

# Exploring Students' Attitudes, Challenges, and Strategies in Learning Carbon Compounds in Chemistry

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## Abstract

This study investigates the factors influencing Form 5 students' attitudes, challenges, and learning strategies in learning carbon compounds in Chemistry. Carbon compounds are widely recognised as one of the most complex topics in the Malaysian secondary school Chemistry curriculum, requiring students to comprehend abstract concepts, reaction mechanisms, and multistep synthesis processes. A quantitative survey design was employed, involving 100 science stream students from SMK Jalan Empat and SMK Pulau Indah in Selangor. Data were collected using a structured questionnaire comprising sections on demographic information, attitudes towards learning carbon compounds, challenges encountered, and strategies adopted by students. The data were analysed using descriptive statistics via the Statistical Package for the Social Sciences (SPSS). The findings indicate that students generally exhibit positive attitudes towards the learning of carbon compounds, with teaching approaches identified as a significant influencing factor. However, students reported difficulties primarily related to the memorisation and application of multistep synthesis. In terms of learning strategies, practising past-year examination questions was identified as the most effective approach. The study highlights the importance of addressing both cognitive and pedagogical factors to enhance students' understanding and engagement. It is recommended that educators adopt targeted instructional strategies and provide structured support to improve students' performance in learning carbon compounds.

**Keywords:** Carbon Compounds, Form 5 Chemistry, Students' Attitudes, Learning Challenges And Learning Strategies

## Introduction

Secondary school constitutes a crucial phase in students' academic progression, connecting fundamental learning with more sophisticated studies. In Malaysia, secondary education typically encompasses Form 1 to Form 5, offering students extensive exposure to subjects

including science, mathematics, languages, and the humanities, while fostering their intellectual, social, and personal growth. In this setting, students' attitudes toward learning significantly influence their academic engagement and performance. Positive dispositions, including curiosity, motivation, and resilience, can enhance learning and assist pupils in navigating difficult academic challenges, but negative dispositions may impede academic advancement (Ince, 2023).

These challenges are extremely significant in chemistry education, particularly when students face abstract and cognitively challenging subjects like carbon compounds. Examining carbon compounds presents difficulties as it necessitates comprehension of intricate molecular structures, characteristics, and interactions, many of which are not readily visualised. Consequently, students may encounter confusion, ambiguity, and diminished confidence when studying the subject. These challenges may be exacerbated by the requirements of additional academics and extracurricular obligations. To address these challenges, kids frequently require efficient learning tactics, such as visual aids, collaborative learning, repetitive review, and teacher assistance. An optimistic disposition towards these tactics may facilitate a more manageable and significant learning experience.

The Form 5 Chemistry syllabus in Malaysia emphasises carbon compounds, encompassing their structures, characteristics, and reactions. Students are required to study hydrocarbons, functional groups, isomerism, nomenclature, and significant reactions including esterification, addition, substitution, and combustion. Laboratory activities are crucial for consolidating theoretical knowledge via practical experience. Despite being a fundamental aspect of the chemistry curriculum, numerous students still see carbon compounds as challenging to comprehend.

An essential rationale for investigating this topic is that students' motivation and involvement can profoundly affect their comprehension and performance in chemistry. Elements such as perceived complexity, topic interest, and the educational environment may influence students' reactions to carbon compounds. The subject poses significant obstacles, such as comprehending abstract concepts, retaining various responses and mechanisms, and linking academic knowledge to practical applications. These challenges may lead students to feel inundated and may impact both their educational experience and success.

To tackle these issues, appropriate pedagogical strategies are required. An encouraging educational atmosphere that fosters inquiry, dialogue, cooperative learning, and prompt feedback can enhance students' comprehension of the subject matter. Methods include group discussion, guided practice, and instructor feedback help mitigate misconceptions and enhance students' confidence in understanding carbon compounds. When students receive sufficient help and employ appropriate tactics, they can enhance their performance in chemistry and cultivate a heightened interest in associated scientific disciplines.

The Malaysian education system increasingly emphasises higher-order thinking skills, particularly through curricular modifications in accordance with the Malaysia Education Blueprint 2013–2025. This transition in science education necessitates that students not only gain topic knowledge but also employ reasoning and problem-solving abilities. Nonetheless, students' performance in science disciplines remains troubling, with chemistry frequently

perceived as challenging due to its abstract concepts, technical language, and problem-solving requirements.

In chemistry, carbon compounds are often regarded as one of the most difficult subjects for secondary school pupils. Challenges frequently emerge in comprehending reaction classifications, chemical characteristics, homologous sequences, and especially multistep synthesis. Prior studies indicate that students' attitudes may affect their interest and performance in the study of carbon compounds (Damo & Prudente, 2019). Furthermore, challenges in mastering this topic may be influenced by various factors, including the students, the instructor, and the characteristics of the subject matter.

Despite prior research investigating students' issues in understanding carbon compounds, these difficulties remain prevalent, particularly for organic synthesis and reaction mechanisms. This signifies the necessity for additional inquiry into students' experiences about the topic, encompassing both the challenges they encounter and their attitudes and coping techniques in response to those difficulties. Grasping these elements is especially crucial for Form 5 pupils, who are anticipated to attain proficiency in this subject as a component of the secondary school chemistry syllabus.

This study investigates the elements affecting students' attitudes towards learning carbon compounds, the problems they face, and the tactics they employ in mastering the subject. The study is important as it may offer valuable insights for students, educators, and curriculum developers in enhancing the instruction and comprehension of carbon compounds. This study concentrates on Form 5 science-stream students enrolled in chemistry at selected secondary schools in Selangor, Malaysia, and is confined to this particular educational setting. In this study, students denote Form 5 science-stream pupils enrolled in chemistry, while carbon compounds pertain to the Form 5 chemistry subject encompassing the structures, properties, and reactions of organic compounds. Attitudes signify students' perceptions and inclinations towards the study of carbon compounds, challenges denote the learning obstacles they face, and strategies refer to the methods employed to enhance their comprehension of the topic. This study aims to elucidate students' learning experiences and provide insights that may enhance the teaching and learning of carbon compounds.

