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Unveiling Effective CSCL Constructs for STEM Education in Malaysia and Indonesia

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ABSTRACT

The acquisition of knowledge and skills in the fields of Science, Technology, Engineering, and Mathematics (STEM) plays a crucial role in fostering the development of future innovators. These subjects are critical for creating future thinkers. Additionally, it is important to note that there are a lot of job openings in the STEM fields, and this trend is expected to keep growing. However, students don't seem to be as motivated to study in STEM fields or work in STEM fields. One teaching method that is becoming more popular is computer-supported collaborative learning (CSCL). This is because it can have a big effect on how people learn, especially in STEM subjects. It is very important to set up a CSCL learning environment for STEM schooling right away. However, that there isn't a good framework and there aren't many widely used design methods in this area. Without a question, there is a strong need to learn more about design methodologies in the areas of collaborative and technology-enhanced learning to come up with simple methods for CSCL. Because of this, the goal of this study is to investigate the conceptual parts of CSCL methods in STEM education. This will be used to make CSCL educational methods that are good especially for STEM education. STEM academics in Malaysia and Indonesia were surveyed using questionnaires to find the most important parts of CSCL strategies in STEM education, and the results were analysed using the Fuzzy Delphi Method. The results give us a list of CSCL settings used in schools, which can be used as a guide for creating and using CSCL strategies in STEM education.

1. Introduction

Science, Technology, Engineering, and Mathematics (STEM) education has altered considerably in recent years. In light of the COVID-19 pandemic, social isolation and separation have been employed to halt its spread. In these situations, several techniques of content distribution for

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education are impractical. Notwithstanding these constraints, children engage in STEM project-based learning and other online activities [1]. Since innovations and changes occur swiftly, the STEM education system must adapt and develop its application of learning. ICT can enhance STEM learning outcomes [2]. ICT is modifying teaching and learning by allowing students to actively participate in their education and interactions, enhancing knowledge interchange, and establishing space- and time-free learning and communication platforms [3]. According to certain studies, computer-supported collaborative learning (CSCL) provides STEM-specific teaching benefits. According to Hernández-Sellés, Muoz-Carril, and González-Sanamed [4], the timing of socially shared monitoring influences the efficiency of collaborative learning, which has implications for teaching approaches and adaptive scaffolding in CSCL of students completing a STEM activity. CSCL may also provide the best learning experience for students by encouraging them to actively construct knowledge [5]. It may facilitate group learning, the exchange of information, and co-construction [6,7].

Yet, there are few established design practices for CSCL environments, and research on developing standards and publishing formal studies is limited. Research on collaborative learning design approaches is required to simplify CSCL methodologies. All research fields involved in the creation of CSCL environments must be considered and integrated with an appropriate design guideline emphasis. Several studies have built a CSCL environment framework for varying circumstances and objectives. Stahl and Hakkarainen [8] devised a framework for reviewing and integrating CSCL ideas as instructional frameworks and guidelines for innovative CSCL implementation. Contrary to sociocultural and constructivist theories, which employ descriptive classroom designs, a small subset of CSCL research employs experimental approaches, according to Jeong *et al.,* [7].

Reynolds *et al.,* [9] provided a framework by conducting an in-depth analysis of how technologies are utilised to enhance collaborative learning in CSCL research and by selecting exemplary design methods and technology examples. In STEM education, we lack an efficient design and development framework for CSCL. STEM education has a limited framework, and CSCL technique is understudied at present [10]. STEM education requires CSCL as a basis. The framework will help develop a STEM-focused CSCL environment. This educational opportunity will increase students' interest in STEM, which may subsequently influence their choice of university major. More STEM lessons should be developed to foster transdisciplinary learning in the classroom.

This study aimed to develop STEM education framework structures for the CSCL approach, a new discipline of learning sciences that explores how people learn with computer assistance [11]. The Malaysian and Indonesian Ministries of Education intend to employ a framework for developing tools and technologies within the CSCL environment to enhance their curricula. The design framework may find CSCL-based methods for enhancing students' scientific conceptual knowledge.

2. Methodology

In this study, a quantitative research design was used, in which survey questionnaires were distributed to a panel of experts consisting of STEM education specialists. They identified, evaluated, and justified the aspect of CSCL strategy components in STEM education. Fuzzy Delphi Method (FDM) was subsequently used to analyse the questionnaire data.

2.1 Procedures

The study began with a focus and problem statement. The problem statement described the research problem, aims, and questions. Then, a systematic review of the literature revealed relevant references. The second phase identified problem areas and generated and revised questionnaire items prior to validating and pilot testing the instrument. Before conducting a pilot research, three subject-matter experts evaluated the instrument's validity. The pilot research identified reliability and areas for enhancement before the actual investigation. In the third phase, data were collected using the research design. The researchers drew theoretical, analytic, or logical inferences from the sample [12]. For the purpose of this study, it is crucial to select STEM experts with experience [13]. Thus, this study defined STEM expert in terms of academic credentials, experience, subject content, and practical knowledge in the field of practice. For this study, STEM specialists must meet three of four criteria:

i. Five or more years of professional expertise in STEM teaching.
ii. Have a master's or Ph.D. credential or career/credibility in the STEM sector.
iii. Good knowledge and comprehension of CSCL ideas.
iv. Have at least one publication on CSCL or STEM topics.

Most ex post facto research in Fuzzy Delphi investigations employs 10–15 STEM specialists to maintain panel homogeneity [14,15]. The size of a Delphi group is governed by group dynamics as opposed to statistical power, and O'Neill, Murray & Conboy [16] suggested 10–18 experts. The Delphi method relies on the informed opinions of expert panels, not random selection [17]. So, the conclusions would be strengthened by more than ten specialists. On the basis of availability, 20 Malaysian and 20 Indonesian STEM specialists were selected. The anticipated turnout is sufficient.

