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Learning Style Preferences of Diploma Students in Multimedia Interactive Courses: A VARK-Based Study of Computer Science and Statistics Programmes

Saffa Raihan Zainal Abidin[1,*], Halimatun Saadiah Abd Mutalib[2], Rozeleenda Abdul Rahman[1], Nursyahida Mokhtar[3], Nor Zalina Ismail[1], Mohd Rizal Razak[1]

[1] Faculty of Computing and Mathematical Sciences, Universiti Teknologi MARA, Cawangan Pahang, Raub Campus, 27600 Raub, Pahang, Malaysia
[2] Academy of Language Studies, Universiti Teknologi MARA, Cawangan Seri Iskandar, Perak Campus, 32610 Seri Iskandar, Perak, Malaysia
[3] Faculty of Computing and Multimedia, Universiti Poly-Tech Malaysia

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ABSTRACT

Understanding students' learning preferences is important for designing effective instructional strategies, especially in courses that integrate visual, verbal, textual, and practical elements. This study investigates the learning style preferences of diploma students enrolled in the Multimedia Interactive course (CSC253) at Universiti Teknologi MARA Cawangan Pahang, Kampus Raub. It aims to identify the dominant learning styles of students from the CS110 and CS111 programmes using Fleming's VARK model and to examine the implications for teaching and learning. The study offers context-specific evidence on learning preferences among Malaysian diploma students in computer-related programmes, a population that has received limited attention in previous VARK-based studies. A descriptive mixed-methods design was employed, combining quantitative data from an adapted VARK questionnaire with qualitative data from structured interviews and classroom observations. A total of 150 students participated. The results indicate that visual learning was the dominant preference, followed by kinaesthetic learning, with a substantial proportion of students also demonstrating multimodal preferences. These findings suggest that students benefit from diverse instructional approaches rather than a single mode of delivery. The study concludes that multimedia interactive courses should adopt flexible and inclusive teaching strategies that integrate visual materials, guided discussion, written support, and hands-on activities to strengthen student engagement and learning outcomes.

* *Corresponding author.*
E-mail address: saffaraihan@uitm.edu.my

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1. Introduction

Educational practices in the 21st century have changed substantially with the expansion of digital technologies and technology-enhanced learning environments. In higher education, multimedia platforms, simulations, and interactive systems have made instruction more flexible, engaging, and student-centred. These tools allow lecturers to present content through multiple formats and learning activities, which can support deeper understanding and participation. However, the effectiveness of such approaches depends not only on the availability of technology, but also on how well instructional design responds to differences among learners [1–3].

One important dimension of learner diversity is learning preference. Learning preferences refer to the ways students tend to receive, process, and engage with information. Among the available frameworks, Fleming's VARK model remains widely used because it classifies preferences into four modalities: visual, auditory, read/write, and kinesthetic [4]. In higher education, the VARK framework has often been used to help lecturers reflect on how students interact with instructional materials and how teaching can be diversified to support engagement. At the same time, the educational value of learning styles remains debated. Some researchers argue that students benefit when instruction incorporates varied modes of delivery, whereas others report limited evidence that strict matching of teaching to a preferred learning style improves academic performance [5,6]. This suggests that learning styles should be treated cautiously, not as fixed predictors of achievement, but as a useful lens for designing more inclusive and varied learning experiences.

This issue is especially relevant in computer science and statistics education. Students in these fields must engage with abstract concepts, interpret visual representations, use software tools, follow written instructions, participate in discussion, and apply knowledge through practical tasks. Multimedia interactive courses combine many of these demands within a single learning environment. As a result, such courses provide a suitable context for examining how students' learning preferences may shape their engagement with teaching and learning activities. Research on multimedia-supported and technology-enhanced learning has shown that digital learning environments can improve participation and understanding when they are designed with a clear pedagogical purpose and with attention to learner variability [1,7–9].

Despite the growing interest in personalized and student-centred learning, empirical evidence on learning preferences among diploma students in computer-related programmes remains limited, particularly in the Malaysian higher education context. Much of the existing literature has focused on medical, nursing, science, or general university populations rather than diploma-level learners in computing and statistics programmes [10,11]. In addition, relatively little attention has been given to multimedia interactive courses, where multiple sensory modes are naturally embedded in the teaching process. This leaves a contextual gap in understanding how learning preferences are distributed among diploma students and how such preferences may inform instructional practice in technology-oriented courses.