### **Problem Statement**

Malaysia's education system increasingly emphasises higher-order thinking skills, particularly through curricular modifications in accordance with the Malaysia Education Blueprint 2013–2025. This transition in science education necessitates that students not only obtain topic knowledge but also employ reasoning and problem-solving abilities. Nonetheless, students' performance in science disciplines remains troubling, with chemistry frequently perceived as challenging due to its abstract concepts, technical language, and problem-solving requirements.

In chemistry, carbon compounds are often regarded as one of the most difficult subjects for secondary school pupils. Challenges frequently emerge in comprehending reaction classifications, chemical characteristics, homologous sequences, and especially multistep synthesis. Prior studies indicate that students' attitudes may affect their interest and performance in the study of carbon compounds (Damo & Prudente, 2019). Moreover,

challenges in mastering this topic may be influenced by various factors, including the students, the instructor, and the characteristics of the subject matter.

Despite prior research investigating students' issues in understanding carbon compounds, these difficulties remain prevalent, particularly for organic synthesis and reaction mechanisms. This signifies the necessity for additional inquiry into students' experiences about the topic, encompassing both the challenges they encounter and their attitudes and coping mechanisms employed to address those difficulties. Grasping these elements is especially crucial for Form 5 pupils, who are required to attain proficiency in this subject as part of the secondary school chemistry syllabus.

This study investigates the elements affecting students' attitudes towards learning carbon compounds, the problems they face, and the tactics they employ in mastering the subject. The study aims to elucidate students' learning experiences and provide insights that could enhance the efficacy of teaching and learning regarding carbon compounds.

### **Significance of the Study**

This study enhances comprehension of Form 5 students' learning of carbon compounds by analysing their attitudes, the obstacles they encounter, and the techniques they employ. The results are anticipated to advantage multiple stakeholders. The study may enhance students' knowledge of the elements affecting their learning and assist them in identifying effective techniques for increasing their comprehension of carbon compounds. The findings may offer valuable insights into students' attitudes and learning challenges, perhaps enhancing teaching methods and instructional tactics for educators. The study may provide curriculum planners and education authorities with evidence regarding unique learning issues related to carbon compounds, hence guiding enhancements in curriculum design, instructional support, and topic delivery in secondary school chemistry. This study offers practical insights on enhancing the teaching and learning of carbon compounds in secondary education.

### **Research Objectives and Research Questions**

This study seeks to discover the elements affecting students' attitudes toward learning carbon compounds, investigate the problems they have in this subject, and ascertain the tactics employed in their learning process. In accordance with these objectives, the study examines three principal questions: What factors affect students' perceptions of learning carbon compounds? What difficulties do pupils have when studying carbon compounds? What tactics do students employ to learn about carbon compounds?

### *Scope and Limitations of the Study*

This study examines Form 5 science-stream students enrolled in chemistry at selected secondary schools in Selangor, Malaysia, specifically regarding their attitudes, problems, and learning strategies concerning carbon compounds. The findings are confined to this particular educational context and may not be applicable to students from different year levels, academic streams, or geographical locations. Furthermore, the study depended on replies obtained via an online questionnaire, which may have been affected by students' willingness to engage, degree of attentiveness, and internet accessibility. The quantitative methodology enabled the study to discern overarching patterns; yet, it failed to yield comprehensive insights into students' individual experiences or elucidations of their learning challenges.

*Definition of Key Terms*

This study focuses on Form 5 science-stream students enrolled in chemistry at selected secondary schools in Selangor. Carbon compounds pertain to the Form 5 chemistry curriculum, encompassing the structures, characteristics, and reactions of organic compounds, including homologous series such as alkanes, alkenes, alkynes, alcohols, carboxylic acids, and esters. Attitudes represent students' perceptions and inclinations about the study of carbon compounds. Challenges denote the learning obstacles students face while studying the subject matter. Strategies denote the tactics or strategies employed by pupils to enhance their comprehension of carbon compounds.

**Theoretical Background**

This research is according to Walberg's Theory of Educational Productivity, which elucidates students' learning outcomes via the interplay of aptitude, teaching, and environment. In 1981, Walberg presented a theory to determine the elements affecting pupils' academic progress. The approach underscores that students' learning is influenced by various interconnected factors rather than solely by aptitude. Walberg's Theory of Educational Productivity, illustrated in Figure 1, offers a theoretical framework for comprehending the impact of aptitude, education, and environment on students' learning results.

