INDONESIAN JOURNAL OF EDUCATIONAL RESEARCH AND REVIEW
Volume 5 Nomor 1 2022, pp 192-204
E-ISSN: 2621-8984; P-ISSN: 2621-4792
DOI: https://doi.org/10.23887/ijerr.v5i1.44247

5E-Metacognitive Lesson Plan in Education: Development and Validation for Higher Secondary School Students

Venkateswar Meher[1*], Rajashree Baral[2]
[1] *IFTM University, Moradabad, UP, India*
[2] *Govt. Women's College, Sambalpur, Odisha, India*
**Corresponding author: venkatesmeher90@gmail.com*

Abstrak

Metakognisi adalah kemampuan individu untuk menerapkan pengetahuan dan pengalaman yang diperoleh sebelumnya untuk mengoperasikan kegiatan yang berhubungan dengan pembelajaran. Tujuan dari penelitian ini adalah untuk mengembangkan RPP metakognitif 5E (Engage, Explore, Explain, Elaborate, Evaluate) dalam pendidikan dan memvalidasi RPP metakognitif 5E dengan mengambil penilaian ahli. Jenis penelitian ini yaitu penelitian pengembangan. Subjek penelitian yaitu ahli validitas isi. Subjek uji coba yaitu siswa di sekolah menengah atas. Metode yang digunakan dalam mengumpulkan data yaitu wawancara dan kuesioner. Instrumen yang digunakan untuk mengumpulkan data yaitu kuesioner. Kuesioner digunakan untuk mengumpulkan data berupa penilaian yang diberikan oleh ahli. Teknik yang digunakan dalam menganalisis data yaitu analisis deskriptif kualitatif dan kuantitatif. Content Validity Ratio (CVR) digunakan sebagai ukuran kuantitatif untuk mendapatkan pemahaman tentang validitas isi dari RPP yang dikembangkan. Hasil analisis data yaitu berdasarkan umpan balik dan komentar para ahli dan siswa, RPP akhir disusun. Rasio Validitas Isi keseluruhan dari rencana pelajaran yang dikembangkan adalah 0,73. Jadi, nilai CVR berkisar antara 0,6 hingga 0,8, sehingga dari sini terlihat bahwa RPP memiliki validitas isi yang baik. Disimpulkan bahwa dapat digunakan untuk mengajar siswa SMA.

Kata kunci: *5E, Metakognitif, RPP*

Abstract

Metacognition is an individual's ability to apply, and experience previously acquired to operate knowledge related to learning. This study aimed to develop 5E metacognitive RPP (Engage, Explore, Explain, Elaborate, Evaluate) in education and validate 5E metacognitive RPP with expert judgment. This type of research is development research. The research subject is a content validity expert. The test subjects were students in high school. The methods used in collecting data are interviews and questionnaires. The instrument used to collect data is a questionnaire. Questionnaires are used to collect data in the form of data provided by experts. The technique used in analyzing the data is descriptive qualitative, and quantitative analysis. Content Validity Ratio (CVR) is used as a quantitative measure to understand the content validity of the developed lesson plans. The results of data analysis are based on feedback and comments from experts and students. The final lesson plans are prepared. The overall content validity ratio of the developed learning plan is 0.73. So, the CVR value ranges from 0.6 to 0.8, so it can be seen that the lesson plans have good content validity. It was concluded that it could be used to teach high school students.