2.2 Research Instrument

This study collected data through a questionnaire because it is standardised and easy to manage. The questionnaire's lack of researcher bias could also improve the respondents' comments. Due to Malaysia's and Indonesia's multiracial STEM workforce, the questionnaire was written in English and Malay. Respondents rated each item on a 7-point scale from 1 (strongly disagree) to 7 (strongly agree) to determine the components/features of a STEM CSCL environment. Utilising FDM, questionnaire results were investigated to identify the Collaboration, Pedagogy, and Technology constructs of the STEM CSCL teaching method. In FDM, the threshold value (d), percentage of expert agreement, and fuzzy score (A) were determined in the defuzzification process to discover admissible constructs in the framework. The linguistic variables used in this study were selected and converted to triangular fuzzy numbers with three values (m1, m2, and m3), representing the least, reasonable, and maximum values. The threshold value (d) was calculated using the following formula:

$$d(\tilde{m},\tilde{n}) = \sqrt{\frac{1}{3}[(m_1-n_1)^2+(m_2-n_2)^2+(m_3-n_3)^2} \quad (1)$$

Each item with a threshold value (d) of 0.2 or less was approved and converted to a percentage value using the Delphi technique [18]; otherwise, expert agreement must surpass 75% [15] (Jaya). For the items to be accepted and ranked, the average of fuzzy numbers, defined as fuzzy (A) value, must exceed the α-cut value of 0.5 [14]. Language variables should be odd. The more factors a linguistic scale includes, the more exhaustive and accurate it is. Fuzzy theory converts linguistic variables to fuzzy numbers, creating fuzzy linguistic variables. The triangular fuzzy number represents the linguistic variable scale. As shown in Table 1, the 7-Likert scale replaces the linguistic variable (fuzzy number scale) to simplify questionnaire responses for experts [15]:

Table 1
Linguistic variable scale

Linguistic Variable	Fuzzy Number Scale		
	Likert Scale	Tolerance Range	Fuzzy Scale
Strongly Disagree	1	0.0	0.1
Moderately Disagree	2	0.0	0.1
Slightly Disagree	3	0.1	0.5
Either Disagree or Agree	4	0.3	0.7
Slightly Agree	5	0.5	0.9
Moderately Agree	6	0.7	1.0
Strongly Agree	7	0.9	1.0

2.3 Questionnaire Development and the Fuzzy Delphi Method

In this phase, STEM professionals in Malaysia and Indonesia were surveyed to identify, define, and determine the items in the Collaboration, Pedagogy, and Technology constructs for CSCL strategy in STEM education. After the findings from quantitative methodologies have been finalised using Excel, FDM was employed to test or validate these elements of the CSCL approach structures in STEM education.

3. Results and Discussion

Forty individuals comprising Malaysian and Indonesian STEM professionals responded to the Google Form survey. Based on their viewpoints, the researcher proposed the study topic, which is to explore the list of educational CSCL settings that serve as a benchmark for building and constructing the framework for CSCL strategy in STEM education. Part (I) of the strategy is the Collaboration construct This construct consisted of 26 items, as shown in Table 2. The subconstructs of Collaboration are cognitive presence, social presence, and teaching presence.

Table 2
The summary of the defuzzification process for the items in the Collaboration construct

Items/ Elements	Triangular Fuzzy Numbers Requirements		Fuzzy Evaluation Requirement				Expert Consensus	Acceptable Elements	Ranking
	The threshold value, d	Expert Consensus Percentage, %	m_1	m_2	m_3	Fuzzy Score (A)			
A1	0.114	100.0%	0.770	0.920	0.985	0.892	Accepted	0.892	3
A2	0.103	90.0%	0.795	0.938	0.990	0.908	Accepted	0.908	2
A3	0.108	97.5%	0.750	0.910	0.983	0.881	Accepted	0.881	4
A4	0.113	95.00%	0.810	0.943	0.980	0.911	Accepted	0.911	1
A5	0.138	95.00%	0.730	0.890	0.970	0.863	Accepted	0.863	9
A6	0.118	97.50%	0.735	0.898	0.978	0.870	Accepted	0.870	8
A7	0.152	92.50%	0.735	0.890	0.965	0.863	Accepted	0.863	9
A8	0.148	95.00%	0.675	0.852	0.960	0.829	Accepted	0.829	16
A9	0.142	92.50%	0.755	0.905	0.970	0.877	Accepted	0.877	5
A10	0.130	97.50%	0.740	0.898	0.975	0.871	Accepted	0.871	7
A11	0.140	95.00%	0.695	0.868	0.965	0.843	Accepted	0.843	14
A12	0.146	92.50%	0.720	0.883	0.965	0.856	Accepted	0.856	11
A13	0.177	90.00%	0.700	0.863	0.953	0.838	Accepted	0.838	15

A14	0.223	85.00%	0.678	0.840	0.928	0.815	Accepted	0.815	19
A15	0.267	45.00%	0.535	0.718	0.858	0.703	Rejected	0.703	-
A16	0.252	55.00%	0.575	0.760	0.890	0.742	Rejected	0.742	-
A17	0.203	85.00%	0.645	0.823	0.933	0.800	Accepted	0.800	21
A18	0.144	92.50%	0.715	0.880	0.965	0.853	Accepted	0.853	12
A19	0.142	90.00%	0.725	0.888	0.965	0.859	Accepted	0.859	10
A20	0.249	77.50%	0.615	0.790	0.905	0.770	Accepted	0.770	23
A21	0.102	97.50%	0.740	0.905	0.983	0.876	Accepted	0.876	6
A22	0.160	95.00%	0.710	0.873	0.960	0.848	Accepted	0.848	13
A23	0.193	92.50%	0.678	0.843	0.940	0.820	Accepted	0.820	18
A24	0.173	92.50%	0.670	0.843	0.950	0.821	Accepted	0.821	17
A25	0.234	85.00%	0.623	0.795	0.910	0.776	Accepted	0.776	22
A26	0.171	90.00%	0.655	0.835	0.948	0.813	Accepted	0.813	20

