ARK	96	2%
		VAK	162	3%
		VRK	78	2%
Quadmodal	VARK	138	3%	

A visual representation of the prevalence of the various learning styles of the IUT undergraduate students is given in Figure 4.5. Kinesthetic modality was the most favored

among all modalities and the combination of VAR was the least favored among all modalities.

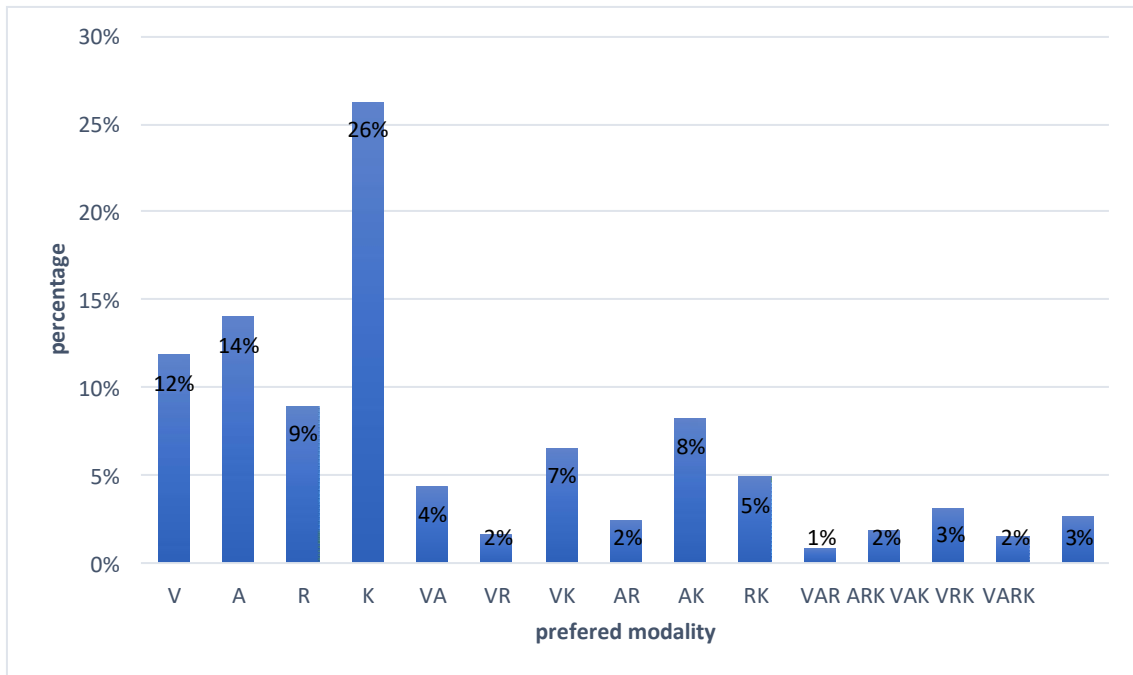


Figure 4.5: Undergraduate Learning Styles

Research Question 2:

What learning styles do IUT postgraduate students prefer most?

Table 4.3 shows the distribution of the data collected from postgraduates and their level of preferences basing on the *Visual, Aural, Read/Write and Kinesthetic* learning styles. The unimodal learning style was dominant over the multimodal learning style with a percentage of 56.0% over 44.0% for multimodal. *Kinesthetic* (29%) was the most preferred learning style among the unimodal learning styles followed by *Aural* (11%) learning style, *Read/Write* (9%) learning style and finally the *Visual* (7%) learning style. Among the multimodal learning styles, the combination of *Aural* and *Kinesthetic* (10%) was the most preferred learning style.

Table 4.3: Postgraduate VARK scores

Learning Style	Category	VARK Score	% of VARK Score	
Unimodal Learning Styles		V	26	7%
		A	44	11%
		R	35	9%
		K	110	29%
Multimodal Learning Styles	Bimodal	VA	11	3%
		VR	6	2%
		VK	33	9%
		AR	11	3%
		AK	37	10%
		RK	17	4%
	Trimodal	VAR	3	1%
		ARK	9	2%
		VAK	20	5%
		VRK	15	4%
Quadmodal	VARK	6	2%	

A visual representation of the prevalence of the various learning styles of the postgraduate students of IUT is given in Figure 4.6.

