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Needs Analysis: Exploring The Development of an Organic Module in Teaching Organic Reaction Mechanism (ORM)

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ABSTRACT

Organic Reaction Mechanism (ORM) is a challenging topic in organic chemistry that students must learn meaningfully. ORM studies are expanding in various ways, yet there is still a scarcity of studies on module development incorporating the teaching and learning ORM. This paper reports the needs analysis phase of the Design and Development research (DDR) study, which aims to explore the need to develop an Organic Module for teaching ORM among experts. Note that five experts were interviewed in this phase. The data were examined using thematic analysis to meet the study's objectives. Based on the findings, experts are having problems teaching the topic of ORM in schools. Most of them claim that students lack basic knowledge of the ORM concept, misunderstand placing the arrow correctly in the mechanism reaction and believe that ORM requires memorization. At the same time, there are not enough learning materials, such as modules appropriate for the pre-university syllabus. Most experts agreed that the ORM module should be developed to enhance and assist students' understanding of organic mechanisms. The study implies that this module may be utilized by chemistry educators, lecturers, or teachers since the ORM module in this study is based on the pre-university syllabus.

Keywords:
Module development; needs analysis; organic chemistry; organic reaction mechanism

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1. Introduction

Organic chemistry is often linked to difficulties. Students majoring in Science, Technology, Engineering and Mathematics (STEM) subjects such as chemistry, biology, pharmaceutical sciences, chemical engineering, applied science, or public health science must effectively grasp the concept of organic chemistry. Nevertheless, there is a high failure rate recorded among undergraduate students [1,2]. This indicates that organic chemistry has always been an obstacle for students to pursue a STEM career. Organic chemistry, which studies compounds containing carbon, is mainly taught to upper-secondary, post-secondary, and tertiary students. In preparing for 21st-century challenges, STEM education has shifted its attention to the post-secondary and tertiary levels for greater diversity in the

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STEM careers for the future workforce [3-5]. As a result, a strong foundation in organic chemistry is essential for long-term impacts. It might even promote student persistence and interest in STEM fields, forming a strong STEM workforce.

Many symbolic representations are utilized in organic chemistry to describe chemical transformations, particularly the Electron Pushing Formalism (EPF). However, some students knew little about the arrow [6-8]. The mechanism is the heart of a chemical reaction by breaking it down into smaller steps [9]. The arrows illustrate the movement of electrons from non-bonding electrons or bonds to an electron-deficient atom. In 1959, Morrison and Boyd [10] released the first edition of a textbook that transformed the teaching strategy of organic chemistry by implementing EPF for possible stepwise reaction pathways [10,11].

Nonetheless, students still have trouble simultaneously utilizing the EPF to track electron and atom movement [12]. Besides, Flynn and Ogilvie [11] suggested that students should grasp the organic chemistry language before being taught chemical reactions to master the course. In addition, students must avoid relying on rote learning so that they may be able to organize new knowledge to their prior knowledge when solving organic mechanism tasks [13-16].

A vital issue with efficiently teaching organic subjects is the lack of teaching materials and modules mainly focused on reaction mechanisms. Even though the teachers created their teaching materials, the investigation revealed that those learning aids have not yet fully boosted students' understanding of addressing mechanism problems [17,18] and absence of independent learning [19], [20]. In addition, preparing a specific module is time-consuming and constrains teachers and educators. Hence, an alternate module concentrating on ORM topics that foster independent learning must be offered to support students in comprehending the organic chemistry syllabus.

Several ORM teaching modules have been developed over the years, utilizing diverse instructional strategies such as priority and selectivity rules [21], molecular orbital theories [22,23]**,** online learning [11,24], and reaction pattern recognition [11]. While these approaches have contributed to student learning, they often fail to address key conceptual difficulties, particularly in visualizing electron movement and applying mechanistic reasoning. Many existing modules emphasize rote memorization rather than fostering a deep conceptual understanding of ORM, limiting students' ability to apply their knowledge in novel contexts. Although online learning modules have been explored in previous studies, they are primarily designed for international curricula, making them less relevant to the Malaysian education system. The differences in syllabus structure, assessment styles, and learning objectives present a challenge in directly implementing these modules for Malaysian pre-university students.

A significant shortcoming of current ORM modules is the lack of interactive learning experiences and real-time feedback. Traditional text-based materials do not engage students effectively, and the absence of self-regulated learning (SRL) components restricts independent exploration of reaction mechanisms. Furthermore, educators face challenges in delivering ORM content due to limited well-structured teaching resources, time constraints, and the need for adaptive learning tools.

This study distinguishes itself by employing a DDR approach, integrating qualitative insights from expert interviews to design an innovative ORM module. Unlike previous studies, this research aims to bridge theoretical knowledge and practical application by incorporating SRL strategies, interactive multimedia, and structured problem-solving exercises. The module is tailored to pre-university chemistry syllabi, ensuring alignment with educational objectives while enhancing student engagement and conceptual mastery. By addressing these limitations, this study contributes a novel, technology-enhanced framework for improving ORM education, providing both students and educators with a more effective teaching and learning solution.

Needs analysis is the first phase in the DDR approach. Essentially, the DDR approach is formed through four stages: (i) analysis, (ii) design, (iii) development, and (iv) evaluation. However, some researchers combine the design and development phases into one phase [25-27]. Thus, the development process of the module consists of three stages: the needs analysis phase, the development phase, and the evaluation phase [28]. Meanwhile, as this is the first part of the study, the researcher describes the method used in phase one to determine the needs and problems.