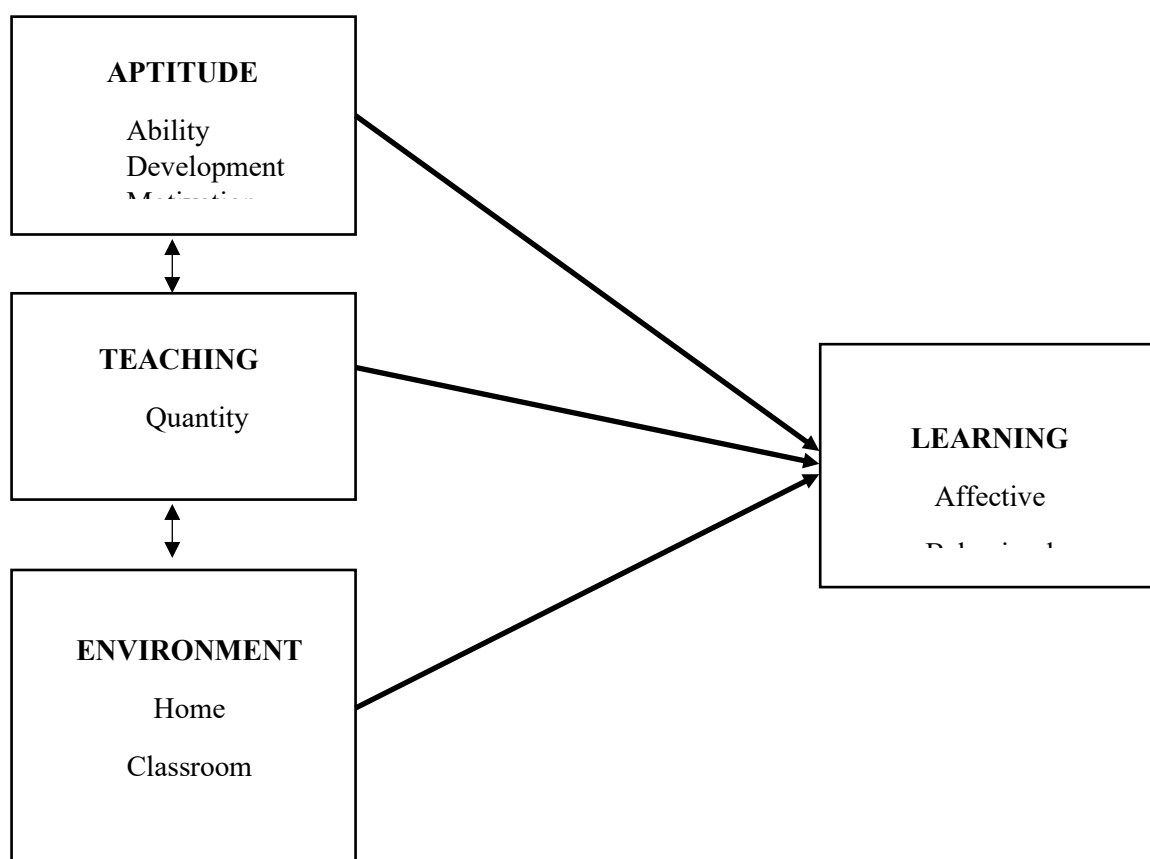


Figure 1: Walberg's Theory of Educational Productivity

Walberg's framework posits that educational output is determined by three primary components: aptitude, instruction, and environment. These components are associated with many modalities of learning, encompassing cognitive, behavioural, and affective dimensions. Aptitude encompasses traits such as capability, growth, and drive, all of which can influence

students' academic performance. In the study of carbon compounds, variations in cognitive ability and motivation may affect students' comprehension of complex concepts and their responses to difficult tasks. Angelica (2021) observed that pupils with superior cognitive capacities may find intricate subjects more comprehensible, whereas motivation significantly contributes to maintaining involvement in learning.

Instruction constitutes another essential element of the system. Walberg's concept emphasises the significance of both the quantity and quality of instruction in influencing educational results. Effective instruction can enhance student performance and bolster their motivation to learn (Angelica, 2021). In a subject like carbon compounds, where students engage with abstract structures, reaction mechanisms, and symbolic representations, the efficacy of instruction can significantly impact students' attitudes and comprehension.

Walberg's thesis posits that the learning environment is a crucial factor. Environmental factors, including the classroom, peers, and extensive learning support, may impact students' involvement and academic performance. This study's idea is pertinent as it offers a valuable foundation for comprehending how students' attitudes about learning carbon compounds may be affected by internal factors, instructional methods, and the overall learning environment.

#### *Related Literature on Students' Attitudes, Challenges, and Strategies in Learning Carbon Compounds*

Students' perceptions of learning carbon compounds are influenced by cognitive, emotional, and behavioural reactions to the topic. Attitudes are not static; they can be shaped by individual experiences, previous knowledge, and educational environments (Cherry, 2022). Prior research indicates that students' perceptions of carbon compounds may be affected by various factors, including the students, the instructor, and the characteristics of the subject matter. Students' perception of chemistry as challenging may considerably influence their interest and willingness to engage with carbon compounds.

Factors associated to teachers also seem to play a significant role in influencing pupils' perceptions. The utilisation of appropriate teaching aids and instructional methods may affect students' perceptions of the topic and their confidence in engaging with it. Utilising visual aids, interactive resources, and diverse teaching strategies may alleviate academic stress and foster more favourable learning experiences in carbon compounds.

Aside from attitude, students encounter many hurdles in the study of carbon compounds. Salame et al. (2022) indicated that a primary challenge is in synthesis processes, while misunderstandings about the identification of functional groupings may additionally hinder students' comprehension. Ojima (2017) emphasised that reaction mechanisms represent one of the most formidable challenges in the study of carbon compounds. The findings indicate that the subject is challenging not just due to the multitude of reactions involved but also because it necessitates students to comprehend structural links, reactivity, and conceptual linkages among various types of organic molecules.

The intricacy of carbon compounds is additionally evident in the extensive scope of the field, encompassing many subdisciplines and reaction categories. Students must comprehend both

two-dimensional and three-dimensional structures, along with the interconnections among structure, stability, reactivity, and function. The conceptual requirements may render the subject particularly challenging for secondary school students who are still enhancing their comprehension of abstract chemical representations.

To address these challenges, students may employ several learning methodologies. Dood and Watts (2020) addressed the persistent issue of students' comprehension of reaction mechanisms in chemistry education, noting that learners frequently encounter difficulties with mechanism-related problems in evaluations. Proposed solutions encompass product-centric reasoning, emphasising structural characteristics within homologous series, and employing mentor-mentee methodologies to enhance representational comprehension. These tactics demonstrate that proficient learning of carbon compounds involves more than just memorisation; it also relies on guided practice, conceptual comprehension, and organised problem-solving assistance.

### Conceptual Framework

A conceptual framework elucidates the interrelations among the principal variables being examined and delineates the study's organization to yield significant results (Swaen, 2022). The conceptual foundation for this investigation is illustrated in Figure 2.