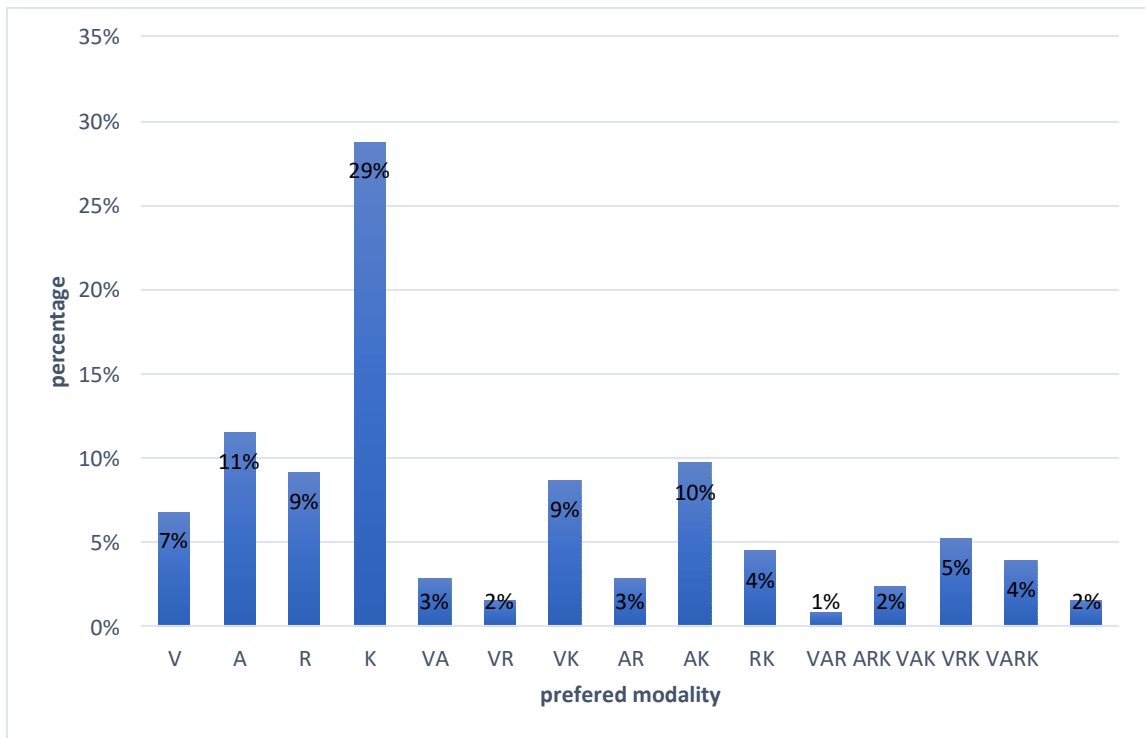


Figure 4.6: Postgraduate Learning Styles

Research Question 3:

How different are the learning styles of the male from female students in IUT?

Figure 4.7 shows the distribution of the unimodal and bimodal learning styles among female and male students. The unimodal and multimodal learning styles were evenly distributed in the females with percentages of 50.5% and 49.5% respectively but not evenly distributed in the males with percentages of 62.8% and 37.2% respectively (Figure 4.7). The percentage of the *visual* and *kinesthetic* scores was much higher in males than in the females whereas the percentage of the *read/write-kinesthetic* score was much higher in females than in males. This is clearly illustrated in figure 4.8.