On the other hand, Hutchinson and Waters [29] identified three classifications of needs; Necessities, Lacks, and Wants. 'Necessities' refer to what needs to be learned to function effectively in a target situation. 'Lacks' refers to the gap between what students already know and targeted knowledge, while 'Wants' relates to students' subjective needs. McKillip [30] stated that needs analysis is a judgment value that a specific group has a problem that must be solved. Therefore, this phase is essential and requires definite knowledge of the study's underlying issues before taking the product developed [25,26,31]. Other than that, McKillip [30] provided three models of needs assessment; (i) Discrepancy Model, (ii) Marketing Model, and (iii) Decision-Making Model. This study was referring the Discrepancy Model as the underpinning model of the needs analysis phase [26]. This model emphasizes normative expectations and involves three steps: (i) Goal setting in identifying what ought to be, (ii) Performance measurement for determining what is, and (iii) Discrepancy identification for ordering differences between what ought to be and what is.

In the context of module development, Isman [32] suggested that developing a module begins with several steps, including identifying needs, identifying objectives, defining teaching methods, and defining media intrusion. According to Morrison, Ross, and Kemp [33], identifying problems through needs analysis, goal analysis, and performance analysis is the first step in developing a module. This study conducted a needs analysis at the beginning of the module development study to establish the lack of teaching and learning ORM and how teachers implement appropriate teaching strategies. This is so that ORM learning becomes more meaningful.

1.1 Research Question

This study was conducted to identify what teachers need to develop an effective Organic Module for teaching ORM. Hence, the objective of this study is to explore the need to create the Organic Module for teaching ORM among experts. Other than that, two primary questions are being formulated to be answered:

i) What are the needs in developing Organic Module for teaching ORM among experts?
ii) How are experts' suggestions for the effective Organic Module for teaching ORM?

2. Methodology

The researcher carried out qualitative research, in which the data were collected through semi-structured interviews. This type of interview is guided by a list of questions to be explored without pre-determined words and order. This allows the researcher to respond to the situation at hand encountered by participants emerging worldview with new ideas on the topic [30]. The data collection involves teachers and lecturers of the Ministry of Education (MOE) Malaysia from different institutions who teach the Organic Chemistry subject to pre-university students. This method was applied by Norlidah Alias [35] and Aliza Ali [36] to obtain needs analysis data to produce physics pedagogical modules and preschool children’s modules for teaching and learning language skills, respectively.

The interview aimed to discover information about the process of teaching activities and problems encountered during learning. The teacher interview guidelines consisted of six open-ended questions on the teaching-learning process, teaching strategies, students' issues, teacher needs, and outcomes of the learning process. After formulating the experts' interview protocol, the researcher proceeded with the validation process and pilot interview. During the pilot interview, a participant was questioned to assess the comprehension and clarity of the questions. Furthermore, the study incorporated instrument validation procedures, including face validity and content validity. Three experts have been selected, from two language experts to face validity to one expert chemistry teacher who developed a module in his PhD study. The experts' feedback assisted the researcher in developing the semi-structured questions. Additionally, the study must be conducted ethically to ensure validity and reliability in qualitative research [34]. In this study, the researcher used the audit trail, members check, and triangulation to determine the validity and reliability.

Besides that, Inter-Rater Reliability (IRR) was conducted in this research as part of the process of formulating codes in thematic analysis. IRR serves a critical role as an aid in coding, helping to alleviate potential systematic biases [37]. Two experienced professionals, including a supervisor and an expert who conducted qualitative research as part of their PhD studies, participated in scrutinizing the codes. Kappa analysis was utilized in the IRR analysis of this study to determine the agreement among raters. Consequently, the inter-rater agreement of the codes yielded a Kappa value of 0.80 ($p < 0.010$), with a 95% confidence interval of (0.43, 1.16). This indicates substantial agreement for the semi-structured interview for the experts, following the criteria set by [38].

Purposive sampling was employed to select participants from a homogenous group, with the criteria of the participants directly reflecting the purpose of the study and being able to give a range of information [34]. In addition, the study participants were selected based on the criteria of teachers who have served more than five years in chemistry education and are senior lecturers in pre-university institutions. Note that the participants were guaranteed that any statements identifying them would be kept confidential and that they might withdraw at any moment without penalty or loss of profit. This study's participants are listed in Table 1. Meanwhile, the interview procedures were carried out according to Creswell and Creswell [39] as demonstrated in Figure 1. Finally, the data obtained from the interview protocol with five experts were analyzed using the ATLAS.ti 9 software.