Keywords: 5E, Metacognitive, Lesson plan

History:
Received : February 02, 2022
Revised : February 03, 2022
Accepted : April 04, 2022
Published : April 25, 2022

Publisher: Undiksha Press

1. INTRODUCTION

Metacognition refers to the abilities of persons where they do apply their previously acquired knowledge and experience to design a framework to operate learning-related activities, follow strategies and approaches to overcome issues and make self-reflection and self-assessment with a requisite variation. The knowledge about cognition and monitoring/regulation of cognition are the two elements of metacognition (Gul & Shehzad, 2012; Sukarno & Widdah, 2020). Metacognitive knowledge also called metacognitive awareness refers to "the individuals' knowledge about their own knowledge and cognitive activities" (Molin et al., 2020; Schoenfeld, 2016). Metacognitive regulation is the second important aspect of metacognitive which refers to the individuals' monitoring regulating skills, which enable them to gain understanding about controlling their cognitive tasks. It

refers to "the skills of individuals to regulate and control their cognitive activities and learning experiences" (Akbari et al., 2021; Calafato, 2020; Sart, 2014). Educational psychologists revealed that the metacognitive theories are constructed for the systematization of metacognitive knowledge, and understanding and planning cognitive activities with certain frameworks (Gandolfi et al., 2021; Palennari, 2016; Tsai et al., 2018). Their metacognition model highlights the two basic components of metacognition i.e., 'knowledge about cognition' and 'regulation of cognition'. They also discussed major subcomponents of the above two components.

Knowledge about cognition is generally understood as the individual's knowledge about their own cognitive functioning. This includes declarative, procedural, and conditional knowledge (Ahmad, 2018; Contreras et al., 2020; Loh & Kanai, 2016). Declarative knowledge refers to an individual's knowledge about his/her own knowledge as a learner and the knowledge about the factors that affect his/her learning and outcomes. It is a widely accepted fact that a good learner possesses more knowledge about his/her memory, understanding, strength, and weakness as compared to poor learners (Belland et al., 2013; Kostyrka-Allchorne et al., 2017; Walkington et al., 2019). Individuals' knowledge about the implementation of different procedures and skills is referred to as procedural knowledge. Researcher shows that the students with high procedural knowledge become able to apply their skills of their own automatically (Marschark M, 2012; Srinivasan, 2019). The students with higher procedural knowledge become able to arrange different strategies sequentially and apply them effectively. Individuals' knowledge about when and why to apply their cognitive strategies in actions is referred to as conditional knowledge (Gong et al., 2018; Zabelina & Silvia, 2020). This kind of knowledge is concerned with the knowledge of individuals about the situations in which their procedures or skills need to be implemented effectively.

Regulation of cognition refers to cognitive activities of the individuals used for regulating and controlling their own thinking process or learning. The regulation of cognition includes a lot of things, but some essential skills are planning, monitoring, and evaluation (Ahmad, 2018; Contreras et al., 2020). Planning is the initial component of the regulation of cognition which refers to the strategies that the individuals choose and allocate available resources for the betterment of their performance (Loh & Kanai, 2016; T. T. Wu & Wu, 2020). Monitoring refers to individuals' awareness and understanding of their tasks and performance. The monitoring abilities among students can be developed through proper training and best practices. Evaluation refers to the process of analysis performance, strategy effectiveness, examining and re-examining own goals and conclusion regarding any phenomena by the individual is the example of evaluation (Mauliate et al., 2019; Sholihin et al., 2020; W. H. Wu et al., 2019).

The research studies related to metacognition reveals some kinds of strategies and interventions for both teachers and students involving a mixture of theory and practices. In implementing metacognitive interventions in the classroom context, both the teachers and students play an equal role, but more emphasis is given to students' thinking. The teachers provide an opportunity to the students to identify their learning gaps, their strengths, and weakness, communicate their knowledge and skills, set their learning goals, evaluate their learning activities, identify and implement appropriate learning strategies, and transfer their learning in different situations (Arsy et al., 2020; Cigdemoglu et al., 2017; Karam et al., 2020). To accomplish the above-cited purposes, the teachers have to facilitate equal participation of the students in the teaching-learning process and help them in every phase of learning. The metacognitive interventions are multidimensional and interdisciplinary, which can be implemented in different subject areas of science and social science to make the teaching-learning process effective (Al-Harthy et al., 2010; Memiş & Kandemir, 2019). From