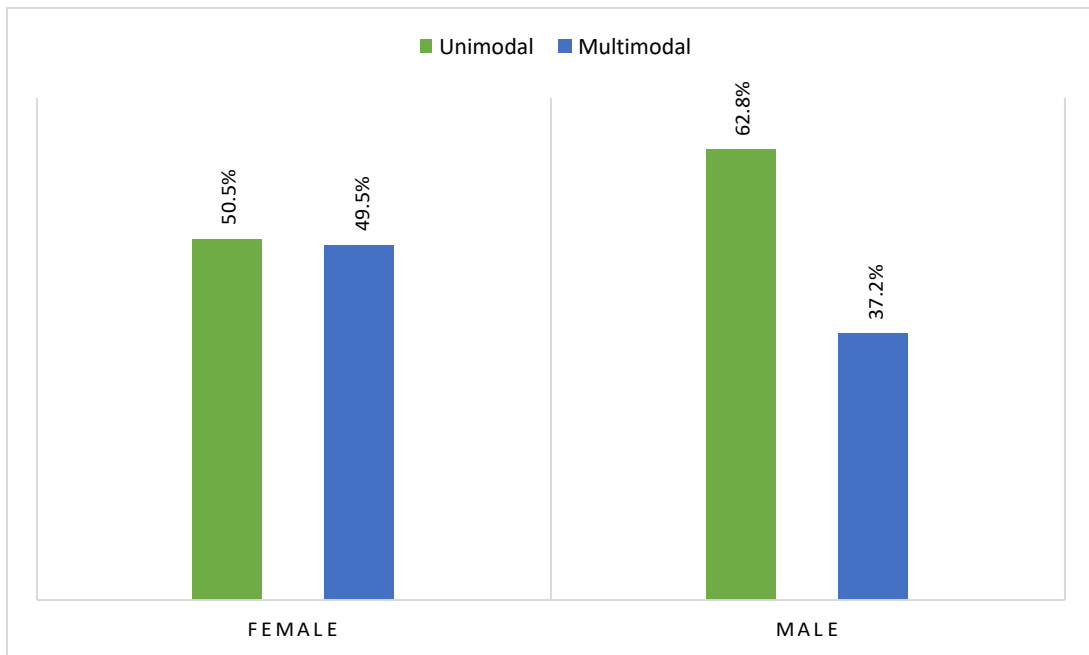


Figure 4.7: Male and Female Learning Styles

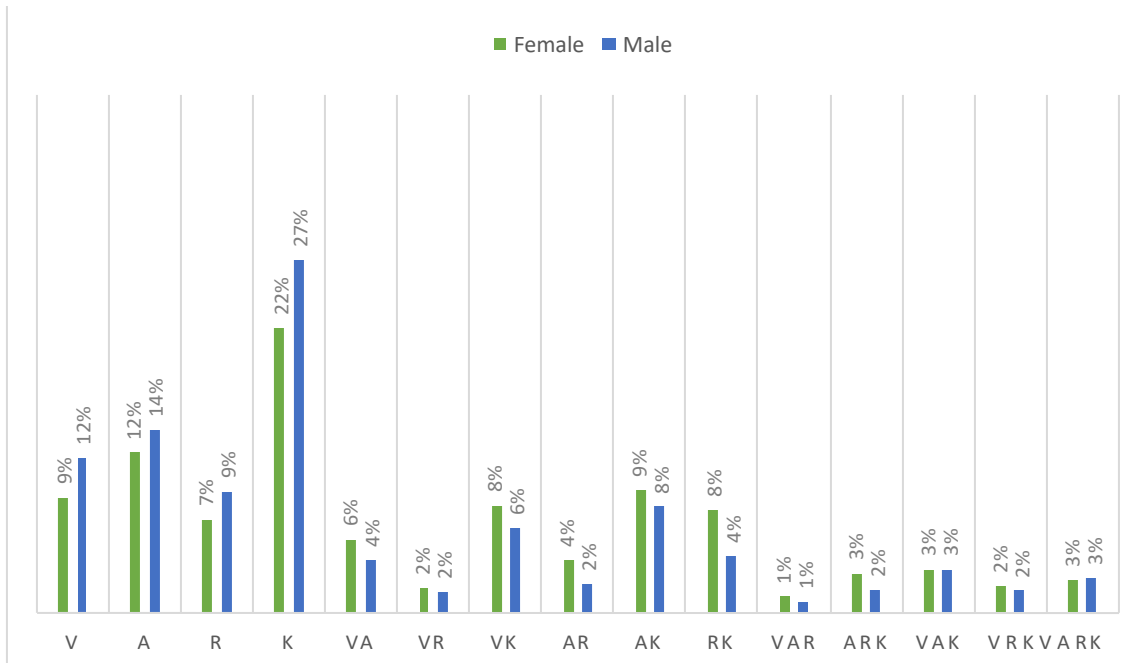


Figure 4.8: Male and Female students' learning styles

The difference in learning styles preference between male and female students of IUT was tested using the Mann-Whitney U test in SPSS. The test revealed a significant difference in the unimodal learning style preference between the male (Median=11.0, n=288) and female (Median=6.50, n=52) students, $U = 6059.500$, $z = -2.208$, $p = .027$, $r = 0.119745613$. The test also revealed a significant difference in the multimodal learning style preference between the male (Median= 5.00, n=288) and female (Median= 9.50, n=52) students, $U = 6059.500$, $z = -2.208$, $p = .027$, $r = 0.119745613$.