For the Collaboration construct, six items did not satisfy the triangular fuzzy number (d ≤ 0.2) criterion: A14 (d = 0.223), A15 (d = 0.267), A16 (d = 0.252), A17 (d = 0.203), A20 (d = 0.249), and A25 (d = 0.234). Items A15 and A16 with expert consensus percentages of 45.0% and 55.0% respectively, did not fulfil the triangular fuzzy number requirement, which stipulates that each element must have greater than 75% expert consensus. Thus, these two items were rejected. The fuzzy score (A) resulting from defuzzification reflected the expert agreement ranking for each item. According to the fuzzy score (A) analysis, all 24 items from the Collaboration construct had α-cut values exceeding 0.5. The expert committees approved all 24 items. According to the fuzzy score (A) analysis, A4 ranked number one, followed by A2, A1, A3, A9, A21, A10, A6, A5 and A7, A19, A12, A18, A22, A11, A13, A8, A24, A23, A14, A26, A17, A25 and A20.

Out of 26 items, 24 were accepted. A4 (the instructor communicates crucial due dates for learning assignments to students) and A2 (the teacher communicates important topic objectives) ranked first and second, respectively, among the Collaboration construct for CSCL strategy in STEM education.

The Collaboration construct centres around developing and maintaining teaching presence. Establishing due dates for learning activities and STEM topic objectives help teachers acquire and maintain teaching presence while using CSCL in online learning. The teacher sets the learning atmosphere and the due dates for student assignments. Students learn to communicate and collaborate by developing and maintaining a learning community. Additionally, identifying a collaboration requires negotiating and changing a common aim [19]. Before collaboration, the common goal is partially known. This ensures everyone knows the goal. Therefore, these elements are important to achieve meaningful and useful educational learning outcomes, similar to learning processes in face-to-face settings [20-22], because the teaching presence in an online learning environment is a significant predictor for students' sense of a learning community (social presence) and the development of students' enquiry on course content (cognitive presence) [23].

Part (II) of the CSCL strategy investigated the Pedagogy construct, which consists of 19 items. Pedagogy consists of 4 subconstructs: teaching resource, activities, learning support, and formative learning evaluation. Table 3 illustrates the threshold value (d), expert consensus percentage, and fuzzy score (A) for the items in the Pedagogy construct.

Table 3
The summary of the defuzzification process for the items in the Pedagogy construct

Items/ Elements	Triangular Fuzzy Numbers Requirements		Fuzzy Evaluation Requirement				Expert Consensus	Acceptable Elements	Ranking
	The threshold value, d	Expert Consensus Percentage, %	m_1	m_2	m_3	Fuzzy Score (A)			
B1	0.188	87.5%	0.680	0.848	0.945	0.824	Accepted	0.824	12
B2	0.200	90.0%	0.675	0.840	0.940	0.818	Accepted	0.818	14
B3	0.096	92.5%	0.795	0.940	0.993	0.909	Accepted	0.909	1
B4	0.135	97.50%	0.750	0.903	0.975	0.876	Accepted	0.876	4
B5	0.193	92.50%	0.683	0.848	0.940	0.823	Accepted	0.823	13
B6	0.212	82.50%	0.700	0.858	0.938	0.832	Accepted	0.832	11
B7	0.182	87.50%	0.725	0.878	0.953	0.852	Accepted	0.852	8
B8	0.117	97.50%	0.775	0.923	0.983	0.893	Accepted	0.893	2
B9	0.117	95.00%	0.765	0.918	0.980	0.888	Accepted	0.888	3
B10	0.233	77.50%	0.630	0.803	0.915	0.783	Accepted	0.783	18
B11	0.170	92.50%	0.747	0.893	0.955	0.865	Accepted	0.865	6
B12	0.166	92.50%	0.738	0.888	0.955	0.860	Accepted	0.860	7
B13	0.213	85.00%	0.635	0.810	0.925	0.790	Accepted	0.790	17
B14	0.207	87.50%	0.665	0.835	0.935	0.812	Accepted	0.812	15
B15	0.193	85.00%	0.650	0.828	0.938	0.805	Accepted	0.805	16
B16	0.117	95.00%	0.745	0.905	0.978	0.876	Accepted	0.876	4
B17	0.194	85.00%	0.700	0.860	0.945	0.835	Accepted	0.835	9
B18	0.171	95.00%	0.693	0.858	0.950	0.833	Accepted	0.833	10
B19	0.125	97.50%	0.730	0.893	0.975	0.866	Accepted	0.866	5

Four items in the Pedagogy construct did not satisfy the triangular fuzzy number ($d \leq 0.2$) condition: B6 ($d = 0.212$), B10 ($d = 0.233$), B13 ($d = 0.213$), and B14 ($d = 0.207$). However, these 4 items reached 75% expert consensus; hence, all items in the Pedagogy construct were accepted. The fuzzy score (A) analysis showed that all 19 items had α-cut values higher than 0.5. The expert committee approved all 19 measures. For the Pedagogy construct, B3 ranked first, followed by B8, B9, B4 and B16, B19, B11, B12, B7, B17, B18, B6, B1, B5, B2, B14, B15, B13, and B10.

All 19 items in the Pedagogy construct were accepted. The top two items in the Pedagogy construct are B3 (The learning materials enable students to study whenever and wherever they choose from the subconstruct of resources in teaching) and B8 (Students must interact more with peers by responding to their ideas from the subconstruct of conducting activities). The findings show that to completely achieve learning outcomes, resources and activities must be sufficient and engaging. The resources should comprise:

i. content, such as textbooks, digital media, and teacher lectures
ii. material, such as chemicals for an experiment
iii. tools that students use to complete their task, such as lab equipment and calculators.

Students should learn with, not just through, digital technological tools. Students can master new literacies using this method. Besides resources, teachers should consider activities that involve pupils in task completion. It helps students understand, test, generalise, and apply.