Table 1
Demographics of participants

Aspects	Category	Number
Experience in education	10-15	2
	16-20	1
	>20	2
Expert Field	Malaysian Higher School Certificate (STPM) Teacher	2
	Matriculation Lecturer	3

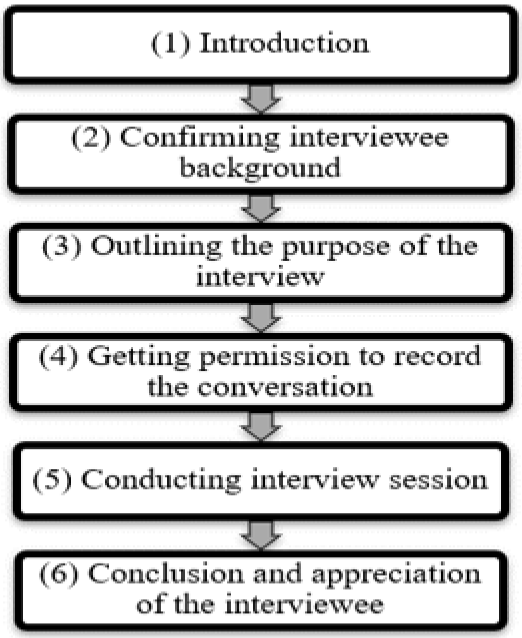

Fig. 1. Interview procedures

3. Results and Discussion

Based on the interview data analysis, the study's findings from five participants produced four themes for RQ 1 and four themes for RQ 2. In answering RQ 1, four broad themes had cropped up, which are (1) Problems in teaching and learning ORM, (2) The importance of learning ORM, (3) Current teaching strategies of ORM, and (4) Desired teaching strategies of ORM. The summary of RQ 1 findings is presented in Figure 2.

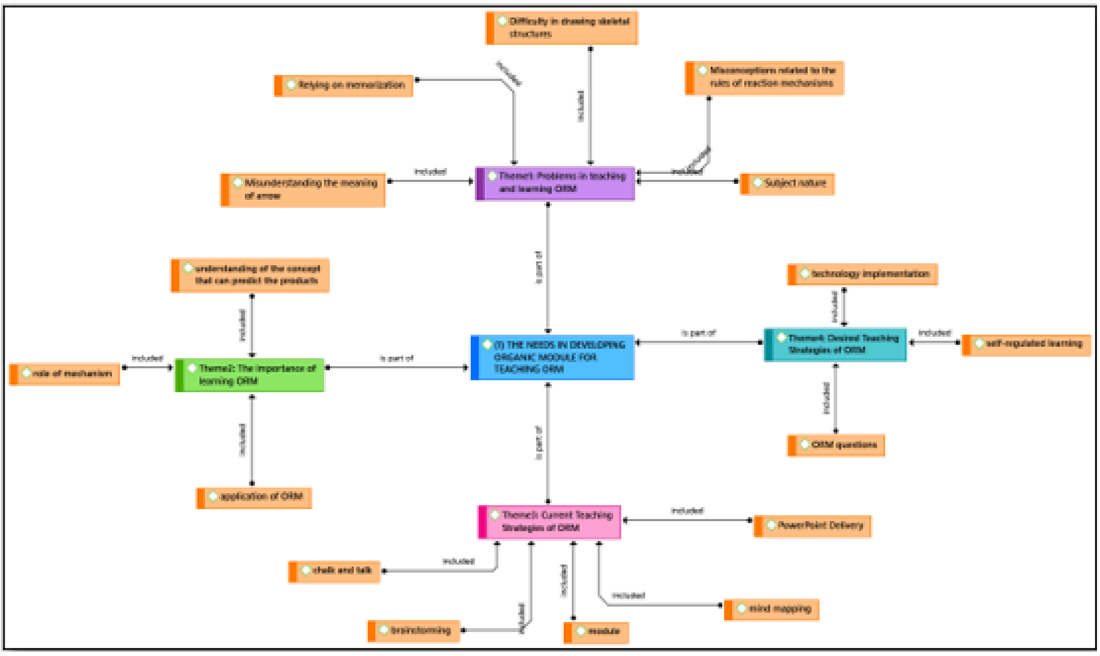

Fig. 2. Findings of RQ1. Representing a thematic analysis using ATLAS.ti network. It includes themes related to problems in teaching and learning ORM, the importance of learning mechanisms, current teaching strategies, and the needs for developing a teaching module for ORM

3.1 RQ 1: What Are the Needs in Developing Organic Module for Teaching Orm Among Experts?
3.1.1 Theme 1: Problems in teaching and learning ORM.

Need 'Describing Mechanism' is one of the subtopics presented in each chapter of the Organic Chemistry Syllabus. These topics are taught in pre-university institutions, whether Form Six Chemistry Curriculum or Matriculation Syllabus. Five objectives listed in the STPM syllabus are (1) Describe the Mechanism of free radical substitution, (2) Describe the Mechanism of electrophilic addition in alkenes, (3) Describe the Mechanism of electrophilic substitution in arenes, (4) Describe the Mechanism of nucleophilic substitution in haloalkanes, and (5) Explain the Mechanism of the nucleophilic addition reactions of hydrogen cyanide with aldehydes and ketones. However, many teachers discovered their students' difficulties learning organic chemistry [40].

During interview sessions, students encounter many problems in learning ORM. All five teachers expressed a few codes regarding the issues in teaching and learning ORM. The codes are; skeletal structure, arrow, reaction mechanisms, memorization and the nature of the compounds themselves. The emerging codes, categories and theme are summarised using schematic diagrams in Figure 3 below.