the intensive literature review, four most frequently used metacognitive interventions were found i.e., thinking aloud (Alqahtani, 2015; Dike et al., 2017), brainstorming (Al-Samarraie & Hurmuzan, 2018; Filgona et al., 2016), concept mapping, and self-assessment (Koumy, 2017). Other research also conducted a meta-analysis on the effectiveness of the above-cited metacognitive interventions and found that these interventions are having a large effect size in the context of the teaching-learning process (Meher et al., 2020). The analysis of above all metacognitive interventions in teaching reveals that by using these strategies in the classroom context, the teachers may be able to make a congenial learning environment focusing on the construction of knowledge and experiential learning by enabling the students to analyse and think critically about their thinking about their cognitive operations. By analysing the available related kinds of literature related to metacognitive interventions and strategies in the present study four important frequently used metacognitive interventions were used in the form of 5E lesson plans to teach higher secondary school students, viz. thinking aloud, concept mapping, brainstorming, and self-assessment.

Thinking aloud is a teaching technique where the students become able to externalize their thinking while engaging in the learning task (Güss, 2018; Ikram et al., 2020). In this process the students say aloud about their thinking before others while performing learning tasks i.e., responding to questions, solving a problem, reading a textbook, etc. In the classroom context, both the teachers and students can use this thinking aloud method to promote metacognitive awareness and skills among students. Concept mapping is an innovative strategy where the presents the information and knowledge in a graphical way, which helps the students to grasp the connection of a concept with the sub-concepts (Bilik et al., 2020; Lopez-Belmonte et al., 2020). This technique develops the critical thinking of the students towards the subject matter. Self-assessment is a process of evaluating the knowledge, aptitude, and skills of the students by themselves (Gawrycka et al., 2021; Tamboer & Vorst, 2015; Yüksel & Gündüz, 2017). In this approach, the teachers allow the students to assess their own performance and measure their own learning process. Brainstorming teaching technique is usually a group activity where discussion is done about a particular problem in a group by gathering innovative ideas from the members of the group (Al-Samarraie & Hurmuzan, 2018; Utami, 2015). This technique enables the students to collaborate with others in learning. Experimental studies related to metacognition have been found on mathematics, geometry, business education, social studies, reading comprehension skills etc., but a few studies have been undertaken in Education subject at higher secondary level. As the adolescence stage is considered as a transitional stage of physical and psychological development among students, here the mental activities of a child develop very fast, so higher secondary stages have been taken into account for the present study. The aim of this study was to develop 5E metacognitive lesson plans in education and validate 5E metacognitive lesson plans taking expert judgment.

2. METHODS

This type of research is development research. This study developed a 5E lesson plan with a metacognitive intervention. After an extensive literature review on metacognitive interventions, the 4 most frequently used interventions were considered: thinking aloud, self-assessment, brainstorming, and concept mapping. The research subject is a content validity expert. The test subjects were students in high school. This study consisted of high school students (Class-XII) Odisha who came from the Arts stream and had 'Education' as their subject of choice. Students from the experimental group, 5E lesson plans were developed, and suggestions from subject matter experts were taken to establish the content validity of the lesson plans before actual implementation. The lesson plans of the experimental group

included metacognitive interventions such as thinking aloud, concept mapping, brainstorming, and self-assessment. The methods used in collecting data are interviews and questionnaires. Interviews were conducted to collect data on the opinions given by students and experts regarding 5E lesson plans with metacognitive intervention. The instrument used to collect data is a questionnaire. Questionnaires are used to collect data through assessments given by experts. The technique used in analyzing the data is descriptive qualitative, and quantitative analysis. Content Validity Ratio (CVR) is used as a quantitative measure to understand the content validity of the developed lesson plans. Following the CVR procedure, 10 Education experts were purposively selected from Government Assisted High School and the Government of Sambalpur, Odisha.