Addressing this gap is important for both pedagogical and practical reasons. A clearer understanding of students' learning preferences can help lecturers design teaching strategies that are more responsive to diverse learners, particularly in courses that require both conceptual understanding and practical application. For multimedia interactive learning, this may involve balancing visual materials, verbal explanation, written support, and hands-on activities to improve student engagement and learning experiences.

Therefore, this study examines the learning style preferences of diploma students from the CS110 and CS111 programmes enrolled in the Multimedia Interactive course (CSC253) using Fleming's VARK model. Specifically, the study is guided by the following research questions:

i. What are the dominant VARK learning style preferences among CS110 and CS111 students enrolled in CSC253?
ii. How do these preferences inform instructional design in multimedia interactive learning?

2. Literature Review

2.1 Learning Styles and the VARK Model in Higher Education1.1 Google Tools in Education

Learning styles have long been discussed in higher education as a way of understanding how students prefer to receive, process, and use information in learning environments [10,11]. Among the models commonly applied in educational research, Fleming's VARK framework remains one of the most practical and widely used because it categorises learning preferences into four modalities: visual, auditory, read/write, and kinesthetic [4]. The model has been used across a range of higher education settings to examine how students engage with instructional materials and to help educators diversify teaching strategies according to learner variability [10,11].

The continued use of the VARK model is partly due to its value as a descriptive and reflective tool. It helps researchers and educators identify broad patterns in student preferences and consider how teaching approaches may be made more inclusive. In this sense, VARK is useful not as a rigid classification of students, but as a framework for recognising that learners may not respond equally to the same mode of instruction [4,10,11]. This is especially relevant in contemporary higher education, where students are increasingly exposed to multimodal learning environments that combine text, visuals, verbal explanation, and practical activity.

However, the educational significance of learning styles remains debated. Several studies have questioned the strong form of the learning-styles hypothesis, particularly the assumption that students necessarily achieve better outcomes when instruction is strictly matched to a preferred learning style [5,6,12]. Instead, the literature suggests that factors such as instructional quality, active learning, and study strategies may play a more direct role in influencing academic performance [5,6,12]. This critique does not make VARK irrelevant. Rather, it suggests that the model should be used cautiously, as a guide for designing varied and student-aware instruction rather than as a basis for deterministic claims about achievement. For the present study, this perspective is important because the focus is not on proving style matching, but on understanding student preference patterns that may inform teaching in a multimedia learning environment.

2.2 Learning Styles in Technology-Enhanced and Multimedia Learning

The growth of technology-enhanced learning has expanded the possibilities for addressing learner diversity in higher education [1,7–9]. Digital platforms, videos, simulations, learning management systems, and interactive tools now allow lecturers to present content through multiple channels and forms of engagement. In multimedia-based environments, students may encounter visual demonstrations, spoken explanation, written content, and practical interaction within the same lesson. This makes multimedia learning especially relevant to the study of learning preferences because it naturally involves several VARK-related modalities at once.

Previous research has shown that multimedia tools can strengthen teaching and learning when they are used with a clear pedagogical purpose and when learning activities are designed to promote engagement rather than passive exposure [7]. Research on student-centred and personalised learning similarly indicates that digital environments are most effective when they respond to learner readiness, provide flexibility, and support meaningful interaction [1,8]. Adaptive e-learning studies

further suggest that learning environments can enhance engagement when they take learner characteristics into account, including how students prefer to interact with instructional content [9]. These findings are particularly significant for courses that combine conceptual understanding with applied practice. In multimedia interactive learning, students are not only expected to understand content but also to interpret images, follow demonstrations, interact with software, and complete practical tasks. As a result, the effectiveness of instruction depends less on the use of technology itself and more on how different instructional modes are integrated to support participation and comprehension [1,7,9]. This makes multimedia courses an important setting for examining how learning preferences may shape student engagement with instructional design.

2.3 Learning Styles in Computer Science Education and Research Gap

The relevance of learning preferences becomes more pronounced in computer-related education, where students must engage with both abstract concepts and applied problem-solving. In computer science and statistics, learners are often required to interpret diagrams, understand procedural steps, use software tools, respond to demonstrations, and apply ideas through hands-on activities. Such demands suggest that instruction in these fields is inherently multimodal. Previous studies in higher and professional education have reported that visual, kinesthetic, and multimodal approaches may support comprehension, especially in subjects that require students to connect conceptual knowledge with practical performance [10,11,13]. In computer science education specifically, kinesthetic and active learning activities have been shown to support engagement and understanding in technical content areas [14].