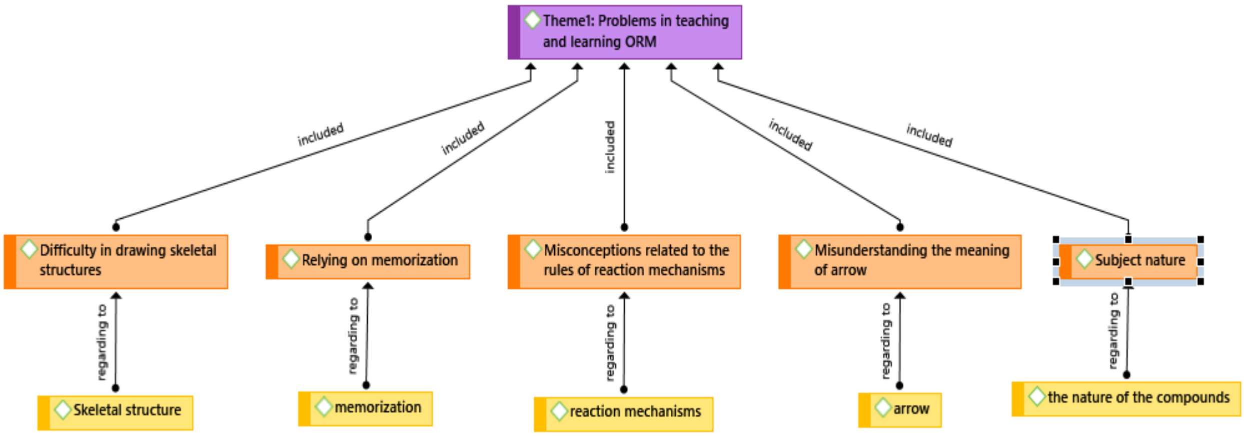

Fig. 3. Problems in teaching and learning ORM Theme. Representing a thematic analysis using the ATLAS.ti network, it includes codes and categories related to difficulty in drawing skeletal structures, relying on memorization, misconceptions of ORM rules, misunderstanding the meaning of arrows, and the subject nature of ORM

Most students and teachers sought to argue the difficulties of organic chemistry. Millar [41] divided students' difficulties into two categories: intrinsic difficulties and extrinsic difficulties. Intrinsic difficulties are related to cognition and the learning process, whereas extrinsic difficulties are associated with the topic and are beyond the students' control. Intrinsic factors include difficulty in drawing chemical structure, misunderstanding the meaning of the arrow, misconception, and reliance on memorization. Fibonacci *et al.,* [19] realized that school teaching materials emphasize memorizing symbols and formulae without being correlated to solving problems, resulting in a higher cognitive load. This caused the high cognitive load of the organic mechanisms, leading to students' misconceptions [42-45].

Meanwhile, teachers' classification of a topic as simple or challenging to teach is an extrinsic factor [41,46]. The studies by Bhattacharyya [47], Caspari *et al.,* [50], Galloway *et al.,* [49], and Popova & Bretz [50] correspondingly revealed that the multi-dimensional and abstract nature of organic chemistry itself contributed to the subject's difficulty in learning. Johnstone [51,52] stated that the concepts in chemistry had to do with the subject's nature since many topics in everyday life might be demonstrated and made tangible to learners. Subsequently, this laid the groundwork for his Triangle Model (Figure 4), which was built on three levels of thought; macroscopic, microscopic, and symbolic representation [52-54].

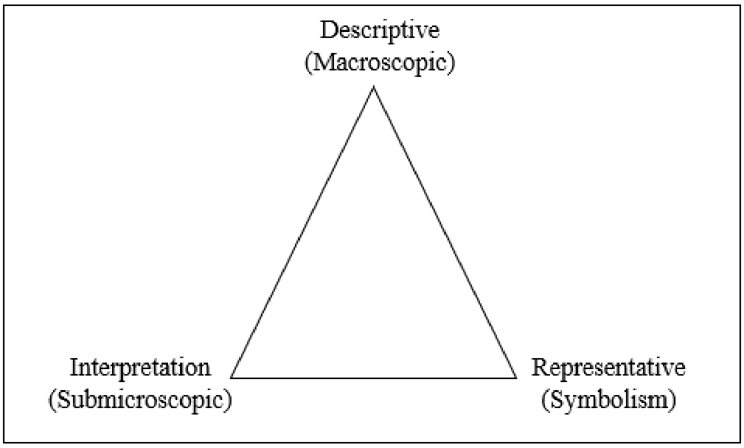

Fig. 4. Johnstone Triangle's Model. The three levels of understanding in chemistry: Descriptive (Macroscopic) - observable properties and phenomena, Interpretation (Submicroscopic) - molecular and atomic level interactions, and Representative (Symbolism) - chemical symbols, formulas, and equations

3.1.2 Theme 2: The importance of learning ORM.

Understanding a mechanism is an essential and fundamental part of the organic chemistry curriculum. Mechanism is a crucial topic in learning organic chemistry because ORM will provide a basic understanding of chemical reaction and why the reaction occurs. From the interview session, several codes emerged under the theme 'The Importance of Learning ORM's': predicting outcomes, avoiding memorization only, providing a comprehensive description of reactions, enhancing understanding of the nature of organic reactions, understanding the origin of reaction product formation, and applying mechanisms to compounds with similar functional groups. All these codes were then reduced to three categories, as shown below. The emerging codes, categories, and theme are summarized using schematic diagrams in Figure 5.