3. RESULTS AND DISCUSSION

Results

The detailed procedures of developing the 5E lesson plans as follows. In the process of constructing knowledge, both the teacher and students play active roles and they also evaluate the knowledge of their own, as a result, metacognition is also playing an important role in their learning as it refers to the awareness, understanding, and regulation of the teachers' and students' own cognitive functioning. The metacognitive students are considered an integral part of the constructivist classroom, where they get the opportunity to interpret their viewpoints in a social setting, and become able to monitor and regulate their learning progress. In the classroom context, the metacognition of students is socially mediated and it is influenced by the nature of the classroom learning environment to a great extent (Gul & Shehzad, 2012). The students' self-regulation needs some aspects of metacognition i.e., planning, monitoring, and evaluating.

Keeping the relationship between metacognition and constructivism in mind, in the present study 5E lesson plans were developed, and in each step of the lesson plan, the metacognitive intervention was included. These lesson plans were based on the procedures given by (Bybee, 1993). The constructivist 5E lesson plans consisted of five steps viz. engage, explore, explain, elaborate, and evaluate, where the students got scope for knowledge construction about the concepts of the subject matter. Keeping these five steps in mind, specific learning activities were planned to implement in the classroom. In each learning activity, the students were exposed to asking some sort of metacognitive questions to themselves. Apart from this, in each stage, specific metacognitive interventions were used to enable the students for understanding their own cognitive functions. In the Engage stage, the students were encouraged for thinking aloud, in Explore stage, the students were encouraged for brainstorming approach, in Explain stage, the students were encouraged for concept mapping strategy, in the Elaborate stage, the students were encouraged for both brainstorming and thinking aloud strategy, and in Evaluate stage, the students were encouraged for thinking aloud and self-assessment strategy. So, during the whole process, four important metacognitive interventions were implemented i.e., thinking aloud, brainstorming, concept mapping, and self-assessment.

The present study consisted of the higher secondary school students (Class-XII) of Odisha belonging from the Arts stream and having 'Education' as their elective subject. So, contents for the lesson plans were selected from the revised Education Syllabus uploaded by the Council of Higher Secondary Education, Odisha, India. Lesson plans were prepared for Unit-I, II, III of the syllabus of Education subject, which included Contributors of educators, Learning and Motivation, and Current issues in education respectively. Unit-I covered the educational thoughts of M. K. Gandhi, Gopabandhu Das, and Rousseau. Unit-II covered concepts and factors of learning, theories of learning (Trial and Error, Classical conditioning,

insightful learning), motivation in learning (concept, types, and techniques). Unit-III covered universalization of elementary education, Right to Education, Education for national integration, environmental education, and life skill education. Since constructivist lesson plans with metacognitive interventions were designed, the students were given utmost freedom to construct their knowledge actively with the group discussion. However, the contents were selected based on the previous learning of the students, which provided an opportunity to the students for applying their previous knowledge in constructing new knowledge.

The primary form of the lesson plans was prepared based on the five steps viz. engage, explore, explain, elaborate, and evaluate, where specific learning activities were included. The five steps of the primary form of lesson plans along with specific learning activities were undertaken in each step, which is illustrated. **Stage-1 E: Engage.** In the first step of teaching, the teacher favoured certain activities to capture and stimulate the students' attention, interest, and thinking. Here, the teacher tried to draw the child's curiosity towards learning and keep them mentally engaged in concepts, processes, or skills. Activity-1, The teacher showed some photographs gave some relevant examples related to the topic and asked them to share their reflections. The teacher posed some suitable questions related to the topic and informed the students about the topic of discussion. The teacher allowed each student to answer individually. During this process, the students were instructed to ask the following questions to themselves independently and note down their reflections in their notebooks. Here, the students were encouraged to think aloud about the questions asked to them. During the whole process, the think-aloud strategy was followed, and the responses of each student were recorded.