Despite these broader findings, the literature remains limited in relation to diploma-level students in computer-related programmes, particularly within the Malaysian higher education context. Existing VARK-based studies have focused largely on medical, anatomy, science, or general university populations [10,11,13], with comparatively little attention given to students enrolled in diploma programmes in computing and statistics. This matters because diploma students may differ from degree-level students in terms of academic preparation, classroom experience, and the balance between theoretical and practical learning. Therefore, findings from other disciplines or populations cannot simply be assumed to apply directly to this group.

This gap is especially relevant in the context of the Multimedia Interactive course (CSC253) taken by students in the CS110 Diploma in Computer Science and CS111 Diploma in Statistics programmes at Universiti Teknologi MARA Cawangan Pahang, Kampus Raub. CSC253 is a course that involves visual content, software-based interaction, guided explanation, written support, and practical activities. These characteristics make it a particularly suitable context for examining how VARK-related preferences are distributed among diploma students and how those preferences may inform instructional practice. Although the course naturally incorporates multiple learning modes, there is still limited empirical evidence on which preferences are most dominant among students in this setting and how lecturers might respond to those patterns in a more systematic way.

Accordingly, the present study addresses a clear contextual gap by examining the learning style preferences of Malaysian diploma students in CS110 and CS111 enrolled in CSC253 using the VARK model. By focusing on a specific diploma-level multimedia course in a local higher education setting, this study extends existing VARK research beyond the more commonly studied medical and general university populations. The study also provides context-specific insight into how learning preference patterns may be used to support more inclusive and responsive instructional design in multimedia interactive learning.

3. Methodology

3.1 Research Design

This study employed a mixed-methods explanatory sequential design to examine the learning style preferences of diploma students enrolled in the Multimedia Interactive course (CSC253). In this design, quantitative data were collected and analysed first to identify dominant learning style patterns, followed by qualitative data collection to provide a deeper explanation and contextual understanding of the quantitative findings. The use of a mixed-methods approach was considered appropriate because the study sought not only to describe the distribution of students' VARK preferences, but also to understand how these preferences were reflected in actual classroom engagement and learning experiences.

The study was conducted in three stages. In the first stage, quantitative data were collected through an adapted VARK-based questionnaire to identify students' preferred learning modalities. In the second stage, qualitative data were obtained through structured interviews and classroom observations to explore how students engaged with different instructional approaches in multimedia interactive learning. In the final stage, the quantitative and qualitative findings were integrated to provide a more comprehensive interpretation of student learning preferences and their implications for instructional design. The workflow of data collection and analysis is shown in Fig. 1.

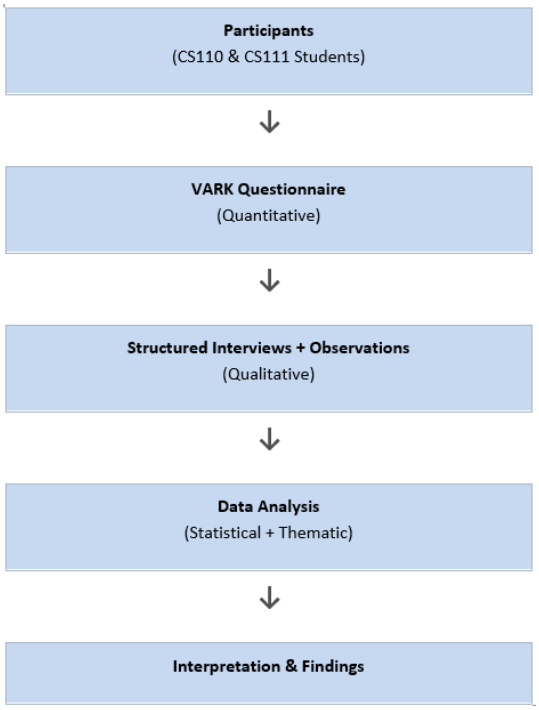

Fig. 1. Workflow of data collection and analysis for the learning style study

3.2 Participants and Research Setting

The study was conducted at Universiti Teknologi MARA Cawangan Pahang, Kampus Raub, and involved students enrolled in the Multimedia Interactive course (CSC253). The participants consisted of diploma students from two programmes: CS110 (Diploma in Computer Science) and CS111

(Diploma in Statistics). A total of 150 students participated in the questionnaire phase of the study. Participants were selected using purposive sampling, as only students enrolled in CSC253 were directly relevant to the research objectives. To strengthen the demographic profile of the sample, the respondents' background information was also recorded, including programme and gender. Of the 150 respondents, 68 were male and 82 were female.