Part (III) describes the Technology construct of the CSCL strategy, which has 21 items. Technology has 4 subconstructs: diversity of ideas, autonomy in managing relationships and content, accessibility to promote communication, and interactivity to learn. Table 4 illustrates the threshold value (d) and a synopsis of the defuzzification results for the Technology construct.

Table 4
The summary of the defuzzification process for the items in the Technology constructs

Items/ Elements	Triangular Fuzzy Numbers Requirements		Fuzzy Evaluation Requirement				Expert Consensus	Acceptable Elements	Ranking
	The threshold value, d	Expert Consensus Percentage, %	m_1	m_2	m_3	Fuzzy Score (A)			
C1	0.158	95.0%	0.670	0.848	0.955	0.824	Accepted	0.824	2
C2	0.171	90.0%	0.655	0.835	0.948	0.813	Accepted	0.813	6
C3	0.172	92.5%	0.663	0.840	0.945	0.816	Accepted	0.816	5
C4	0.184	90.00%	0.670	0.843	0.945	0.819	Accepted	0.819	3
C5	0.188	90.00%	0.645	0.820	0.938	0.801	Accepted	0.801	8
C6	0.244	80.00%	0.608	0.778	0.898	0.761	Accepted	0.761	17
C7	0.202	87.50%	0.645	0.820	0.933	0.799	Accepted	0.799	10
C8	0.244	82.50%	0.648	0.810	0.913	0.790	Accepted	0.790	13
C9	0.191	87.50%	0.635	0.818	0.935	0.796	Accepted	0.796	12
C10	0.199	85.00%	0.640	0.818	0.933	0.797	Accepted	0.797	11
C11	0.233	62.50%	0.588	0.765	0.895	0.749	Rejected	0.749	-
C12	0.227	60.00%	0.585	0.768	0.900	0.751	Rejected	0.751	-
C13	0.188	85.00%	0.640	0.822	0.938	0.800	Accepted	0.800	9
C14	0.188	87.50%	0.625	0.808	0.933	0.788	Accepted	0.788	14
C15	0.190	87.50%	0.670	0.840	0.943	0.818	Accepted	0.818	4
C16	0.223	85.00%	0.618	0.793	0.913	0.774	Accepted	0.774	16
C17	0.198	85.00%	0.630	0.810	0.930	0.790	Accepted	0.790	13
C18	0.158	95.00%	0.695	0.863	0.960	0.839	Accepted	0.839	1
C19	0.182	90.00%	0.665	0.838	0.945	0.816	Accepted	0.816	5
C20	0.205	85.00%	0.615	0.798	0.923	0.778	Accepted	0.778	15
C21	0.217	85.00%	0.663	0.830	0.928	0.807	Accepted	0.807	7

For the Technology construct, 8 items did not meet the triangular fuzzy number condition ($d < 0.2$): C6 ($d = 0.244$), C7 ($d = 0.202$), C8 ($d = 0.244$), C11 ($d = 0.233$), C12 ($d = 0.227$), C16 ($d = 0.223$), C20 ($d = 0.205$), and C21 ($d = 0.217$). From these 8 items, C11 and C12 did not reach 75% expert agreement and they were rejected. The remaining 19 items had an α-cut value exceeding 0.5, according to the fuzzy score (A) analysis. Expert panels approved all 19 elements. C18 ranked first, followed by C1, C4, C15, C19 and C3, C2, C21, C5, C13, C7, C10, C9, C8 and C17, C14, C20, C16, and C6.

The item in the Technology construct that ranked the highest was C18 (Students' interaction with CSCL technology helps them exchange information with others to fully understand subject content from the subconstruct of interactivity to gain knowledge) followed by C1 (CSCL technology allows students to communicate with peers and teachers outside the traditional classroom setting from the subconstruct of student diversity of ideas). These components are crucial to STEM education quality because students can interact in class, online, and increasingly, remotely [24]. The factors promote learning, learning design, and student engagement.

The findings suggest that STEM learning communities must prioritise "interactive" and "diverse" learning and knowledge sharing to succeed with CSCL. "Interactivity" or connectivity first relates to whether knowledge is the result of member interaction or simply the aggregate of members' opinions [25]. In networked learning environments, students use technology to find and build relationships between resources and ask questions [26]. Next, "diversity" of members, opinions, and solutions to learn new facts and knowledge by connecting kids to classmates and teachers both inside and outside the classroom [25]. This includes fostering and promoting a diversity of perspectives and ways to problem-solving in which students from varied cultural, social, and ethnic backgrounds can collaborate to achieve a similar goal, such as by considering their peers' ideas and priorities when producing solutions [26]. Thus, the CSCL strategy in STEM education for knowledge creation and acquisition must include not only the provision of computers and equipment, but also the integration and use of technology to improve student-centred learning process in which students must construct their mental models in an individualistic manner through real-world experiential learning and play a positive role in acquiring, analysing, and creating knowledge [25,27].

CSCL interaction is called collaboration. Collaborative learning is thought to help CSCL students learn. Students must cooperate on a project with shared responsibility [5]. Students must articulate their views, actively participate, discuss, and negotiate their perspectives with peers in group learning activities, coordinate and regulate their behaviours, and share accountability for both the learning process and the cooperation to be successful [28]. Next, technology refers to computer-supported learning aids and their benefits and drawbacks for collaborative, cognitive, and social learning. Tools, scripts, scaffolding's educational and collaborative capabilities depend on the CSCL environment's technical brilliance and constraints or probabilities. Teachers use CSCL pedagogy. Pedagogical tactics aid student learning in collaborative learning environments. Hence, educational aspects support task learning objectives. With collaborative learning, learning objectives may be focused on individual students, the learning team, or the community (class or school) to which the cooperating groups belong [29]. Since the educational efficiency of the CSCL approach is not solely dependent on its features, Feyzi Behnagh, and Yasrebi [30] recommend focusing on pedagogical and learning theory while adopting and developing tools and technologies.