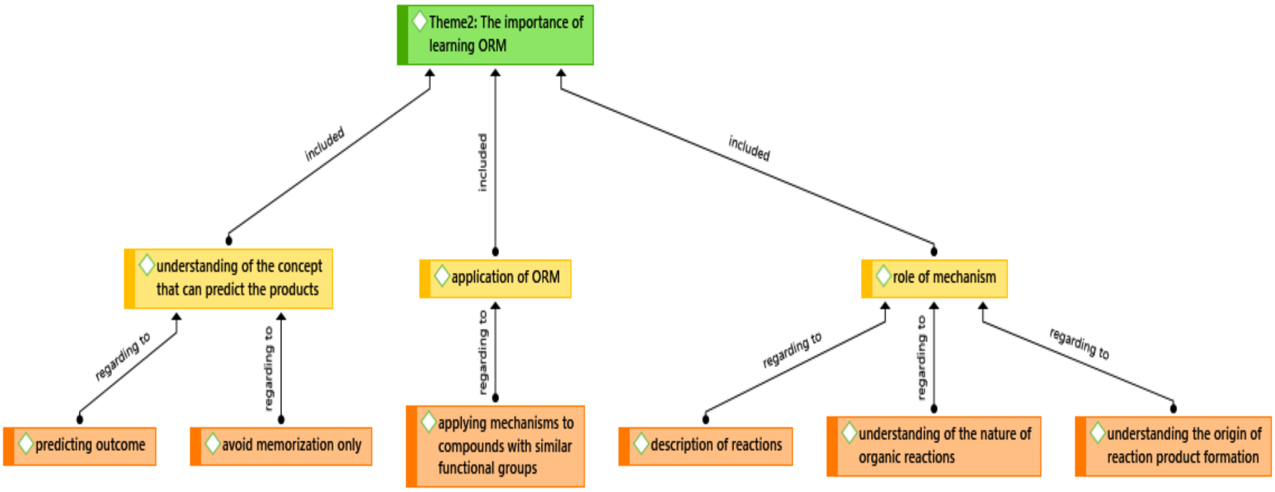

Fig. 5. The importance of learning ORM Theme. Representing a thematic analysis using the ATLAS.ti network, it includes codes and categories related to understanding the concept that can predict the products, application of ORM, and the role of mechanisms

All participants agreed that ORM is the basic concept in Organic Chemistry, which provides an understanding of the concept that can predict the products. The mechanisms play an essential role in determining products and give the meaningful reason why some reactions produce the specific product. For example, Participant Two (P2) and Participant Five (P5) answered:

"Organic reaction mechanisms provide an understanding of the concept of a reaction that helps students predict the outcome of a reaction and understand the concept of a reaction in depth." (P2)

"If students memorize without understanding, they will be unable to connect the different parts of reactions. That is why students are so necessary to master this organic reaction mechanism." (P5)

All P2, Participant Three (P3) and Participant Four (P4) had emphasized the role of mechanisms that is:

"The reaction mechanism provides a complete description of how a reaction occurs and the conversion from substance to the reaction product, whether electrons are donated or received." (P2)

"Students can understand the nature of organic reaction more clearly and deeper. This is able for them to manipulate the rate of reaction, reaction products, and the purification of organic products in future use and furthermore manufacturing industries." (P3)

"Organic reaction mechanism is very important because to know the origin of how to form the product of a reaction." (P4)

The application of ORM also had been mentioned by participants during the interview. Students need to understand the purpose of studying the ORM to implement what they have learned for the other compound with the same functional group. P3 proposed that:

"Once the students understand the basis of any mechanism, they can apply to compound from the same homologous series on the organic compound with a similar functional group." (P3)

Nedungadi [55] and Sabitu *et al.,* [56] revealed how vital the ORM topic is for organic chemistry. The mechanistic processes involved in teaching and learning organic chemistry have used the curved-arrow notation called the EPF to convey electron flow [8,47,57]. EPF, as a core part of organic chemistry's culture, is represented by a single-headed or double-headed curved arrow. The tail starts from the electron source (lone pair or bond) to the electron sink (an atom with deficient electrons) [7,12,58]. This electron flow depicts how bonds are produced and broken during a reaction [59]. EPF has been utilized extensively to explain and forecast chemical reaction products, such as side product formation, regioselectivity, and stereochemistry [47].

3.1.3 Theme 3: Current teaching strategies of ORM.

The current teaching strategies of ORM consist of five codes: chalk and talk, PowerPoint delivery, mind mapping, module, and brainstorming strategies. The emerging codes, categories and theme are summarised using schematic diagrams in Figure 6.