For the qualitative phase, a smaller group of students was selected from the survey participants using purposive maximum variation sampling to ensure representation of different learning preferences and both academic programmes. A total of 10 students participated in the structured interviews. These students were selected based on their willingness to participate, variation in VARK learning preferences, and representation from both CS110 and CS111.

3.3 Research Instruments

3.3.1 Adapted VARK Questionnaire

The quantitative instrument used in this study was an adapted VARK questionnaire developed based on Fleming's VARK model, which classifies learning preferences into four modalities: visual, auditory, read/write, and kinesthetic. The original VARK framework was adapted to suit the context of multimedia interactive learning in CSC253. Specifically, the wording of the items was modified so that the learning situations reflected activities commonly experienced by students in the course, such as viewing multimedia content, listening to explanations, reading written instructions, and engaging in practical computer-based tasks.

The adapted questionnaire consisted of 20 items. Each item presented a learning situation and included response options representing the four VARK modalities. Respondents were allowed to select the option or options that best reflected how they preferred to learn in each situation, consistent with the multidimensional nature of learning preferences. Because students could select more than one response across items, the instrument allowed the identification of both single-mode and multimodal preferences.

Before the main data collection, the questionnaire was reviewed for content clarity and contextual relevance by three subject experts/lecturers in education or multimedia learning. A pilot test was then conducted with 15 students who were not part of the final sample in order to check the clarity of the items and the suitability of the adapted wording. Based on the pilot feedback, minor revisions were made to improve wording and comprehension.

3.3.2 Adapted VARK Questionnaire

To support the quantitative findings, a structured interview protocol was developed for the qualitative phase. The interview questions focused on students' preferred ways of learning, their level of engagement with different instructional approaches, and the challenges they experienced during multimedia learning activities. The protocol was designed to obtain comparable responses across participants while still allowing students to elaborate on their experiences. Each interview lasted approximately 15-20 minutes and was conducted in face-to-face. With participants' consent, the interviews were audio-recorded and later transcribed for analysis.

3.3.3 Classroom Observation Protocol

Classroom observations were also conducted to examine how students responded to different instructional methods during multimedia interactive learning sessions. An observation checklist or

protocol was used to record students' engagement with visual materials, verbal explanations, written guidance, and hands-on practical activities. The observations focused on behaviours such as participation, attention, interaction with learning materials, and responses to instructional tasks.
A total of three observation sessions were conducted during practical class sessions. Observation notes were recorded systematically to support the interpretation of both the interview and questionnaire findings.

3.4 Data Collection Procedures

Data collection was carried out in two phases. In the first phase, the adapted VARK questionnaire was administered to the 150 students during scheduled class sessions. Administering the questionnaire during class helped ensure a high response rate and consistency in the data collection process. Before completing the questionnaire, students were informed of the purpose of the study and were told that their participation was voluntary.

In the second phase, qualitative data were collected after the preliminary quantitative analysis had been completed. Interview participants were selected from among the questionnaire respondents based on their willingness. Structured interviews were then conducted to gain deeper insight into how students experienced different teaching approaches in CSC253. Classroom observations were carried out during selected multimedia practical sessions to examine how students engaged with instructional materials and activities in a natural learning environment.
The integration of the two phases allowed the qualitative findings to explain and support the trends identified from the quantitative results.

3.5 Data Analysis

Quantitative data from the adapted VARK questionnaire were analysed using descriptive statistics, specifically frequency and percentage distributions. Responses were grouped according to the four VARK modalities: visual, auditory, read/write, and kinesthetic. For each respondent, scores were tabulated based on the number of selections associated with each modality across the 20 items. The modality with the highest score was interpreted as the respondent's dominant learning preference.

Respondents who obtained similarly high scores across more than one modality were classified as multimodal learners. In this study, multimodal classification was determined when no single modality clearly dominated the response profile. Because multimodal classification may overlap with individual modality counts, the results were interpreted cautiously and reported with clear explanations of whether categories were mutually exclusive or overlapping. This is important to avoid ambiguity in the presentation of percentages and frequencies.

Qualitative data from the interviews and classroom observations were analysed using thematic analysis. First, the interview recordings were transcribed verbatim and the observation notes were compiled. Second, the data were read repeatedly to achieve familiarity. Third, initial codes were assigned to segments of data related to students' preferred learning approaches, engagement patterns, and learning challenges. These codes were then grouped into broader themes that captured recurring patterns across participants. The qualitative themes were subsequently compared with the quantitative findings to identify points of convergence and to provide contextual explanations for the distribution of learning preferences identified in the survey.