4. Conclusion

This study highlighted educational CSCL circumstances that can be applied to the development of a STEM education CSCL framework in Malaysia and Indonesia. This study included a 70-item Google Forms questionnaire for Malaysian and Indonesian STEM education specialists. Three language specialists evaluated the language, presentation, and content of each item, while three content specialists evaluated its capacity to elicit responses from respondents. Relevant personnel in this investigation are competent. The data were analysed using FDM. This research identified numerous STEM CSCL teaching and learning scenarios. CSCL also improves the results and methods of learning in STEM and other subjects. Problem-solving, critical and creative thinking, and teamwork are beneficial to student learning. Incorporating collaboration in computer-based learning environments, utilising computers to support collaboration and interaction during learning, and employing additional learning tools or strategies are all ways in which CSCL can be used to enhance learning. The CSCL technique is based on expert consensus, and teachers should employ Collaboration, Pedagogy, and Technology to develop an effective learning plan. Importantly, the data demonstrate the effects of CSCL on collaborative learning, computer use, and instruction. This list of educational settings that serves as a benchmark for designing and developing the framework for CSCL strategy in STEM education can improve the strategy by addressing issues such as complex idea communication, superficial interaction, a lack of collective responsibility, and insufficient guidance.

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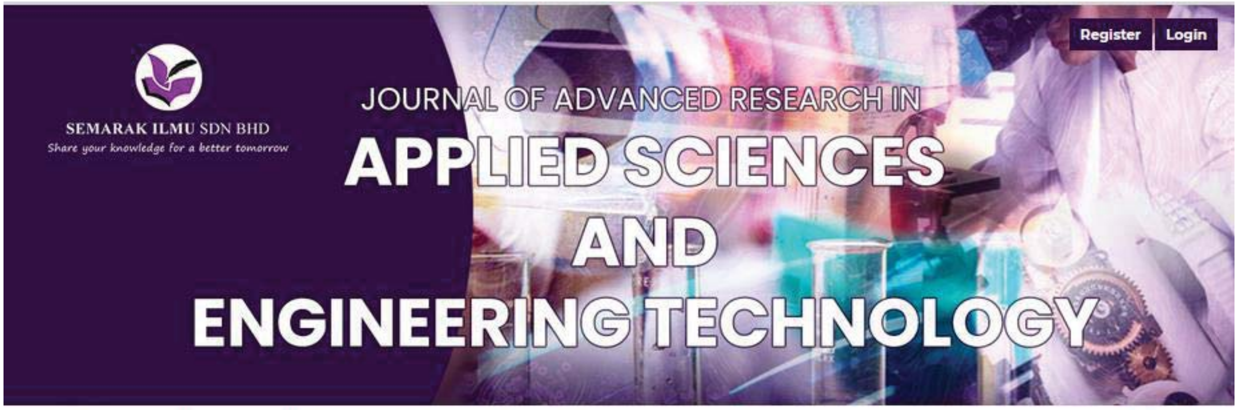

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Linguistic Variable	Fuzzy Number Scale		
	Likert Scale	Tolerance Range	Fuzzy Scale
Strongly Disagree	1	0.0	0.1
Moderately Disagree	2	0.0	0.1
Slightly Disagree	3	0.1	0.5
Either Disagree or Agree	4	0.3	0.7
Slightly Agree	5	0.5	0.9
Moderately Agree	6	0.7	1.0
Strongly Agree	7	0.9	1.0

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Unveiling Effective CSCL Constructs for STEM Education in Malaysia and Indonesia
Nur Zahira Mohamed Zahir, Suhaizal Hashim, Khairul Anuar Abdul Rahman, Nurul Nadwa Zulkifli, Slamet Riyadi, Joko Siswantoro

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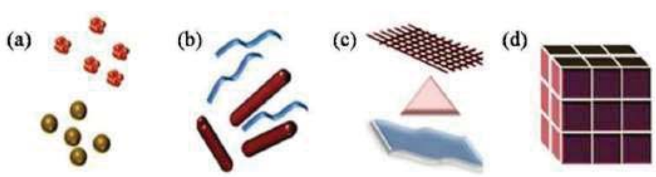

Fig. 1. Classification of Nanomaterials (a) 0D spheres and clusters; (b) 1D nanofibers, and nanorods; (c) 2D nanofilms, nanoplates, and networks; (d) 3D Nanomaterials [35]

Performance Characteristics of Nano Palm Shell Ash (NPSA) in Asphalt Mixture
Fitra Ramdhani, Bambang Sugeng Subagio, Harmein Rahman, Russ Bona Frazila
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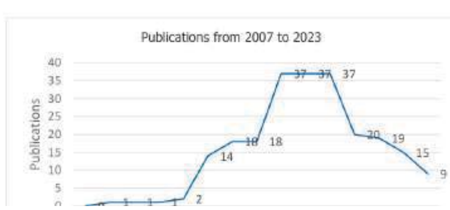

Fig. 1. Published papers applying the flipped classroom in CS education from 2007 to 2023

Analysing Flipped Classroom Themes Trends in Computer Science Education (2007–2023) Using CiteSpace

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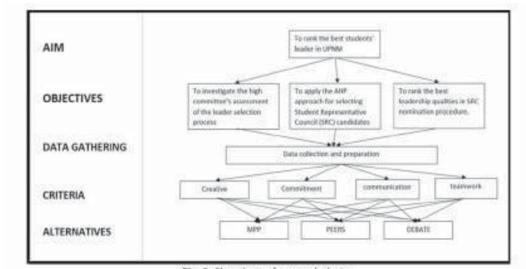

Fig. 1. Flowchart of research design

Selection of the Best Students' Leader in UPNM using Analytic Hierarchy Process Method