Stage-2 E: Explore. In the second step, the teacher provided scope to the students to get involved with the topic and build up their own understanding in groups depending upon the feasibility. In this phase, the students in groups got an opportunity to develop current concepts, processes, and skills as they explored the learning environment. Here, the teacher manipulated learning materials related to the topic and asked the students to go through the same thoroughly in their group. In this step, the students got time to think, plan, investigate, and organize the information collected or received by them. The role of the teacher was as a facilitator. Activity-2. After a few minutes, the teacher divided the whole class into some small groups by assigning 5-6 students to each group. During this, the teacher allowed each student of each group to present a solution to the problem. In this stage, each student was encouraged to ask the necessary questions to other students in their groups. So, each student presented solutions to the problem before the group representative and they arrived at a consensus. After this, the group discussed their procedures to give solutions to the problem, where each member presented procedures before others, and others listened to the presentation, analysed critically, and asked critical questions. At the end of the presentation, the students arrived at a consensus about the procedures of solving the problems. In this stage, the students were encouraged to ask the following questions to themselves individually. During this stage, the students were encouraged to think aloud for finding possible solutions to the problem and work collaboratively. In this stage, the brainstorming method was encouraged.

Stage-3 E: Explain. In the third step, the teacher provided the opportunity to the students for assimilation, where the students tried to connect their previous knowledge with the current learning for conceptual clarity. Here, more focus was on students' attention on a specific part of engagement and exploration, which helped students to verbalize their conceptual understanding or demonstrate skills. Activity-3. In this phase, the teacher encouraged the use of concept mapping. Each group representative discussed with their members of the group presented the answers to the given problem before the group and

showed a concept map for better visualization and understanding. The group representatives got equal time to demonstrate their procedure of solving the problem, and the others actively listened to the presenters and posed essential questions to themselves. During this phase, the teacher also got the opportunity to introduce the definition of the concepts, skills, processes, and behaviour. Here, the teacher encouraged the use of a concept mapping strategy among students and assisted them to relate a concept with other sub-concepts in diagrams. The rationale behind the use of the concept mapping strategy was to help the students in understanding the relationship between concepts and sub-concepts relating to the topic. Here the students worked in a group to create concept maps related to the topic and showed them to each other. The teacher observed the whole process and provided the required assistance wherever required for a better understanding of the students. At the end of this phase, the teacher helped the group to arrive at a consensus on the problem.

Stage-4 E: Elaborate. In the fourth step, the focus was given to students' conceptual understanding to allow them for practicing different skills and behaviour. Here, the opportunity was provided to the students to apply or extend the previously learned concepts and experiences to the new situations, as a result of which, the students developed better understanding, generated more information, and learned adequate skills. Here, the teacher helped the students to apply their learned knowledge and develop a deeper understanding of the subject matter. Activity: 4. The teacher gave a question card to the students comprising of analysis-based questions related to the topic and asked them to discuss the possible answers. Here, the teacher brought the attention of the students in front of the class and provided an opportunity for each group representative to present the answers by summarizing the responses of each member of the group. The other students were encouraged to pose essential questions before the group representative. Here, the teacher provided a question card to each group for discussion. During the whole process, the students were encouraged to think aloud about the questions presented to them and asked them the following questions themselves. The students presented their answers in the group before the group representative, and the representative noted down the responses of each member and summarized the same. Finally, the representative presented the answers before others. The teacher encouraged other students to ask their queries to the representative. In this stage, both thinking-aloud and concept mapping strategies were used.

Stage-5 E: Evaluate. In the fifth step, the teacher and students both determined the extent to which the learning and understanding have taken place about the topic. Here students were provided an opportunity to review and assess their learning in a summative form. Here the students were encouraged to assess their understanding, abilities, skills, and behaviour related to the topic. The teacher gave due emphasis on reflection by following both format and informal assessment procedures rather than traditional quizzes. The teacher gave due importance to self-assessment and writing assignments. The teacher preferred the self-assessment technique in this step, where the students got the opportunity to evaluate their own academic works and learning progress. Through self-assessment, the students got the opportunity to identify the gap in their knowledge, track their own progress, set goals, and revise their works. Activity-5. The teacher favoured some sorts of reflective questions related to the topic before the students and their responses were gathered orally. The reason behind the use of reflective questions was to encourage students for reflecting on their learning skills and generate relevant questions and ideas for propelling future learning experiences. In this stage, the teacher encouraged the students to ask questions about themselves related to their learning activities, processes, and behaviour.