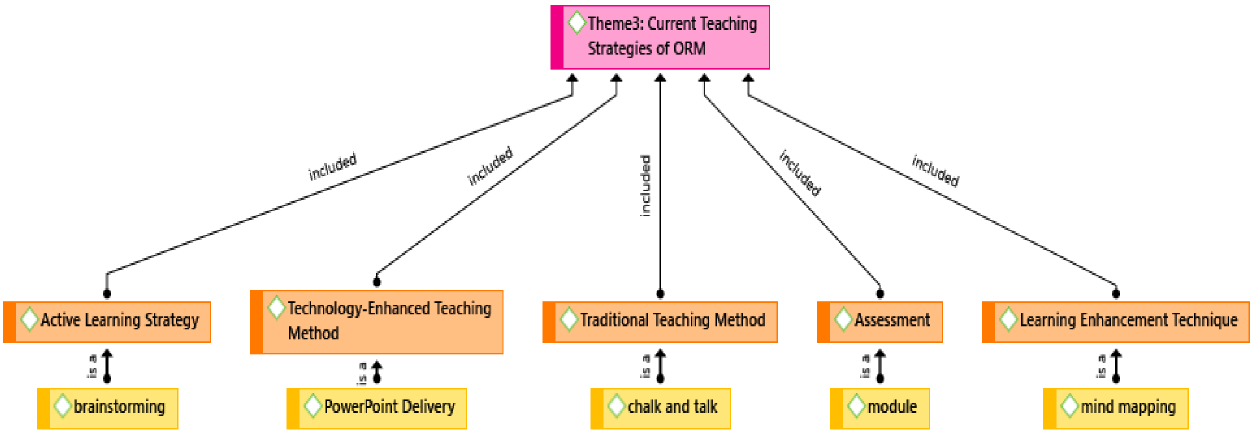

Fig. 6. Current Teaching Strategies of ORM Theme. It represents a thematic analysis using the ATLAS.ti network, incorporating codes and categories related to active learning strategies, technology-enhanced teaching methods, traditional teaching methods, assessment, and learning enhancement techniques

All participants agreed that they still use the 'chalk and talk' method to teach ORM topics to their students. As P1 said, the students accept this method, although it seems a bit outdated, since the teacher can convey it quite well. On the other hand, P1 added that factors such as time constraints prevented him from using other teaching strategies. For P2, the respondent discovered that students understand the concept of writing the ORM more easily when the teacher traditionally shows the steps from the early stage on the whiteboard and asks students to complete the mechanisms. Consequently, students must try it themselves until they master the concept. For P3, the respondent emphasized that utilizing a mind map could help students to remember effectively as a fast reference. Regarding mind map as a learning enhancement technique, she believes that students' mind maps will cater to their long-term memories.

Meanwhile, P4 and P5 implemented brainstorming strategies for their students to promote active learning. Alex Osborn was the first to promote brainstorming as a constructivist technique since brainstorming can generate students' ideas and solve problems [60,61]. Hence, P4 and P5 believed that students could use their problem-solving methods to solve reaction mechanism questions by providing the same final answers. Additionally, P4 and P5 also implemented the modular approach as an assessment method. They noted that the printed module was developed with questions for each topic, whereas the PowerPoint presentation was delivered in the students' presence throughout the teaching and learning process. Despite the teacher's efforts alone, the role of student participation may not be executed, causing students to receive knowledge passively.

3.1.4 Theme 4: Desired teaching strategies of ORM.

All participants shared their desired teaching strategies for teaching ORM. The interview session can be summarized into several codes and three categories: students' SRL, ORM questions and technology implementation. The emerging codes, categories and theme are summarised using schematic diagrams in Figure 7. The participants have the same viewpoint on technology implementation for teaching ORM.

"Modules need to be aligned with the latest technology. Organic lessons also need to be videotaped so that students can review them on their own. The video must be clear and quality so that students do not get bored." (P1)

"Teach students using interactive multimedia that can provide immediate feedback (correct answers) and hardcopy modules." (P2)

"Students may employ the mobile animation and notes picture. They can be practiced through video PowerPoint". (P3)

"It could be better if ORM teaching could implement the simulator. There are also some students who use tik tok whereby teachers check the contents before it being published online. Tik tok is a very match for an induction set." (P4)

"Students must be prepared a video for each mechanism. There should be colored so that students are more interested and clearer enough." (P5)