Muhamad Danial Haikal Muhd Zamzuri, Fazilatulaili Ali, Ruzanna Mat Jusoh, Mohd Fahmi Mohamad Amran, Dilum Dissanayake

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Fig. 1. Area of study

Data Collection and Data Management Approach for Developing a Driving Cycle: A Review

Nurru Anida Ibrahim, Arunkumar Subramaniam, Siti Norbakyah Jabar, Salisa Abdul Rahman

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(a) Source: real world picture (b) Source: OpenStreetMap Web Wizard

Fig. 1. The Lebuhraya Thean Teik-Jalan Thean Teik intersection

Optimising Layout of a Left-Turn Bypass Intersection under Mixed Traffic Flow using Simulation: A Case Study in Pulau Pinang, Malaysia

Amirah Rahman, Hongtao Zhu, Noor Saifurina Nana Khurizan, Mohd Halim Mohd Noor

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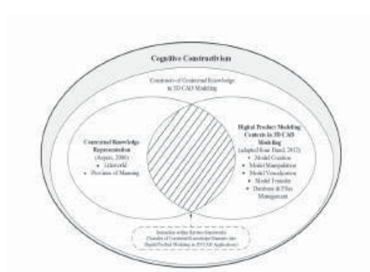

Fig. 1. Theoretical Framework of Research

Contextual Knowledge Framework in CAD Education from the Perspectives of Practicing Engineers

Mohd Fahmi Adnan, Mohd Fadzil Daud, Muhammad Sukri Saud, Azhar Rauf

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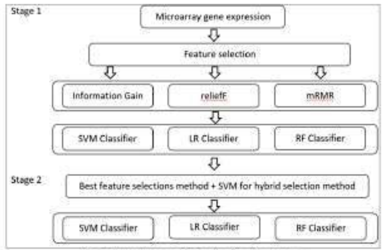

Fig. 1. Breast cancer Classification Procedure

Classification of Breast Cancer Subtypes using Microarray RNA Expression Data

Muhammad Shazwan Suhiman, Sayang Mohd Deni, Ahmad Zia Ul-Saufie Mohamad Japeri, Aszila Asmat, Lirong Wang

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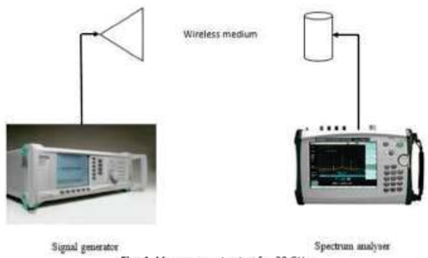

Fig. 1. Measurement setup for 28 GHz

Path Loss Models for 5G Communications System in Corridors Environment

Nor Raihan Zulkefly, Omar Abd. Aziz, Ibraheem Shayea, Ahmed Al-Saman

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Unveiling Effective CSCL Constructs for STEM Education in Malaysia and Indonesia

Nur Zahira Mohamed Zahir, Suhaizal Hashim, Khairul Anuar Abdul Rahman, Nurul Nadwa Zulkifli, Slamet Riyadi, Joko Siswantoro

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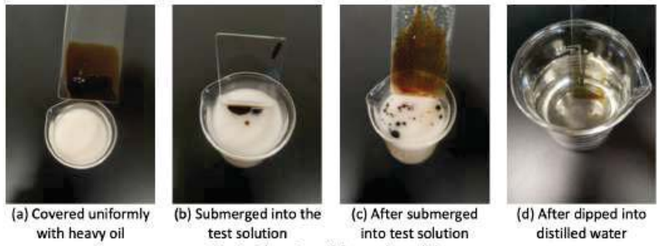
Fig. 1. Lux meter HS1010

Efficiency Analysis of a Passive Daylighting System Based on Northern Malaysia’s Climate

Mohd Sani Mohamad Hashim, Muhammad Amin Zulkifli Din, Abdul Halim Ismail, Mohd Hafif Basha, Nasrul Amri Mohd Amin, Ng Yi Fei, Muhamad Safwan Muhamad Azmi, Siti Marhainis Othman, Nur Saifullah Kamarrudin



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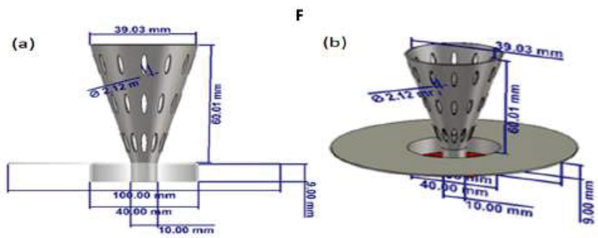


Fig. 1. Antenna geometrical details

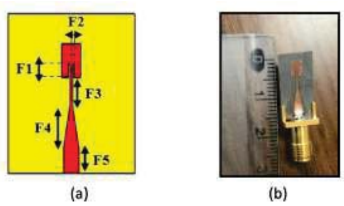


Fig. 1. Single antenna element design (a) CST Model
(b) Fabricated antenna

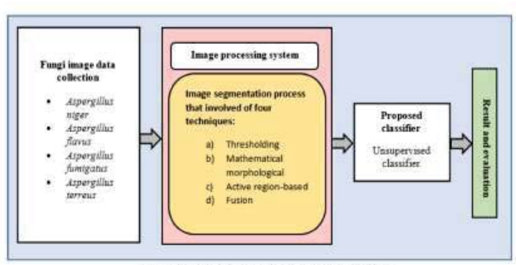
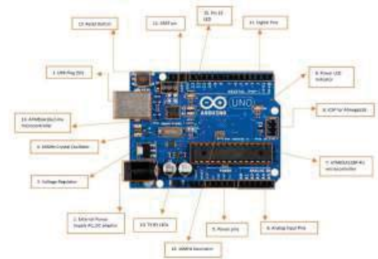