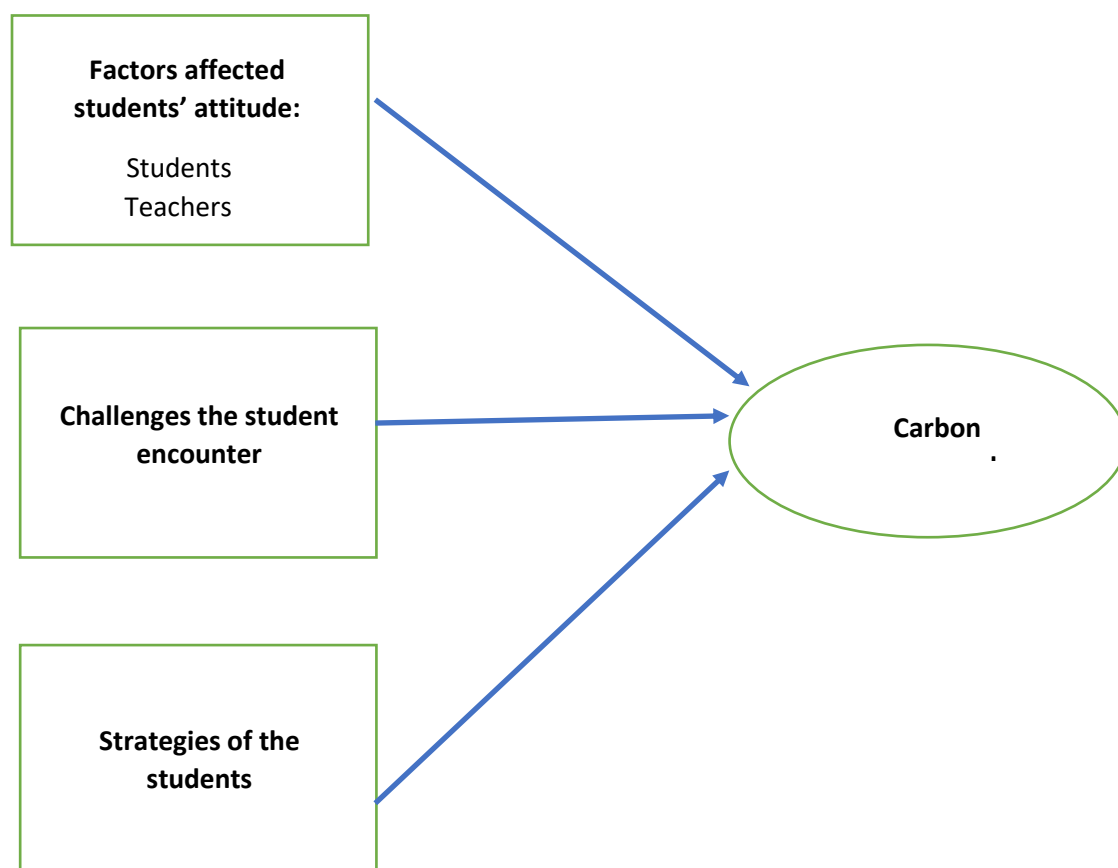


Figure 2: Conceptual Framework

This study, as illustrated in Figure 2, centres on carbon compounds, with three primary variables: factors influencing students' attitudes, challenges faced by students, and strategies

employed in learning carbon compounds. These variables are conceptually interconnected. Students' attitudes may affect their responses to the issue, the problems they encounter may impact their engagement and comprehension, and the tactics they employ may facilitate or impede their learning outcomes. Collectively, these characteristics establish the foundation for analysing students' learning experiences regarding carbon compounds. The research employs these criteria to inform the questionnaire design and the ensuing quantitative analysis of data gathered from Form 5 science-stream students.

### Methodology

This study utilised a quantitative descriptive research approach to investigate the factors affecting students' attitudes, the obstacles they face, and the tactics they employ in learning about carbon compounds. A quantitative approach was chosen as it enables the researcher to collect structured replies, examine patterns quantitatively, and present findings objectively. Mander (2022) asserts that quantitative research is advantageous for rapidly gathering standardised responses and analysing patterns within a specified participant group. The descriptive design employed in this study was suitable as it concentrated on articulating students' viewpoints and learning experiences rather than elucidating causal linkages.

The target group comprised Form 5 science-stream students enrolled in chemistry at selected secondary schools in Selangor. According to Bhandari (2022), the population denotes the entire group from which the study aims to derive findings. Participation was restricted to students engaged in chemistry, as carbon compounds are included in the Form 5 chemical curriculum. A probability sampling method, namely simple random sampling, was employed to mitigate selection bias and ensure that each member of the population had an equal opportunity for selection. The study aimed to include 80 respondents from a population of 100 pupils, as indicated by the table created by Krejcie and Morgan (1970).

Data were gathered via a questionnaire distributed through Google Forms. The tool comprised two primary components: demographic data and Likert-scale items. The demographic part collected data on respondents' age, gender, and current chemistry grade. The second component employed a five-point Likert scale, ranging from strongly disagree to strongly agree. This format was chosen due to its ease of administration and effectiveness in capturing respondents' opinions and perceptions (Maniyamkott, 2022). The survey was segmented into four components. Section A gathered demographic data, Section B assessed factors influencing students' attitudes towards learning carbon compounds, Section C analysed the problems faced by students, and Section D concentrated on the tactics employed by students in studying carbon compounds. The content in these sections was derived from prior research, specifically Hanson (2017), Salame et al. (2020), and Dood and Watts (2022). If you intend to incorporate a visual representation of your instrument arrangement, this is the juncture at which you may enter the pertinent instrument design and introduce it in the sentence preceding the figure or appendix reference.

A preliminary research was executed before the primary data collection to evaluate the reliability of the modified questionnaire. The reliability outcomes are displayed in Table 1, illustrating the Cronbach's alpha values for the three sections of the questionnaire. Table 1 demonstrates that the alpha coefficients were 0.735 for Section B, 0.895 for Section C, and 0.855 for Section D, signifying good internal consistency for subsequent data collection. The

pilot study enhanced the practicality of the research procedure and guaranteed that the respondents from the pilot study were excluded from the final sample.