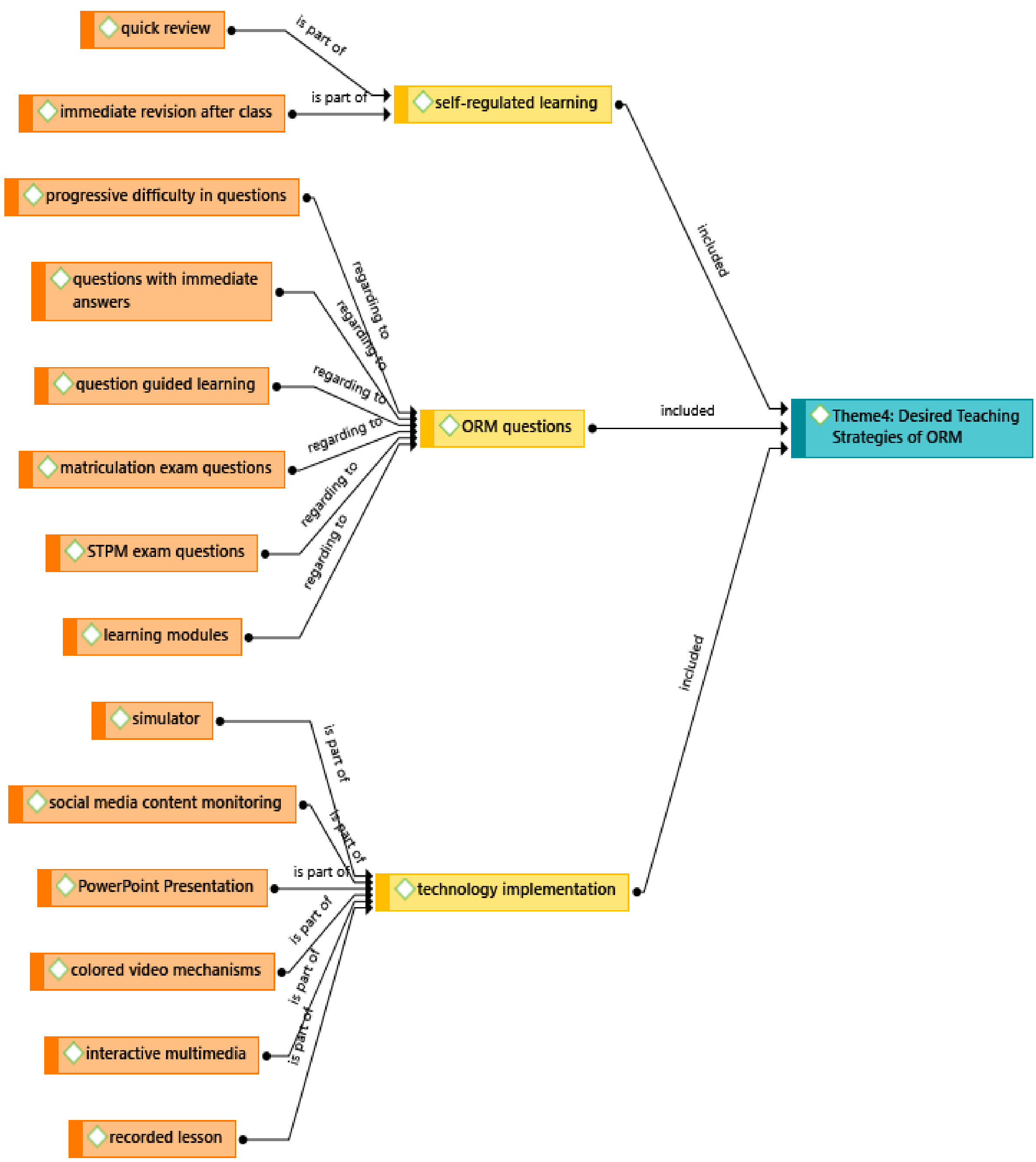

Fig. 7. Desired Teaching Strategies of ORM Theme. Represented using the ATLAS.ti network, it includes categories like self-regulated learning, ORM questions, and technology implementation. Codes that emerged include immediate revision after class, social media content monitoring, and interactive multimedia

According to the participants' perspectives, an ORM module featuring technologies needed to be developed because the existing modules did not specifically focus on reaction mechanisms. Technologies play a key role in engaging students' learning, attracting them to the abstract of ORM, and keeping them from being bored with the lecture. Hence, adopting technology applications improves student engagement and teaching and learning outcomes [62,63]. The participants' main ideas in designing the ORM module were to employ colored images, animation elements, interactive multimedia, recorded lesson, and an online web-based module that offers ORM formative questions with immediate solutions. The purpose of developing the online module is to provide students with a self-regulated learning (SRL) tool that allows them to actively monitor and manage their learning [64,65].

3.2 RQ 2: How Are Experts' Suggestions for The Effective Organic Module for Teaching ORM?

In answering RQ 2, the participants were asked the suggestions for improvement to teaching the ORM subtopic and the components needed for developing an effective Organic Module. The participants' suggestions can be narrowed down into four themes: media selection, module content selection, teaching strategies, and assessment. The summary of RQ 2 findings is presented in Figure 8.