To enhance the trustworthiness of the qualitative analysis, the study employed interview and observation data. The use of multiple data sources also supported methodological triangulation, which helped strengthen the credibility of the interpretation.

3.6 Ethical Considerations

Ethical considerations were observed throughout the study. Prior to completing the Google Form, students were presented with an explanation of the study and an informed consent form. Participation in both the questionnaire and interview phases was voluntary. The participants were assured that the information collected would be used solely for academic research purposes, treated confidentially, and reported in aggregate form without revealing individual identities. Informed consent was obtained from all participants before data collection commenced.

4. Results

This section presents the quantitative findings from the adapted VARK questionnaire and the qualitative findings from the structured interviews and classroom observations. Consistent with the analytical approach described in the methodology, the quantitative results are reported as descriptive patterns of modality representation, followed by qualitative themes that provide contextual explanations for the observed learning preferences.

4.1 Representation of VARK Modalities and Multimodal Profiles

The quantitative analysis showed that students demonstrated varied learning preferences across the four VARK modalities. Visual learning was the most frequently represented modality, appearing in 84 respondents (56.0%). This was followed by kinesthetic learning, represented in 67 respondents (44.7%), auditory learning in 48 respondents (32.0%), and read/write learning in 29 respondents (19.3%). In addition, 86 respondents (57.3%) were identified as multimodal learners, indicating that a substantial proportion of students did not demonstrate one clearly dominant learning modality.

These findings suggest that students in CSC253 tend to engage with learning through multiple channels, although visual and kinesthetic preferences were more strongly represented than auditory and read/write preferences. The high proportion of multimodal learners further indicates that many students may benefit from instructional approaches that combine several forms of content delivery and learning activities rather than relying on a single mode of teaching.

Table 1
Representation of VARK modalities and multimodal profiles among respondents

Learning Style	Frequency	Percentage (%)
Visual	84	56.0
Kinesthetic	67	44.7
Auditory	48	32.0
Read/ Write	29	19.3
Multimodal	86	57.3

Note: The categories reported in Table 1 are not mutually exclusive. Respondents identified as multimodal may also show strong representation in one or more of the individual VARK modalities. Therefore, the percentages exceed 100% and should be interpreted as overlapping response profiles rather than separate groups.