Table 1

*Cronbach's Alpha Reliability Test*

Sections	Cronbach's Alpha	N of Items
Section B (Factors Affected Students' Attitude in learning Carbon Compounds)	0.735	7
Section C (Challenges the Students' encounter during learning Carbon Compounds)	0.895	7
Section D (The Strategies of Students' in learning Carbon Compounds)	0.855	6

Ethical considerations were considered throughout the study. Consistent with Resnik (2019), the study underscored the importance of responsible research practices, encompassing the proper modification of research tools, recognition of sources, and safeguarding participants' welfare. As the respondents were under 18 years of age, parental or guardian consent was necessary before participation. Efforts were made to guarantee that the questionnaire items were explicit, suitable, and non-intrusive. To maintain anonymity, no personal identifiers, including respondents' names or socioeconomic status, were gathered.

The data collection process commenced following the examination of the research objectives, research questions, and questionnaire items by an expert. After this review, the pilot study was conducted, and requisite adjustments were implemented to the instrument before its final distribution. The final questionnaire was sent through Google Forms via WhatsApp and Telegram groups comprising instructors, students, or parents of Form 5 chemistry students. Participants were allotted roughly 10 to 15 minutes to complete the questionnaire, which remained accessible for three weeks or until 80 replies were obtained. To preserve the procedural flowchart, the optimal moment to present it is by stating: The data gathering operations are encapsulated in Figure 3.

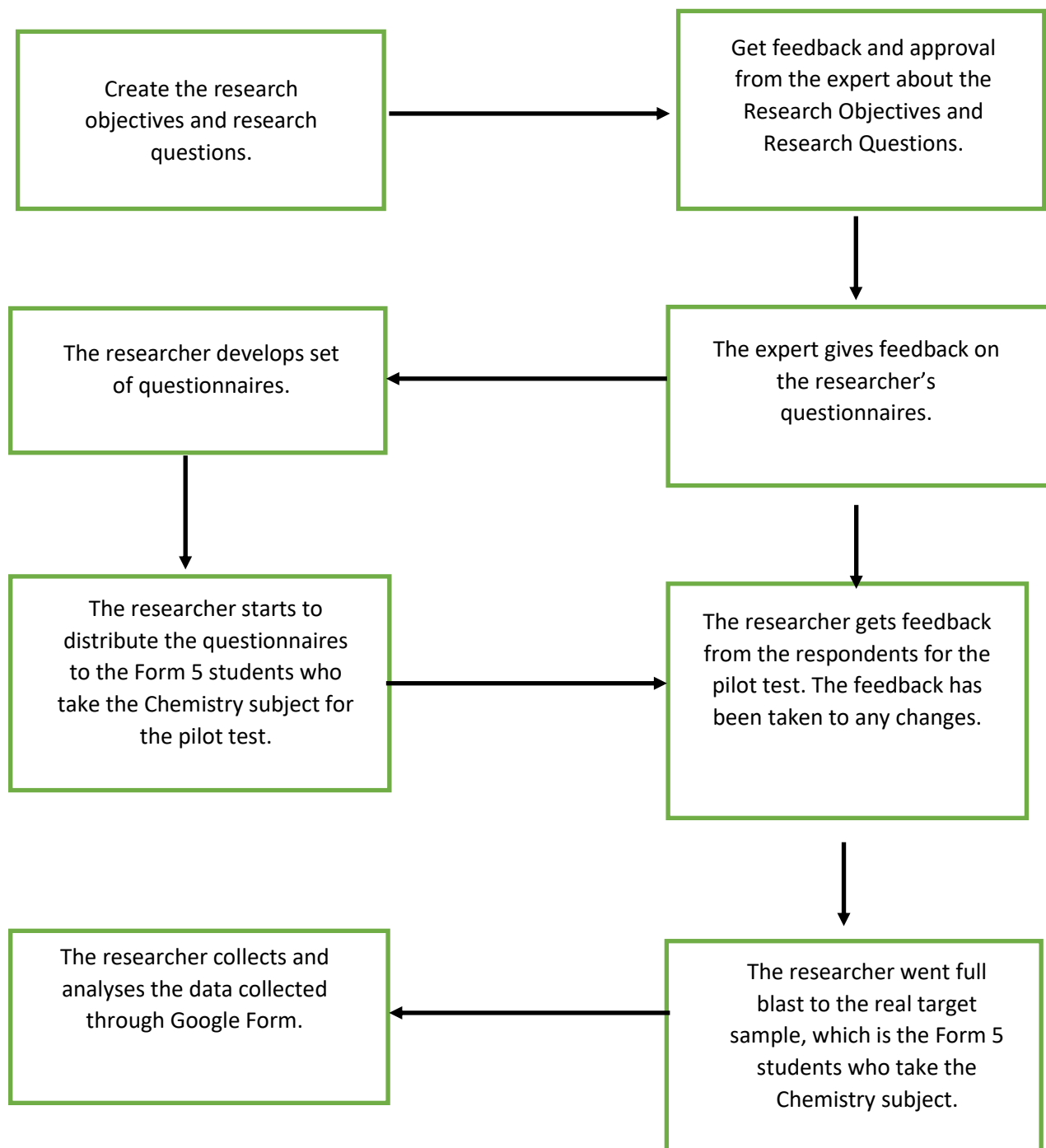


Figure 3: Data Collection Procedures

The gathered data were analysed utilising descriptive statistics with the assistance of the Statistical Package for the Social Sciences (SPSS). The congruence among the research objectives, research questions, instruments, and analysis is encapsulated in Table 2. Table 2 demonstrates that all three research objectives were addressed via the same questionnaire instrument and evaluated via descriptive statistics. The analysis encompassed measures of central tendency, including mean, median, and mode, with measures of dispersion, such as range and standard deviation. This methodology enabled the research to delineate trends in students' attitudes, obstacles, and learning strategies concerning carbon compounds.