The teacher gathered and analysed the responses of the students and measured the learning outcomes of the lesson. The teacher focused on students' abilities to formulate their own meaning and definitions about the topic. Here, the teacher used self-assessment

techniques through this phase. At the end of the class, the teacher provided some home works related to the topic discussed before the class. The stages of RPP with metacognitive questions are presented in Table 1.

Table 1. Phases of lesson plans with metacognitive questions

Phases	5E stages	Metacognitive Questions (Students were encouraged to ask to themselves)
Planning	**Engage** -Generate interest -Connect to past knowledge	**Q1.** What do I know about this? **Q2.** What do I do not know about this? **Q3.** What kind of question is this? **Q4.** What do I need to know about these questions? **Q5.** What should I do to get an idea to answer these questions? **Q6.** What kind of goal should I set for this? **Q7.** How can I solve the problem?
	Explore -Group learning -Examine their thinking	**Q1.** How did I get my answer? **Q2.** What will be other possible solutions to these problems? **Q3.** Which strategy is the best to solve this problem? **Q4.** How did I arrange the information for solving the problems? **Q5.** What kinds of difficulties did I face to solve these problems? **Q6.** How did I think about the procedures? **Q7.** What are the limitations of this strategy?
Monitoring	**Explain** -Communicate new understanding -Explaining ideas	**Q1.** How is this the solution to the problems? **Q2.** Are there any other possible solutions? **Q3.** Am I able to understand this solution? **Q4.** What was running in my mind while listening to the solutions? **Q5.** How is my procedure different from others?
	Elaborate -Apply new learning to present situation	**Q1.** How are these questions related to the previous questions? **Q2.** How will I use previous information to solve these questions? **Q3.** Will I be able to connect my previous knowledge to this problem? **Q4.** What kinds of difficulties am I facing to associate previous information? **Q5.** What kinds of thoughts are running inside my mind concerned with this problem? **Q6.** How can I solve these problems?
	Evaluate -Assess their knowledge	**Q1.** Did I understand what I need to understand? **Q2.** In which condition I learned the most? **Q3.** Where did I feel difficulty in understanding the

Phases 5E stages	Metacognitive Questions (Students were encouraged to ask to themselves)
	topic? **Q4.** How did I learn the subject matter? **Q5.** How my learning style is different from others?
Evaluation	**Q6.** Did I plan properly to adopt procedures for finding the solution to the problems? **Q7.** Did I able to learn correctly about the topic? **Q8.** How did I learn the topic? **Q9.** Do I keep in mind the way of my learning? How? **Q10.** Am I satisfied with my learning style? **Q11.** What is the lacuna in my learning? **Q12.** How can I learn better?

Thus, by following these five stages, the primary form of the 5E model lesson plan with metacognitive interventions was prepared, and it was pre-piloted and valuable suggestions of subject experts were gathered for the final form of the lesson plan. The revised lesson plan was piloted on 60 higher secondary school students (Class-XII) studying in Government Women's College, Sambalpur with prior permission from the principal and Head of the Education department. During the piloting of the lesson plans, 12 groups were formed and the plan was implemented. The students of each group were asked to note down the difficulty that they faced during their learning collaboratively. As the researcher himself implemented the lesson plan, hence noted down some sorts of difficulties that the students were facing during their learning. After the implementation of the lesson plans, the feedback of the students was taken orally, and accordingly essential modifications were made in the final form of the lesson plan. Valuable suggestions of the educational experts were taken into account and accordingly essential modifications were made in the final form of the lesson plan. Based on the piloting also necessary changes were made to the lesson plan. Thus, 40 lesson plans were developed for the experimental group covering Unit-I, II, III of the Education syllabi of CHSE, Odisha, India.