Table 4.4 shows the mean ranks of the VARK scores obtained from the unimodal and multimodal learning styles of both the male and female students. Table 4.5 shows the Mann-Whitney U test statistics obtained from SPSS with gender as the grouping variable.

Table 4.4: Male and Female Mean Ranks

	Gender	N	Mean Rank	Sum of Ranks
Unimodal	Male	288	175.46	50532.50
	Female	52	143.03	7437.50
	Total	340		
Multimodal	Male	288	165.54	47675.50
	Female	52	197.97	10294.50
	Total	340		

Table 4.5: Mann-Whitney U test statistics

	Unimodal	Multimodal
Mann-Whitney U	6059.500	6059.500
Wilcoxon W	7437.500	47675.500
Z	-2.208	-2.208
Asymp. Sig. (2-tailed)	.027	.027

Research Question 4:

Is there any significant difference in the learning styles of the undergraduate and postgraduate students of IUT?

Figure 4.9 shows the distribution of the unimodal and bimodal learning styles among undergraduate and postgraduate students of IUT. The unimodal learning style was dominant in both the undergraduate (61.3%) and postgraduate (56.0%) students when compared to the multimodal learning style.

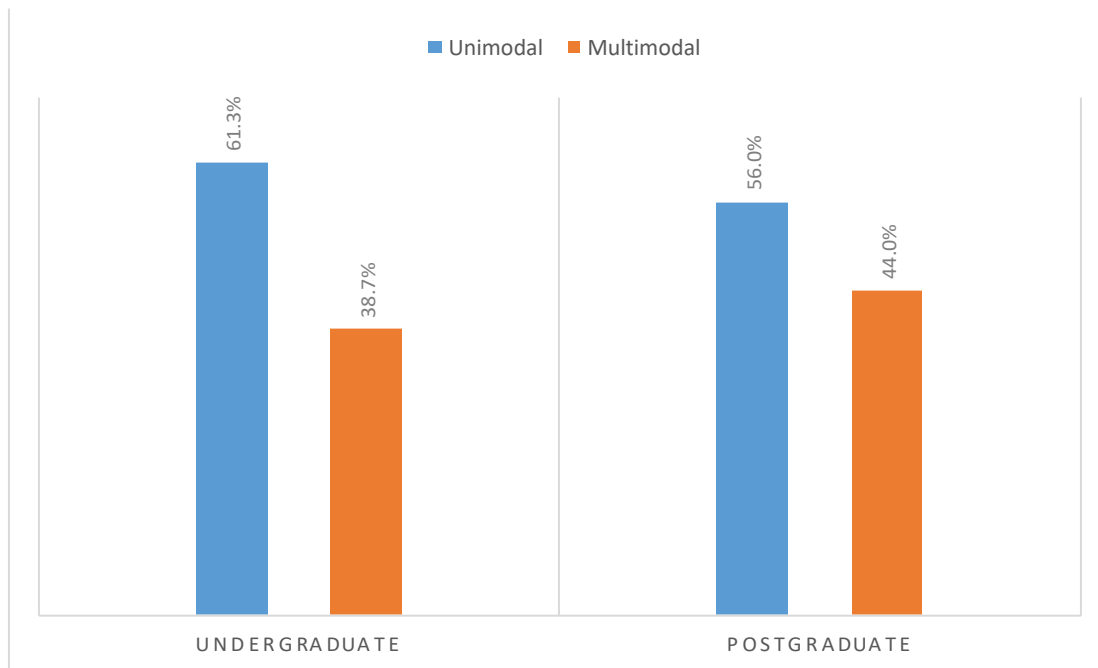


Figure 4.9: Undergraduate and Postgraduate Learning Styles

The significant difference in the learning styles of the undergraduate and postgraduate students of IUT was tested using the independent t test. The test revealed that there is no significant difference in the unimodal and multimodal learning styles between the undergraduate students and postgraduate students, conditions $t(338) = 0.733$, $p = 0.464$ (Table 4.6 and 4.7).