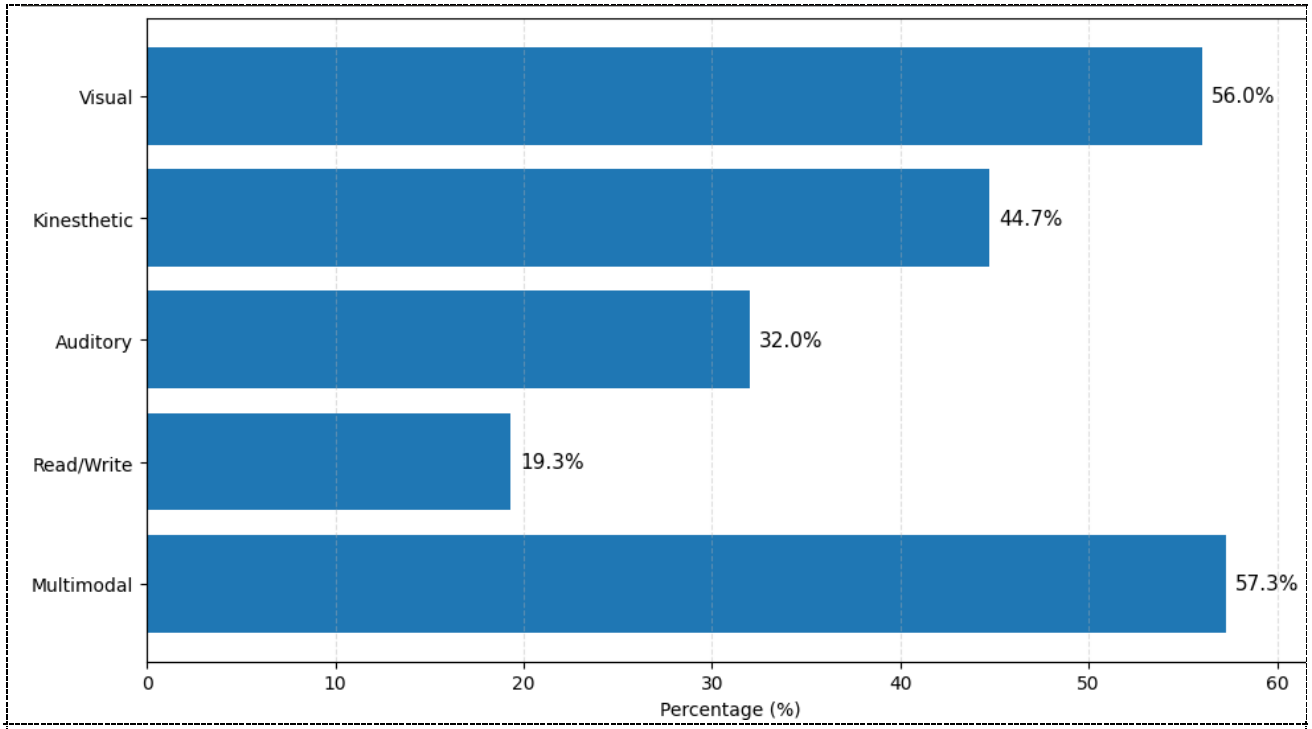

Fig. 2. Representation of VARK modalities and multimodal profiles among respondents

Fig. 2. Shows the learning style distribution among respondents. The analysis revealed that students demonstrated diverse learning preferences across the four VARK categories. Visual learning emerged as the most dominant preference, followed by kinesthetic, auditory, and read/write learning styles. In addition, a substantial proportion of students were identified as multimodal learners.

4.2 Qualitative Findings

The qualitative phase, based on structured interviews and classroom observations, provided further explanation for the quantitative patterns. Three main themes emerged from the data.

i. Theme 1: Visual explanation supported understanding of complex content. Many students reported that diagrams, videos, interface displays, and graphical demonstrations helped them understand multimedia concepts more clearly. Visual presentation was particularly useful when students needed to follow design processes, understand software functions, or interpret multimedia elements step by step. Classroom observations similarly showed that students paid closer attention when lecturers used visual examples and demonstrations during instruction.
ii. Theme 2: Hands-on activities increased engagement and confidence. Students with strong kinesthetic tendencies expressed greater interest in learning when they were directly involved in practical tasks. Activities such as software-based exercises, guided design work, and interactive practice allowed them to apply concepts immediately and strengthened their engagement during class. Observation data also showed that participation increased during sessions that required students to manipulate tools, complete tasks, and test ideas in practice.
iii. Theme 3: Multimodal instruction was preferred over single-mode delivery. Across the interviews, students generally indicated that they learned more effectively when lessons

combined several instructional elements, such as visual demonstrations, verbal explanation, written guidance, and practical activity. Although visual and kinesthetic tendencies were especially prominent, auditory discussion and written notes also played supportive roles in helping students follow instructions and consolidate understanding. This finding helps explain the substantial presence of multimodal learning profiles in the quantitative results and suggests that students in CSC253 benefit from integrated instructional approaches rather than reliance on a single teaching mode.

Overall, the qualitative findings support the quantitative results by showing that students' learning preferences in multimedia interactive learning were not limited to one fixed mode. Instead, engagement appeared strongest when multiple instructional approaches were combined in ways that reflected the practical and interactive nature of the course.

5. Discussion

The findings of this study suggest that diploma students in CS110 and CS111 demonstrated varied learning preferences in the Multimedia Interactive course (CSC253), with visual and kinesthetic modalities being the most strongly represented, alongside a substantial proportion of multimodal learners. This pattern is meaningful in the context of multimedia interactive learning, where students are regularly exposed to visual materials, guided explanations, written instructions, and practical activities. Rather than indicating that one instructional mode is universally superior, the results suggest that students in this setting may engage more readily when teaching incorporates several complementary forms of learning support.

The strong representation of visual learning preferences appears consistent with the nature of the course. Multimedia interactive learning often requires students to interpret images, interface elements, design layouts, demonstrations, and other visually structured materials. In such contexts, visual presentation may support comprehension by helping students organise information and follow processes more clearly. Similarly, the relatively high representation of kinesthetic learning suggests that students may respond positively to practical engagement, particularly when they are required to apply concepts through software use, design tasks, and interactive activities. These findings are broadly in line with previous studies in applied and technology-related education, where visual and active forms of learning have been reported as prominent among learners dealing with technical content [13,14].