Fig. 1. Overall architecture of proposed method



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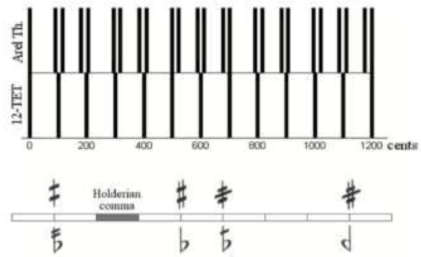

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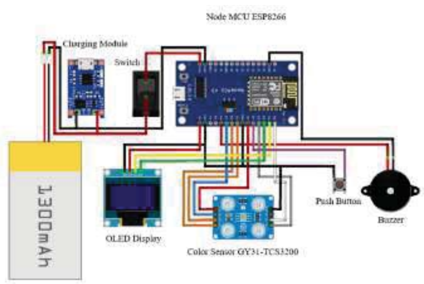

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Fig. 1. Research framework of proposed model

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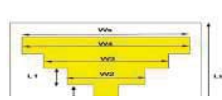

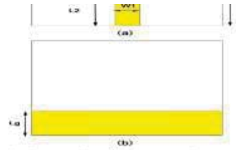

Fig. 1. Conventional Antenna Structure: (a) Top View, (b) Bottom View

Metamaterial Structure Effect on Printed Antenna for LTE/WIFI/Cancer Diagnosis

Fatma Taher, A. M. M. A. Allam, Ahmed F. Miligy, Mohamed A. Mohamed, Mohamed Fathy Abo Sree, Sara Yehia Abdel Fatah

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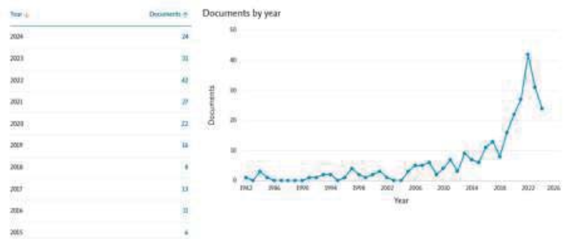

Fig. 1. Scopus database for research trend for "LLDPE waste" taken on May 2024. Detailed information for the bibliometric analysis is explained elsewhere [21]

What Phenomena Happen During Pyrolysis of Plastic? FTIR AND GC-MS Analysis of Pyrolyzed Low Linear Density Polyethylene (LLDPE) Polymer Particles Completed with Bibliometric Research Trend and Pyrolysis Chemical Reaction Mechanism

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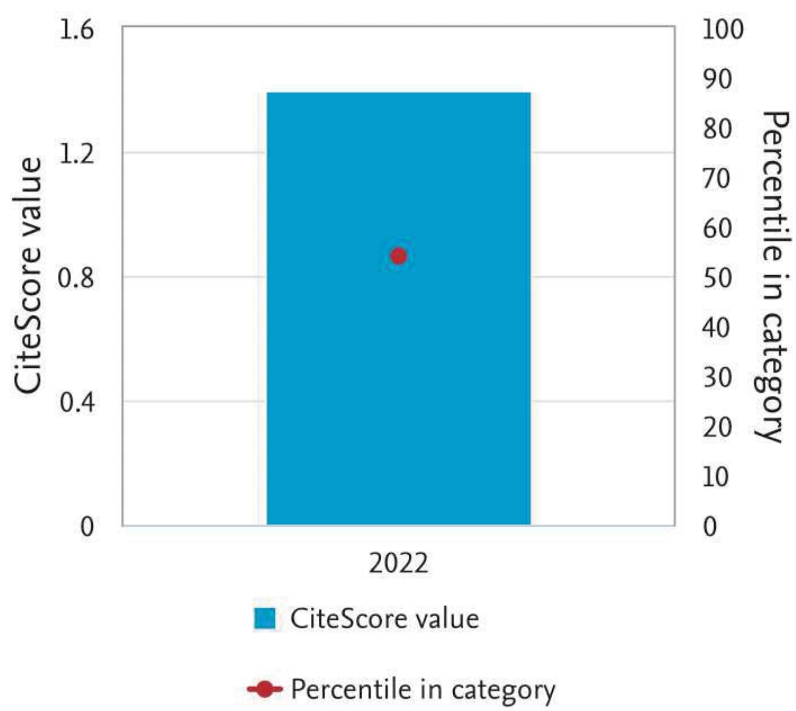

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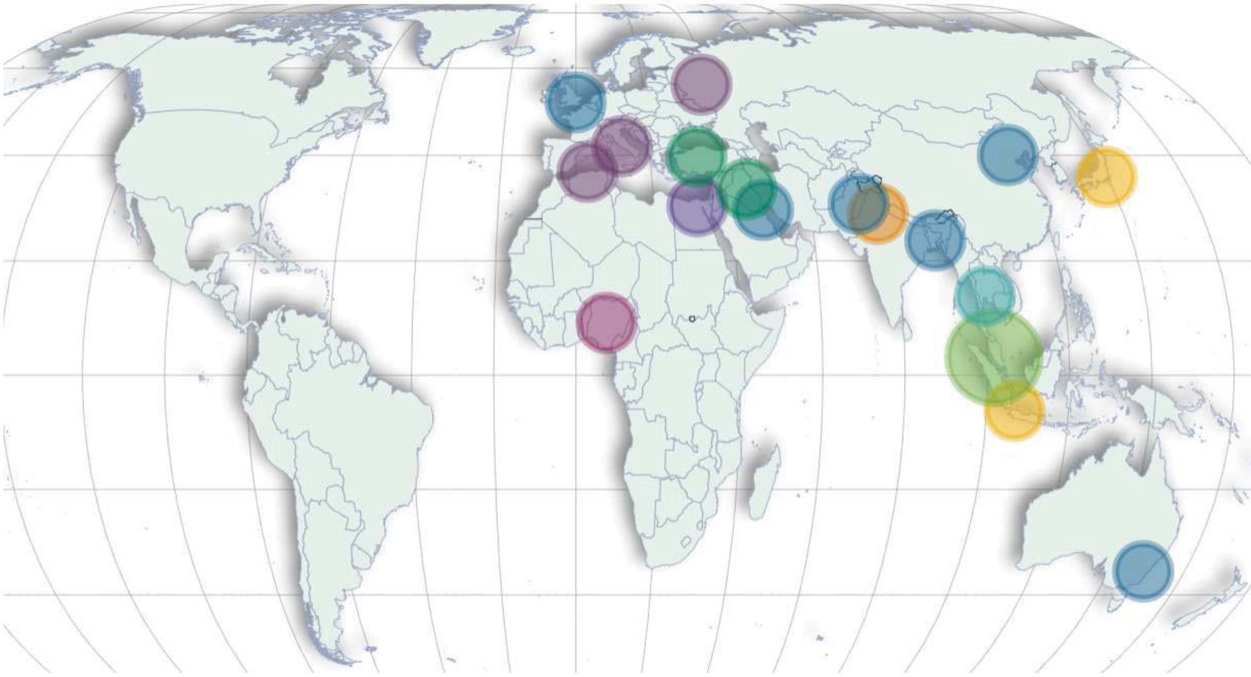