Table 4.6: Independent Samples t test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Unimodal	Equal variances assumed	1.941	.164	.733	338	.464	.842	1.148	1.417	3.101
	Equal variances not assumed			.649	25.693	.522	.842	1.299	1.829	3.514
Multimodal	Equal variances assumed	1.941	.164	-.733	338	.464	-.842	1.148	3.101	1.417
	Equal variances not assumed			-.649	25.693	.522	-.842	1.299	3.514	1.829

Table 4.7: Means and Standard deviations

Level of Education		N	Mean	Std. Deviation	Std. Error Mean
Unimodal	Undergraduate	316	9.80	5.364	.302
	Postgraduate	24	8.96	6.189	1.263
Multimodal	Undergraduate	316	6.20	5.364	.302
	Postgraduate	24	7.04	6.189	1.263

4.2 Summary of Findings

From the overall data obtained, the unimodal learning style (61%) was found to be the more prevailing among all students compared to the multimodal learning style (39%). Our first research question sought to find the most preferred learning style among undergraduates and after analyzing data, the unimodal learning style (61.3%) was found to be dominant over the multimodal learning style (38.7%). Among the unimodal learning style, *kinesthetic* (26%) was the most preferred and among the multimodal, the combination of *Aural* and *Kinesthetic* (8%) was the most preferred. The second research question was intended to find out which learning style do the IUT postgraduate students prefer most and from thoroughly analyzing data, the unimodal learning style (56%) was found to be dominant over the multimodal learning style (44%). *Kinesthetic* (29%) was the most preferred among the unimodal learning style while a combination of *aural* and *kinesthetic* (10%) was the most preferred among the multimodal. The Mann-Whitney U test was conducted to find the difference between the male and female learning styles and the results showed a significant difference between the two groups. Finally, an independent t test was done to test for a significant difference between the undergraduate and postgraduate learning styles and from its results, there was no significant difference found between the learning styles of the two groups. The Figure 4.10 below shows the distribution of the learning styles of all the participants of the study.

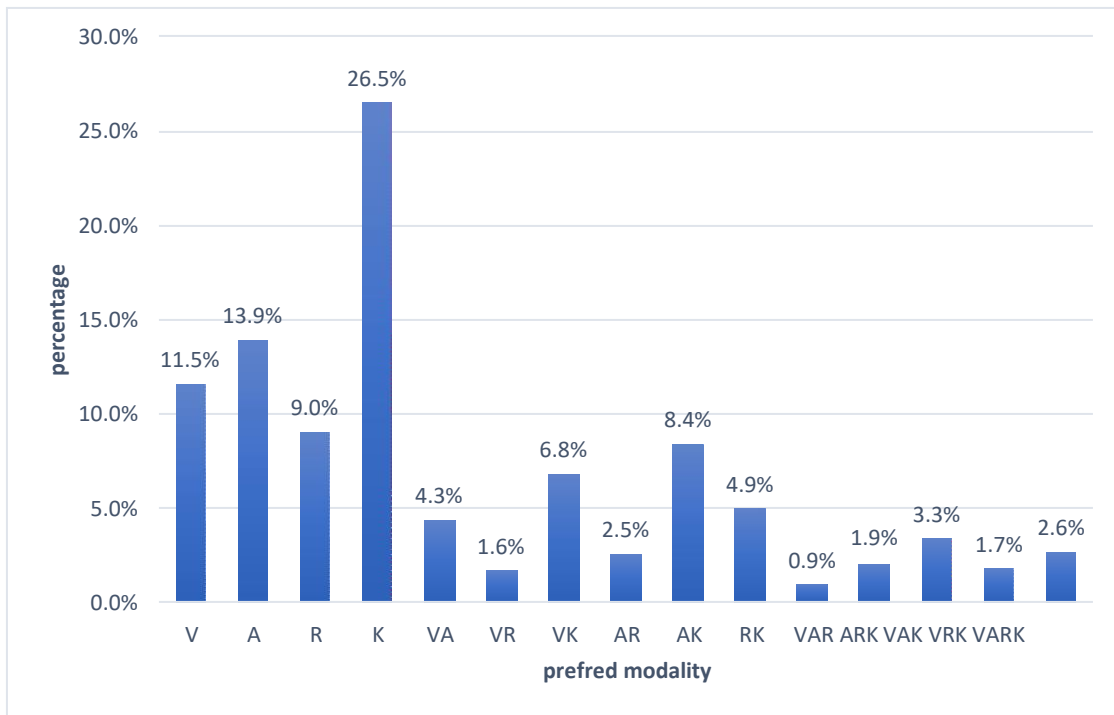


Figure 4.10: Overall Learning Styles

4.3 Conclusion

This chapter presents and discusses the results obtained from the questionnaires presented to the various participants. It further discusses the research questions of the study and reveals that *Kinesthetic* was the most preferred among the dominant learning style which was found to be unimodal learning style.