At the same time, the substantial proportion of multimodal learners indicates that many students do not appear to rely on a single learning modality. Instead, their engagement may depend on how different instructional modes are combined within a given learning context. This finding supports the view that learning preferences should not be treated as fixed or isolated categories, but rather as flexible tendencies that may shift according to task demands and classroom conditions [5]. In the present study, the prominence of multimodal profiles suggests that instructional design in CSC253 should not focus narrowly on one preferred mode, but should provide multiple entry points to support understanding and participation.

The qualitative findings strengthen this interpretation. Students described visual materials as helpful for understanding complex content, while practical activities appeared to support engagement and confidence during learning tasks. At the same time, students also referred to the value of verbal explanations and written guidance, especially when these were combined with demonstrations and hands-on activities. Classroom observations showed a similar pattern, with students appearing more attentive and involved when lessons integrated multiple instructional

elements. Taken together, these findings suggest that multimodal teaching approaches may support engagement more effectively than single-mode delivery in this course context.

However, these results should be interpreted with caution. The present study identifies patterns in self-reported learning preferences and observed classroom engagement, but it does not test whether matching instruction to those preferences improves academic performance. For that reason, the findings should not be taken as evidence in support of a strict learning-style matching approach. This point is important given the broader debate in the literature, which has questioned whether learning styles can reliably predict learning outcomes or justify rigid instructional differentiation [5,6,12]. In this study, the value of the VARK framework lies more in its usefulness as a descriptive tool for understanding learner variability than as a prescriptive formula for teaching effectiveness.

Another important point is that the observed preference pattern may reflect the demands of the course itself. CSC253 combines conceptual understanding with applied digital practice, and this structure may naturally encourage stronger visual and kinesthetic engagement. In other words, the results may reflect as much about the instructional environment as they do about stable learner characteristics. This interpretation is consistent with research on technology-enhanced and multimedia learning, which suggests that the design of the learning environment plays a central role in shaping student participation and engagement [1,7,9]. Therefore, the findings of this study may inform instructional design by highlighting the importance of aligning teaching activities with the multimodal nature of the course.

The study also contributes context-specific insight into diploma-level learners in Malaysian computer-related programmes, a population that has received limited attention in previous VARK-based research. While earlier studies have often focused on medical, science, or general higher education populations [10,11,13], the present findings suggest that students in diploma-level multimedia courses may show a distinctive combination of visual, kinesthetic, and multimodal tendencies. This does not imply that these learners are fundamentally different from other groups, but it does suggest that local course context and programme structure matter when interpreting learning preferences.

Overall, the findings suggest that lecturers in multimedia interactive courses should consider adopting a balanced and inclusive instructional approach. Visual materials, guided explanations, written support, and hands-on tasks each appeared to play a useful role in student engagement. A teaching approach that integrates these elements may be better suited to the learning context of CSC253 than one that relies heavily on a single form of delivery.

6. Conclusions

This study examined the learning style preferences of diploma students from the CS110 and CS111 programmes enrolled in the Multimedia Interactive course (CSC253) using Fleming's VARK model. The findings showed that visual and kinesthetic modalities were the most strongly represented, while a substantial proportion of students also demonstrated multimodal learning profiles. These results indicate that students in this course context tend to engage with learning through multiple channels rather than through a single dominant mode.

The main contribution of this study lies in its provision of context-specific evidence on learning preferences among Malaysian diploma students in computer-related programmes, a group that has received limited attention in previous VARK-based research. By focusing on a multimedia interactive course, the study adds a more localised and practice-oriented perspective to the literature on learning preferences in higher education.

In practical terms, the findings suggest that instructional design in multimedia interactive courses should incorporate a balanced combination of visual materials, verbal explanation, written guidance, and hands-on activities. Such an approach may better support student engagement and participation than reliance on a single mode of instruction.

This study has several limitations. The findings were drawn from one institution and one course context, which may limit their broader generalisability. In addition, the study examined self-reported learning preferences and observed engagement patterns, but it did not test the relationship between these preferences and academic performance. Future research may extend this work by involving larger and more diverse samples, comparing different course contexts, and examining how multimodal instructional strategies relate to learning outcomes over time.

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References

[1] Bond, M., S. Bedenlier, V. I. Marín, and M. Händel. "Emergency Remote Teaching in Higher Education: Mapping the First Global Online Semester." *International Journal of Educational Technology in Higher Education* 18, no. 1 (2021): 50. https://doi.org/10.1186/s41239-021-00282-x.