Table 2

*Data Analysis*

Research Objectives	Research Questions	Instruments	Analysis
RO1: To identify the factors that affected students' attitude in learning carbon compounds.	RQ1: What are the factors that affected students' attitude in learning carbon compounds?	Questionnaires	Descriptive Statistics
RO2: To investigate the challenges that students' encounter during learning carbon compounds.	RQ2: What are the challenges that students' encounter during learning carbon compounds?	Questionnaires	Descriptive Statistics
RO3: To determine the strategies of the students in learning carbon compounds.	RQ3: What are the strategies of the students in learning carbon compounds?	Questionnaires	Descriptive Statistics

This methodology was developed to offer a systematic and dependable approach for analysing students' attitudes, obstacles, and methods in learning carbon compounds among Form 5 science-stream pupils. The study employed a quantitative descriptive design, a validated questionnaire, and descriptive statistical analysis to produce systematic, relevant, and valuable findings regarding students' learning experiences on this issue.

**Data Analysis**

This section delineates the study's findings derived from the data gathered from the respondents. The analysis examines demographic factors and the results for each research topic utilising descriptive statistics. The results are delineated using frequencies, percentages, mean scores, and standard deviations to elucidate students' attitudes, obstacles, and tactics in the study of carbon compounds.

*Demographic Profile of Respondents*

Table 3 displays the demographic profile of the responders. The table encapsulates the respondents' age, educational institution, gender, and current grade in chemistry. Table 3 indicates that all respondents were 18 years old, constituting 100% of the sample. Regarding school distribution, 31 respondents (31.0%) were from SMK Pulau Indah, whereas 69 respondents (69.0%) were from SMK Jalan Empat. The gender breakdown indicates that 30 respondents (30.0%) identified as male, while 70 respondents (70.0%) identified as female. Concerning the present chemistry grades, 44 respondents (44.0%) achieved an A, 24 respondents (24.0%) attained a B, 16 respondents (16.0%) received a C, and 16 respondents (16.0%) fell into the D, E, and F categories. The demographic statistics delineate the composition of the study sample and furnish essential information for evaluating the findings in the succeeding tables.

Table 3  
*Demographic Data Analysis*

	Variables	Frequency	Percentage (%)
Age	18	100	100.0
School	SMK Pulau Indah	31	31.0
	SMK Jalan Empat	69	69.0
Gender	Male	30	30.0
	Female	70	70.0
Current Grade for Chemistry Subject	A (A-, A, A+)	44	44.0
	B (B+, B)	24	24.0
	C (C+, C)	16	16.0
	D,E,F	16	16.0

### Findings for Research Questions

The research questions were examined using descriptive statistics, focusing on mean scores and standard deviations. This method was employed to ascertain the overall inclination of replies and the uniformity of those responses throughout the sample. The outcomes for each research inquiry are outlined in the subsequent subsections.

#### *Factors Influencing Students' Attitudes Towards Learning Carbon Compounds*

Table 4 presents the data about characteristics that influence students' attitudes towards learning carbon compounds. The table presents the average scores and standard deviations for seven items assessing students' opinions regarding the subject. Table 4, Item 3, indicates that the statement "*I do not understand what the teacher teaches about carbon compounds*" had the lowest mean score ( $M = 2.21$ ,  $SD = 1.122$ ). This indicates that, generally, pupils tended to dissent from the assertion, suggesting they believed they comprehended their teacher's instruction regarding carbon compounds. While this indicates a predominantly favourable view of instructor explanations, discrepancies in chemistry grades imply that comprehension may still vary across students.

In contrast, Item 2, "*I like the teacher's style of carbon compounds,*" recorded the highest mean score ( $M = 3.93$ ,  $SD = 1.027$ ). This suggests that pupils predominantly perceived the teacher's educational approach favourably. The comparatively elevated mean indicates that teacher-related factors, especially teaching style, may significantly influence students' attitudes about studying carbon compounds. The findings in Table 4 indicate that students exhibited predominantly favourable opinions about the education and comprehension of carbon compounds, particularly with their teacher's pedagogical methods.

Table 4

*Descriptive Analysis of Factors Affecting Students' Attitudes in Learning Carbon Compounds*

No.	Items	Mean	Standard Deviation
1.	I enjoy my carbon compounds class.	3.84	0.940
2.	I like teacher's style of carbon compounds.	3.93	1.027
3.	I do not understand what the teacher teaches of carbon compounds.	2.21	1.122
4.	The teacher engages us in practical activities of carbon compounds.	3.79	0.988
5.	The carbon compounds content is adequate to learn in the given term.	3.84	0.896
6.	Teacher demonstrations of what he/she teaches will be useful of carbon compounds in the future.	3.85	0.892
7.	Knowing the importance in carbon compounds of what I study will make me learn more.	3.88	0.868

*Challenges Encountered by Students in Learning Carbon Compounds*

Table 5 presents the data about the obstacles students had in learning about carbon compounds. The table presents the average scores and standard deviations for seven questions related to prevalent learning challenges in the subject matter. Based on Table 5, Item 12, "I cannot draw any structures of organic molecules," recorded the lowest mean score (M = 1.92, SD = 1.116). This indicates that, on average, students did not strongly concur that sketching organic structures was a significant challenge, suggesting at least a fundamental level of proficiency in this domain.

Items 8 and 9, which both relate to multistep synthesis, recorded the same mean score (M = 2.79). Item 8, "I am unsure on where to separate the organic molecule into two parts while solving a multistep synthesis," had a standard deviation of SD = 1.209, whereas Item 9, "I struggled remembering all the different kinds of reactions to use in a multistep synthesis," had a slightly higher standard deviation of SD = 1.233. The results indicate that students encountered similar levels of difficulty in both facets of multistep synthesis, although responses to Item 8 exhibited slightly greater consistency.

The highest mean score in Table 5 was recorded for Item 13, "Memorization was a large part of preparation multistep synthesis," with a mean of M = 3.84 and a standard deviation of SD = 1.002. This indicates that students generally agreed that memorisation plays a major role in preparing for multistep synthesis. The comparatively low standard deviation indicates that this perspective was consistently held among the respondents. The results in Table 5 indicate that multistep synthesis and the retention of reaction processes were significant problems faced by students in the study of carbon compounds.