CHAPTER 5 DISCUSSION AND CONCLUSION

5.1 Discussion

The present study aimed at examining the most preferred learning styles and how they differ among the students of Islamic University of Technology (IUT) in terms of gender and level of education. After analysis of the obtained raw data from the participants, there were many various learning styles identified to be present in the students. To better understanding the students' preferred learning styles, the researcher first divided the learning styles into two categories i.e., the unimodal and multimodal learning styles. Overall, the unimodal learning style was found to be dominant over the multimodal learning style. Among the unimodal learning style, kinesthetic was the most preferred mode of learning. Kinesthetic learners relate to real or simulated practices and experiences. These kinds of learners are more inclined to case studies, demonstrations, simulations, practice and applications, videos and movies of "real" things. They learn best through the experience of doing things by themselves (Wege & Keil, 2020). The combination of Aural and Kinesthetic modalities was the most preferred among the multimodal learning style.

The findings also revealed that there was a difference in learning style preference according to gender. Overall, the percentage of the unimodal learning style was much higher than the multimodal learning style in males than in the females. In the unimodal learning style, the percentage of the kinesthetic scores was much higher in males than in the females whereas in the multimodal learning style, the percentage of the read/write-kinesthetic score was much higher in females than in the males. Kinesthetic modality being dominant in males meant that there were more male students who preferred to learn by actively engaging in activities by themselves which is a profound characteristic in males (Good & Brophy, 1995). The read/write-kinesthetic modality prevailing among the females as compared to males meant there were more females than males who preferred acquiring new information through reading as well as hands on experiences.

Finally, the ultimate result obtained from this research was that there was no significant difference between the learning styles of the undergraduate and postgraduate students of IUT. This was contrary to the findings of a study carried out by Samarakoon (2013) that reported a significant difference of learning style and approaches among undergraduate and postgraduate students. This could be due to the fact that most of the postgraduate students in IUT are from the same educational background of IUT or one similar to IUT. Hence continuing with the same learning styles they are accustomed to.

Learning style preferences were also found to be varying among students in other fields of education (Asiry, 2016; Berková et al., 2020; Jr, 2019; Nuzhat et al., 2013; Subia et al., 2019). Various studies investigating learning styles among students have found a difference in learning styles across gender which is in line with this study. (Abdulla & Ph, 2017; Nuzhat et al., 2013). However, in this research, the multimodal learning style was dominant in females than males which is not consistent with a study carried out by Nuzhat (2013) who found that the multimodal learning style was preferred more by male students than the female students. This could be due to the fact that the context of this research was completely different from that study's context. The participants in that study were from the medical field not the engineering field which is a complex domain. From this study, various learning styles were found to be present among the IUT students. The kinesthetic learning style was found to be dominant over all the other learning styles. Combinations consisting kinesthetic modality were also found to be higher in scores compared to other combinations that do not consist the kinesthetic modality.

5.2 Implication of the findings

This study's findings will help engineering educators improve their teaching and learning practices through adopting to the student's preferred learning styles. The findings will further contribute to the literature concerning engineering education.

5.3 Recommendations

In light of the findings obtained above, it is suggested that teachers incorporate in their curriculum more hands on practices, simulations, applications and engage students in real life experiences. This would suite the majority of the students learning preferences and

will in return have a positive impact on their learning experience. It is also recommended that, for future study, researchers may use a larger sample size and with varied demographic background in order to obtain more accurate, insightful and better results that can be generalized. This is due to the fact that this research was restricted only to the engineering students of IUT. Future studies may also compare data between engineering and other domains and go on to use both qualitative and quantitative approaches to better understand the meaning of the findings. Future studies can focus on research questions like; is there a connection between academic performance and learning style in an online learning environment? Is it possible to achieve the desired outcomes of learning by accommodating various learning styles?

5.4 Conclusion

This study illustrated that IUT engineering students differ in their learning styles with the unimodal learning style prevailing over the multimodal learning style. It further revealed that the *kinesthetic* modality of the unimodal learning style was the most preferred among all students. The research also revealed a difference in learning styles between the males and females with the multimodal learning style dominating more in females than in the males. However, there was no significant difference found between the learning styles of undergraduate and postgraduate students. The administration can accommodate different approaches basing on the findings to enhance the teaching and learning experience.