[2] Lai, Jennifer W. M., and Matt Bower. "How Is the Use of Technology in Education Evaluated? A Systematic Review." *Computers & Education* 133 (2019): 27-42. https://doi.org/10.1016/j.compedu.2019.01.010.

[3] Grøndahl Glavind, J., L. Montes De Oca, P. Pechmann, D. Brauner Sejersen, and T. Iskov. "Student-Centred Learning and Teaching: A Systematic Mapping Review of Empirical Research." *Journal of Further and Higher Education* 47, no. 9 (2023): 1247–1261. https://doi.org/10.1080/0309877X.2023.2241391.

[4] Fleming, Neil D. *Teaching and Learning Styles: VARK Strategies*. Christchurch, N.Z.: Neil D. Fleming, 2001.

[5] Husmann, Polly R., and Valerie Dean O'Loughlin. "Another Nail in the Coffin for Learning Styles? Disparities among Undergraduate Anatomy Students' Study Strategies, Class Performance, and Reported VARK Learning Styles." *Anatomical Sciences Education* 12, no. 1 (2019): 6-19. https://doi.org/10.1002/ase.1777.

[6] Cuevas, Joshua. "Is Learning Styles-Based Instruction Effective? A Comprehensive Analysis of Recent Research on Learning Styles." *Theory and Research in Education* 13, no. 3 (2015): 308-333. https://doi.org/10.1177/1477878515606621.

[7] Abdulrahaman, M. D., N. Faruk, A. A. Oloyede, N. T. Surajudeen-Bakinde, L. A. Olawoyin, O. V. Mejabi, Y. O. Imam-Fulani, A. O. Fahm, and A. L. Azeez. "Multimedia Tools in the Teaching and Learning Processes: A Systematic Review." *Heliyon* 6, no. 11 (2020): e05312. https://doi.org/10.1016/j.heliyon.2020.e05312.

[8] Zhong, L. "A Systematic Review of Personalized Learning in Higher Education: Learning Content Structure, Learning Materials Sequence, and Learning Readiness Support." *Interactive Learning Environments* (2022). https://doi.org/10.1080/10494820.2022.2061006.

[9] El-Sabagh, H. A. "Adaptive E-Learning Environment Based on Learning Styles and Its Impact on Development Students' Engagement." *International Journal of Educational Technology in Higher Education* 18, no. 1 (2021): 53. https://doi.org/10.1186/s41239-021-00289-4.

[10] Khanal, Laxman, Sandip Shah, and Sarun Koirala. "Exploration of Preferred Learning Styles in Medical Education Using VARK Modal." *Russian Open Medical Journal* 3, no. 3 (2014): 0305. https://doi.org/10.15275/rusomj.2014.0305.

[11] Kharb, Poonam, Prajna Paramita Samanta, Manisha Jindal, and Vishram Singh. "The Learning Styles and the Preferred Teaching-Learning Strategies of First Year Medical Students." *Journal of Clinical and Diagnostic Research* 7, no. 6 (2013): 1089-1092. https://doi.org/10.7860/JCDR/2013/5809.3090.

[12] Pashler, Harold, Mark McDaniel, Doug Rohrer, and Robert Bjork. "Learning Styles: Concepts and Evidence." *Psychological Science in the Public Interest* 9, no. 3 (2008): 105-119. https://doi.org/10.1111/j.1539-6053.2009.01038.x.

[13] Subagja, Sigit, and Bibin Rubini. "Analysis of Student Learning Styles Using Fleming's VARK Model in Science Subject." *Jurnal Pembelajaran dan Biologi Nukleus* 9, no. 1 (2023). https://doi.org/10.36987/jpbn.v9i1.3752.

[14] Friss de Kereki, Inés P. "Incorporation of 'Kinesthetic Learning Activities' to Computer Science 1 Course: Use and Results." *CLEI Electronic Journal* 13, no. 2, Paper 1 (2010). https://doi.org/10.19153/cleiej.13.2.1.

[15] Sánchez-Mena, Ana, José A. Marín-Marín, Germán López-Belmonte, and Pedro Romero-Rodríguez. "Active Learning Strategies in Computer Science Education: A Systematic Review." *Multimodal Technologies and Interaction* 8, no. 6 (2024): 50. https://doi.org/10.3390/mti8060050.

[16] Kucuk, Sevda, and Gamze Kapakin. "Multimedia Learning Principles in Different Learning Environments: A Systematic Review." *Smart Learning Environments* 9 (2022): 38. https://doi.org/10.1186/s40561-022-00200-2.