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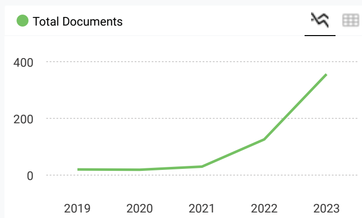

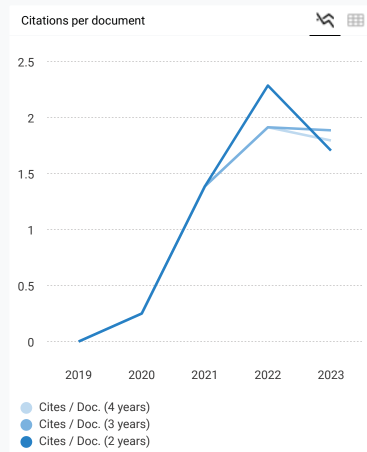

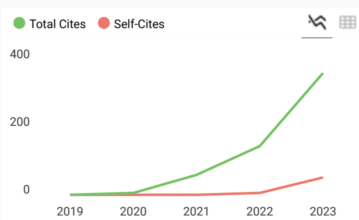

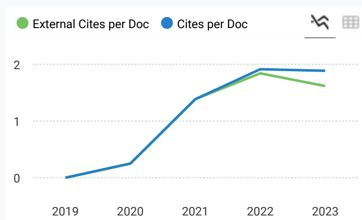

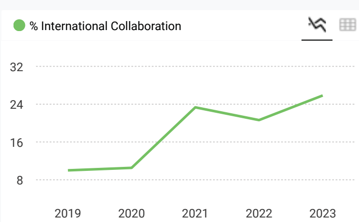

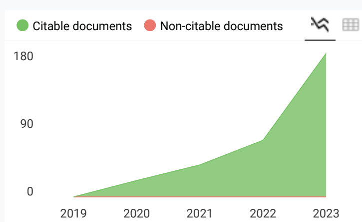

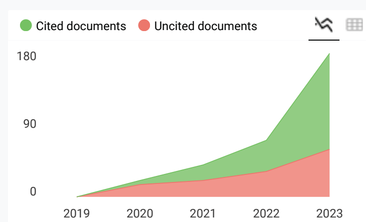

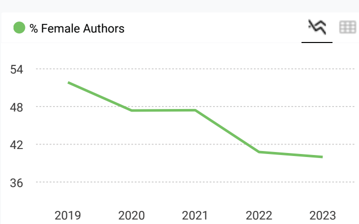

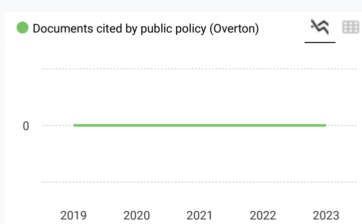

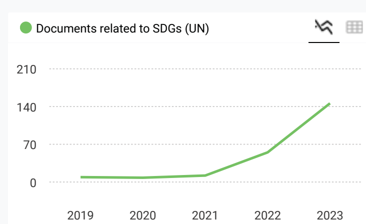

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Melanie Ortiz 3 months ago SCImago Team

Dear Dina,
Thank you very much for your comment. We suggest you contact the Scopus support team here: https://service.elsevier.com/app/answers/detail/a_id/14883/kw/scimago/supporthub/scopus/
Best Regards, SCImago Team

J **Jeremy** 4 months ago

If I may predict, this journal will be discontinued in Scopus eventually.

reply

I **IYAD YOUSEF** 3 months ago

Please explain to me if you allow, how will you stop from Scopus? How did you know that, I see that all her research is qualitative and distinctive but I do not know if she will stop or not

H **heri sasono** 5 months ago

for editors

I will send an article about economics, what is the scope of this journal.
Can my article be published here?
Is this journal indexed by Scopus?
Thank You.

regards

Heri Sasono

reply

Melanie Ortiz 5 months ago SCImago Team

Dear Heri,
Thank you for contacting us.
We suggest you visit the journal's homepage or contact the journal's editorial staff , so they could inform you more deeply.
Best Regards, SCImago Team

C **chakrasali chandrakumar** 6 months ago

Respected sir

I have prepared a journal paper on friction stir welding of aluminum material. will it be published in your journal, what will be the publishing period, and what will be the procedure and cost

reply

Melanie Ortiz 6 months ago

SCImago Team

Dear Chakrasali,
Thank you for contacting us.
We are sorry to tell you that SCImago Journal & Country Rank is not a journal. SJR is a portal with scientometric indicators of journals indexed in Elsevier/Scopus.
We suggest you visit the journal's homepage (See submission/author guidelines) or contact the journal's editorial staff , so they could inform you more deeply.
Best Regards, SCImago Team

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