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APPENDIX A

Learning Styles Questionnaire

Assalam alaikum,

I am conducting a research on the different learning styles of both male and female students to enhance the teaching and learning process. Attached to this is a questionnaire to help determine each student's learning preference.

Please be assured that your responses shall be kept confidential and shall be used only for the purpose of this research.

Thank you.

SECTION A

Please select one answer from the following.

Gender

- Male
- Female

Level of Education

- Undergraduate
- Postgraduate

Department

- EEE
- CSE
- TVE
- MCE
- CEE
- BTM

SECTION B

Select the answer which best explains your learning preference and check it.

Please select more than one if a single answer does not match your perception.

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

- a) Find out where the shop is in relation to some where I know.
- b) Ask my friend to tell me the directions.
- c) Write down the street directions I need to remember.
- d) Use a map.

2. 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:

- a) Seeing the diagrams.
- b) Listening.
- c) Reading the words.
- d) Watching the actions.

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

- 5. Look at details about the highlights and activities on the tour.
- 6. Use a map and see where the places are.
- 7. Read about the tour on the itinerary.
- 8. Talk with the person who planned the tour or others who are going on the tour.

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

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

5. When I am learning I:

- a. Like to talk things through.
 - b. See patterns in things.
 - c. Use examples and applications.
 - d. Read books, articles and handouts.
6. I want to save more money and to decide between a range of options. I would:
- a. Consider examples of each option using my financial information.
 - b. Read a print brochure that describes the options in detail.
 - c. Use graphs showing different options for different time periods.
 - d. Talk with an expert about the options.
7. I want to learn how to play a new board game or card game. I would:
- a. Watch others play the game before joining in.
 - b. Listen to somebody explaining it and ask questions.
 - c. Use the diagrams that explain the various stages, moves and strategies in the game.
 - d. Read the instructions.
8. I have a problem with my heart. I would prefer that the doctor:
- a. Gave me something to read to explain what was wrong.
 - b. Used a plastic model to show me what was wrong.
 - c. Described what was wrong.
 - d. Showed me a diagram of what was wrong.
9. I want to learn to do something new on a computer. I would:
- a. Read the written instructions that came with the program.
 - b. Talk with people who know about the program.
 - c. Start using it and learn by trial and error.
 - d. Follow the diagrams in a book.
10. When learning from the Internet I like:
- a. Videos showing how to do or make things.

- b. Interesting design and visual features.
 - c. Interesting written descriptions, lists and explanations.
 - d. Audio channels where I can listen to podcasts or interviews.
11. I want to learn about a new project. I would ask for:
- a. Diagrams to show the project stages with charts of benefits and costs.
 - b. A written report describing the main features of the project.
 - c. An opportunity to discuss the project.
 - d. Examples where the project has been used successfully.
12. I want to learn how to take better photos. I would:
- a. Ask questions and talk about the camera and its features.
 - b. Use the written instructions about what to do.
 - c. Use diagrams showing the camera and what each part does.
 - d. Use examples of good and poor photos showing how to improve them.
13. I prefer a presenter or a teacher who uses:
- a. Demonstrations, models or practical sessions.
 - b. Question and answer, talk, group discussion, or guest speakers.
 - c. Handouts, books, or readings.
 - d. Diagrams, charts, maps or graphs.
14. I have finished a competition or test and I would like some feedback. I would like to have feedback:
- a. Using examples from what I have done.
 - b. Using a written description of my results.
 - c. From somebody who talks it through with me.
 - d. Using graphs showing what I achieved.
15. I want to find out about a house or an apartment. Before visiting it I would want:
- a. To view a video of the property.

- b. A discussion with the owner.
- c. A printed description of the rooms and features.
- d. A plan showing the rooms and a map of the area.

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

- a. Diagrams showing each stage of the assembly.
- b. Advice from someone who has done it before.
- c. Written instructions that came with the parts for the table.
- d. Watching a video of a person assembling a similar table.

Scoring chart used to find the VARK category that each of the answers corresponds to.

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

This questionnaire was adopted from VARK questionnaire version 8.01 which can be found at <https://vark-learn.com/the-vark-questionnaire/>