Table 5

*Descriptive Analysis of Challenges Encountered by Students in Learning Carbon Compounds*

No.	Items	Mean	Standard Deviation
8.	I am unsure on where to separate the organic molecule into two parts while solving a multistep synthesis.	2.79	1.209
9.	I struggled remembering all the different kinds of reactions to use in a multistep synthesis.	2.79	1.233
10.	It is hard to memorize all the reactions of chemical properties of homologous series.	2.60	1.333
11.	Synthesis problems are the most difficult part of carbon compounds.	2.97	1.185
12.	I cannot draw any structures of organic molecules.	1.92	1.116
13.	Memorization was a large part of preparation multistep synthesis.	3.84	1.002
14.	The organic content is overloaded for the period of study.	2.85	1.201

*Strategies Used by Students in Learning Carbon Compounds*

Table 6 presents the data on students' approaches to learning carbon compounds. The table presents the mean scores and standard deviations for six items concerning students' preferred or perceived successful learning practices. As shown in Table 6, Item 16, *"It is easy to solve the problem by focusing on structural features only,"* recorded the lowest mean score ( $M = 3.42$ ,  $SD = 1.056$ ). This indicates that students were less persuaded that concentrating solely on structural aspects was adequate for addressing issues in carbon compounds.

Items 17 and 18 both had notably elevated mean scores ( $M = 4.15$ ). Item 17, pertaining to study groups with a mentor, exhibited a standard deviation of 0.947, whereas Item 18, concerning teacher support in genuine problem-solving skills involving reaction mechanisms, demonstrated a standard deviation of 0.857. The data indicate that students predominantly appreciated collaborative learning and guided problem-solving methods, with a marginally greater consistency of replies for Item 18.

The highest mean score in Table 6 was recorded for Item 19, *"The right method of learning carbon compounds is by answering all the past year questions related to organic molecules,"* with a table value of  $M = 4.28$ ,  $SD = 0.889$ . This signifies robust consensus among students that responding to the previous year's questions is an efficacious technique for mastering carbon compounds. The comparatively low standard deviation indicates that this perception was broadly held. The results in Table 6 demonstrate that students preferred practice-oriented and guided learning methodologies, especially the utilisation of former examination problems, mentorship, and problem-solving assistance.

Table 6

*Descriptive Analysis of Students' Strategies in Learning Carbon Compounds*

No.	Items	Mean	Standard Deviation
15.	The better way to learn carbon compounds is identifying learning styles that I can adapt.	4.19	0.861
16.	It is easy to solve the problem by focusing on structural features only.	3.42	1.056
17.	By doing study group with mentor represent as a young teacher can help me understand better in carbon compound.	4.15	0.947
18.	Carbon compounds concepts are very easy to understand if the teacher introduces with the real problem-solving skills with reaction mechanisms.	4.15	0.857
19.	Right method of learning carbon compounds is by answering all the past year questions related to organic molecules.	4.28	0.889
20.	Memorize every technique and the steps of mechanisms in organic molecules.	4.12	0.924

**Summary of Findings**

The data analysis reveals that students exhibited predominantly good attitudes about studying carbon compounds, especially for teaching style and instructional support. Simultaneously, pupils indicated significant difficulties related to multistep synthesis, particularly the requirement for memorisation. The data indicate that students considered answering past examination problems, engaging in study groups, and obtaining guided problem-solving assistance as very effective techniques for learning carbon compounds. These findings establish the foundation for the ensuing discourse on the study's consequences and suggestions.

**Discussion**

This study studied the factors influencing students' attitudes, the obstacles they confront, and the tactics they employ in learning carbon compounds among Form 5 students. The discussion of the findings is structured according to the study topics and interpreted in respect to previous studies.

*Students' Attitudes towards Learning Carbon Compounds*

The findings indicate that teacher-related factors have a crucial role in changing students' attitudes towards studying carbon compounds. Based on the results provided in Table 4, the item "I like the teacher's style of teaching carbon compounds" received the highest mean score, demonstrating that students' views towards the topic are substantially influenced by the way it is taught. This research shows that instructional style, clarity of explanation, and

classroom involvement may contribute favourably to students' enthusiasm and confidence in learning carbon compounds.

This interpretation is congruent with Sugano and Mamolo (2021), who observed that cooperative and engaging teaching styles can boost students' motivation to learn chemistry. In the context of carbon compounds, collaborative and interactive education may minimise the perceived complexity of the material and encourage increased student participation. Similarly, Sibomana et al. (2021) underlined that teacher-related factors, particularly the availability and effective use of teaching and learning resources, can greatly affect students' achievement and motivation. When teachers are able to offer courses using adequate instructional methods and materials, students may acquire more favourable attitudes towards tough chemistry topics such as carbon compounds.

The item "I do not understand what the teacher teaches about carbon compounds" earned the lowest mean score, showing that most students generally considered they were able to understand their teacher's presentation of the issue. This shows that, overall, pupils did not consider instructor explanation as a substantial impediment to understanding carbon compounds. However, the diversity in student accomplishment implies that knowledge may not be equally robust across all learners. Some students may still encounter difficulty when applying their information in exams, especially in more demanding aspects of the topic. Du Toit-Brits (2019) stated that factors such as anxiety, restricted self-directed learning, and challenges in managing academic demands may impair students' performance even when they appear to understand the topic during instruction. This shows that students' attitudes and achievement are impacted not only by teacher explanation, but also by larger personal and academic aspects.

#### *Challenges Encountered in Learning Carbon Compounds*

The data also reveal that students have noteworthy difficulty in learning carbon compounds, particularly in respect to multistep synthesis. Based on the results provided in Table 5, the item "Memorization was a large part of preparation for multistep synthesis" earned the highest mean score, showing that memorisation was a major issue for many students. This shows that students see multistep synthesis as a hard element of carbon compounds, requiring them to retain several reactions, routes, and associated ideas.