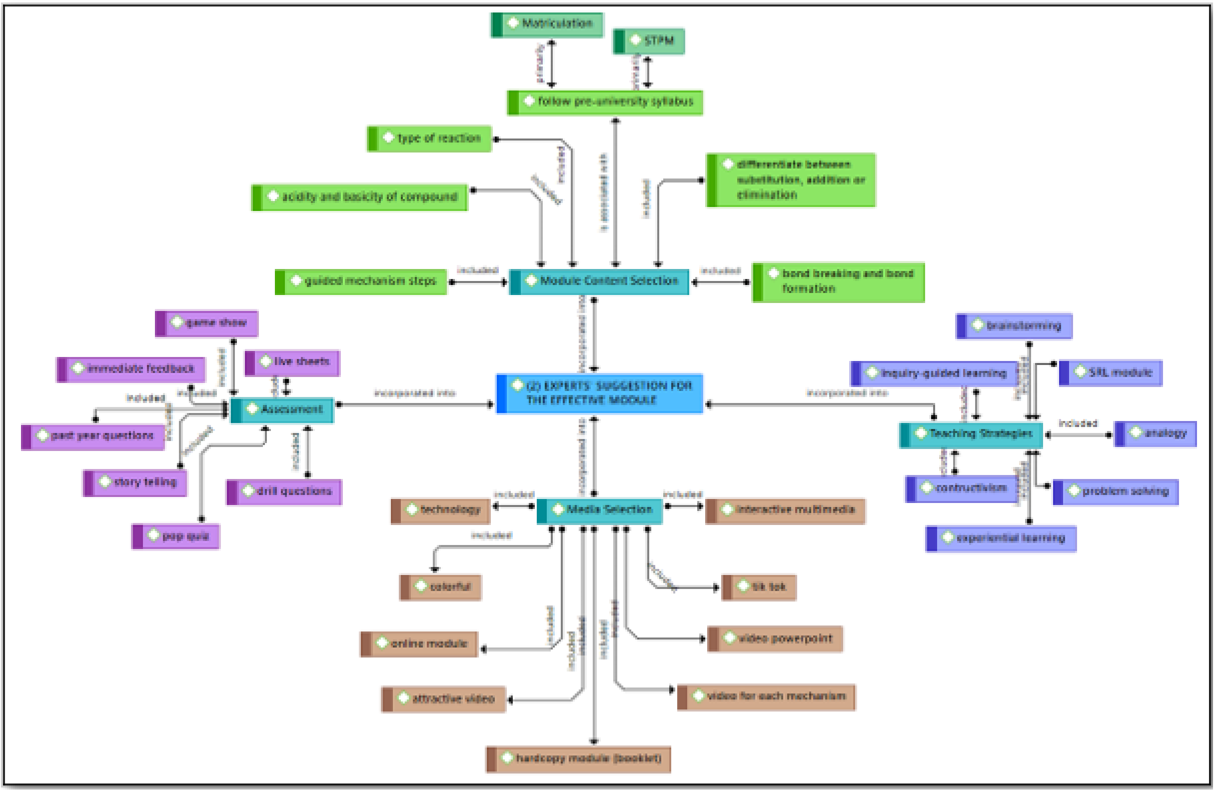

Fig. 8. Findings of RQ2. Representing a thematic analysis using ATLAS.ti network. It includes themes related to module content selection, teaching strategies, media selection and assessment

The effective Organic Module commenced with the theme of module content selection. P2 suggested that the module should begin with a rudimentary knowledge of bond breaking and formation. Meanwhile, P3 stressed the importance for students to understand the three main organic chemistry species: free radicals, electrophiles, and nucleophiles. The respondent also stated that students must understand the nature of compounds, whether they are acidity or basicity reactants. Before deeply exploring each reaction mechanism, P4 emphasizes that students must comprehend the difference between addition, substitution, and elimination reactions.

Nevertheless, the crucial aspect is that all the content in the module must adhere to the STPM or Matriculation Syllabus standards. P2 suggested using inquiry-guided learning, constructivism learning, and experiential learning in the theme of teaching strategies. P1 supported this by proposing the constructivism method, in which students may generate new understandings and knowledge after mastering the fundamental principles of mechanisms. This aligns with the study by Nedungadi [55] and Galloway and Bretz [66], who believed that teachers should support students in constructing knowledge and meaning from their experiences, eventually assisting them in overcoming problems.

Furthermore, students may connect the new lesson with what they already know. Therefore, SRL is suggested as an effective strategy for mastering a lesson. As pointed out by Ramdass and Zimmerman [64] and Zimmerman [65], self-regulated learners are considered active learners who can manage their learning in diverse settings. Hence, students in a technology-enhanced SRL environment will learn topic matter before class independently by accessing online instructional videos and reading material at their own pace and time.

Instructional designs and teaching approaches using technology, such as online modules, have shifted the discussion to the media selection theme. All participants agreed that the presentation using audio, video, animation, and images might help students visualize electron movement in mechanisms. P5 advocated developing a video for each mechanism to engage students by boosting its fascinating color. As an alternative media for students, animation gives a better experience, where the video may motivate students' attention, and they are likely to grasp the topics taught easier [68-70]. Other than that, students must be provided with a hard copy module or booklet supplementary to the online module. Yuliani *et al.,* [71] established that using printed and online modules in learning can increase learning outcomes, performance, and student engagement.

Meanwhile, all participants agreed that a pop quiz after each lesson would be an excellent way to evaluate the lesson. P1 and P2 prefer quizzes with immediate feedback so that students may review their learning. According to Strang [72], encouraging students to perform online activities such as self-assessment quizzes improve their engagement and learning, resulting in higher scores. As a result, online assessment is an excellent alternative for inclusion in the ORM module, as students can repeat the questions once they return home. Apart from that, it is crucial that the questions presented are equivalent to the previous year's questions and that students do drills to support them in mastering reaction mechanisms. Finally, based on the themes and categories that emerged from the expert interviews, alternative teaching modules are necessary to facilitate the teaching and learning process of organic chemistry for the ORM topic.

4. Conclusion

The needs analysis reports the issues related to the teaching and learning of ORM in organic chemistry subjects at pre-university. The issues were discussed in four themes: problems in teaching and learning ORM, the importance of learning ORM, current teaching strategies of ORM, and desired teaching techniques of ORM. Meanwhile, four themes emerged from experts' suggestions for the effective Organic Module for teaching ORM: module content selection, teaching strategies, media selection, and assessment. Generally, the experts involved, the lecturers and teachers, regard the topic as the most difficult among all topics in organic chemistry. As they tend to efficiently apply a module in teaching and learning ORM, the researcher will integrate the SRL into the desired module for teaching ORM.

According to experts' suggestions, an effective Organic Module for teaching ORM will be developed. Despite being a complex subject, the teachers and lecturers believed ORM could be mastered easily if students knew the nature of species, nucleophiles, and electrophiles and whether they would donate or accept electrons. Knowing the importance of arrows in writing mechanisms will also help them systematically solve mechanism problems. Therefore, the results of this study allow for the development of quality modules that prepare teachers to successfully guide students in teaching ORM. It is believed that when the suggested theory, such as constructive learning or SRL combined with new and advanced learning technology, it will produce a remarkable impact on students themselves yet be able to help students understand ORM meaningfully.

There are significant limitations to this study that will be the focus of future research. This qualitative research does not assert how all teachers or lecturers who teach organic chemistry at the pre-university level teach ORM. Other than that, the data might be used in future research to provide quantitative comparisons between educators with varying levels of expertise. Nevertheless, it is hoped that this study has thrown light on the concerns of pre-university educators from various disciplines and will bring to light the discrepancies between students' and educators' needs in the future.

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