This finding is corroborated by Ezzeldin (2022), who highlighted multistep synthesis as an important and demanding component of chemistry learning. To succeed in this subject, students require a good understanding of homologous series and the interactions among distinct kinds of chemicals, such as alkanes, alkenes, alcohols, carboxylic acids, and esters. However, memorisation alone may not be sufficient. Latifah and Suprihatiningrum (2024) claimed that learning strategies based purely on memorisation may lead to cognitive overload and may not assist deeper conceptual understanding. Students therefore require not only recall, but also reasoning, application, and pattern identification in order to solve complex organic synthesis tasks effectively.

The similar mean scores provided for tasks related to separating organic molecules in multistep synthesis and remembering the different reactions necessary further imply that students have difficulty in both structural interpretation and reaction recollection. These data

imply that students may struggle with the procedural and conceptual parts of synthesis concurrently. Focused teaching, frequent guided practice, and step-by-step description of reaction sequences may therefore assist enhance students' confidence and understanding in this area.

In contrast, the question "I cannot draw any structures of organic molecules" earned the lowest mean score, demonstrating that students did not perceive sketching organic structures to be their main issue. This may imply that students have at least a fundamental comprehension of organic structure representation. Braun et al. (2022) stated that even modest competency in drawing structures might serve as a beneficial foundation for subsequent conceptual growth, provided that students receive suitable instructional support. In this study, the outcome shows that while students may be able to represent structures to some level, more difficulty occurs when they are forced to apply that structural knowledge to synthesis and reaction difficulties.

#### *Strategies Used by Students in Learning Carbon Compounds*

The data also suggest that students rely on many practical ways to learn carbon compounds, with test practice emerging as the most strongly supported approach. Based on the results in Table 6, the item referring to responding past year questions linked to organic compounds obtained the highest mean score. This shows that students saw frequent exposure to examination-style questions as a useful strategy to develop understanding and prepare for assessment. Practising prior year problems may help students become comfortable with question styles, enhance topic-specific problem-solving skills, and improve confidence in managing chemistry examinations. Murphy et al. (2024) similarly stated that practice with examination-type questions can assist both material mastery and time management in assessment circumstances.

Students also responded highly to elements linked to mentoring and practical problem-solving approaches. The items covering study groups with mentors and teacher assistance via reaction mechanisms both earned reasonably high mean values, demonstrating that students appreciate collaborative learning and guided application of concepts. McCollum et al. (2019) proposed that contextualised problem-solving and structured support can increase students' learning by integrating theoretical concepts with practical thinking. In the present study, this shows that students benefit from instructional approaches that go beyond memorisation and instead promote guided explanation, conversation, and application.

By comparison, the item "It is easy to solve the problem by focusing on structural features only" received the lowest mean score among the approach items. This suggests that students typically did not believe that structural analysis alone was sufficient for solving difficulties with carbon compounds. The finding implies that students acknowledge the need for a deeper and more comprehensive understanding of the issue, encompassing reaction processes, functional groups, and chemical characteristics. This reflects the complexity of carbon compounds and shows the significance of combining structural information with conceptual and procedural knowledge.

**Implications**

The outcomes of this study contain various implications for teaching and studying carbon compounds in secondary school chemistry. First, the results imply that teacher-related elements, including instructional style and classroom support, play a significant role in developing students' attitudes regarding the topic. This underscores the necessity of equipping instructors with suitable pedagogical tools and teaching resources that can make abstract concepts more approachable and engaging.

Second, the findings indicate that multistep synthesis remains a considerable problem for students, particularly because of the memorisation needs required. This shows a need for instructional methodologies that promote conceptual comprehension, guided reasoning, and planned practice rather than depending largely on rote memorisation. Third, the strong preference for tactics such as prior year questions, mentoring, and guided problem-solving shows that students gain from practical and scaffolded learning chances. These approaches may consequently be effective for enhancing both understanding and examination preparedness.

The study also has contextual implications. Because the research was limited to students from SMK Jalan Empat and SMK Pulau Indah, the findings may reflect differences in school setting, student intake, and accessible learning resources. As indicated in the draft, the disparity between a cluster school and a rural school may have altered students' experiences and performance, which indicates that the findings should be regarded with caution when extended to larger educational settings.

**Recommendations**

Several recommendations can be drawn from the outcomes of this study. First, future research should examine expanding the sample size and incorporating children from a larger range of schools and circumstances. A broader sample would increase the representativeness of the findings and provide a more comprehensive knowledge of students' attitudes, obstacles, and tactics in studying carbon compounds.

Second, future research may benefit from using qualitative approaches such as interviews, focus groups, or classroom observations. These approaches could provide better insight into students' experiences, the reasoning behind their learning preferences, and the classroom dynamics that impact their understanding of carbon compounds. Third, future research should continue to explore the teaching of carbon compounds in relation to the KSSM curriculum so that findings stay relevant to current instructional objectives and national educational goals.

From a practical standpoint, teachers should explore adopting a larger range of instructional tactics, including guided problem-solving, collaborative learning, and structured practice using past year questions. These approaches may assist address typical learning challenges while also enhancing students' confidence and engagement. In addition, precise timing of data collection in future studies may increase the accuracy of findings, as student responses may be influenced by periods of examination stress or practicum-related restraints.

## Conclusion

This study found that Form 5 students generally had positive attitudes toward learning about carbon compounds, which were strongly influenced by the teacher's teaching style and classroom support. However, the major difficulty faced by students was multistep synthesis, especially memorising reactions and applying them correctly. In terms of learning strategies, students most preferred practising past-year questions, working in study groups, and receiving guided problem-solving support.

Based on these major findings, it is suggested that teachers should use more interactive and structured teaching methods, with greater emphasis on step-by-step synthesis practice and conceptual understanding rather than memorisation alone. Students should also be encouraged to continue using past-year questions and collaborative learning to strengthen their mastery of carbon compounds.

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