Primary forms of lesson plans were sent to the educational experts in this field, where they were asked to provide their valuable opinion about the adequacy of the specific learning activities and metacognitive questions. They were also asked to provide their feedback about the suitability of the metacognitive interventions included in the lesson plans. The primary forms of lesson plans were sent to five subject experts, where maximum experts suggested shortening the topics of the lesson plans, as some plans covered the broad topic in one class. The experts also suggested including application and analysis-based questions related to the topics and giving one example of a concept map in each topic. Thus, following the valuable suggestions of the subject experts, essential modifications were made to the lesson plan and it was revised.

Content Validity Ratio (CVR) was used as a quantitative measure to gain an understanding of the content validity of the developed lesson plans. By following the procedure of CVR, 10 subject experts of Education were selected purposively from the Government and Government-Aided Higher Secondary Schools of Sambalpur, Odisha. A hard copy of the lesson plan was given to them along with a separate sheet. The sheet contained 07 important parameters of the lesson plan on the left side and 4 alternatives on the right side of each parameter. First of all, the experts were requested to go through the lesson

plans thoroughly, then rate the plan in terms of each stage, relevance, and clarity. For rating purposes, 04 points were given i.e., 1=not relevant, 2=somewhat relevant, 3=quite relevant, 4=highly relevant (Davis, 1992). Taking into account the proportions of the rating, CVR was calculated with the formula CVR= (Ne- N/2)/(N/2), where Ne is the number of experts indicating 'relevant', N/2 is half of the total number of experts. The CVR ratio remains between 1 to -1. However, the CVR with more than 0.49 was considered acceptable (Lawshe, 1975). The data obtained from the experts are given in Table 2.

Table 2. Content Validity Ratio (CVR)

Parameters	Relevant (rating 3 or 4)	Not relevant (rating 1 or 2)	CVR	Remarks
Engage stage	08	02	0.6	Acceptable
Explore stage	08	02	0.6	Acceptable
Explain stage	09	01	0.8	Acceptable
Elaborate stage	08	02	0.6	Acceptable
Evaluate stage	09	01	0.9	Acceptable
Relevancy	08	02	0.8	Acceptable
Clarity	08	02	0.8	Acceptable
		Proportion of CVR	**0.73**	

According to Lawshe's table for 10 panelists/experts, the minimum value is .62 for the acceptable status of content validity. So, the above table shows that in all the parameters the CVR value is ranging from .6 to .8, and the proportionate CVR is 0.73, so, from this, it is vivid that the lesson plan has got a good content validity.

Discussion

The following instructions should be followed for implementing the 5E model lesson plan with metacognitive interventions. First, the teacher should develop his/her understanding of the 5E model of lesson planning and the use of metacognitive interventions. Second, the teacher should explain the major objectives of the lesson plan before its implementation. Third, the teacher should explain the activities to be undertaken in each step of the lesson plans. Fourth, the teacher should explain the metacognitive interventions before the students. Fifth, the teacher should explain the procedure of group division for brainstorming. Sixth, the teacher should provide a necessary clue, whenever the students are not able to discuss the content. Seventh, the teacher should encourage collaborative learning in the classroom. Eighth, the teacher should follow each step systematically and allow the students for the construction of knowledge. Ninth, the teacher should give suitable examples of concept maps to the students, before asking them to prepare concept maps. Tenth, the teacher should develop the thinking aloud technique in the classroom. Eleventh, the teacher should encourage self-assessment techniques at the end of the class. Twelfth, the teacher should give some sort of homework to the students related to the topic before ending the class.

Knowledge of cognition is generally understood as an individual's knowledge of their cognitive function. It includes declarative, procedural, and conditional knowledge (Ahmad, 2018; Contreras et al., 2020; Loh & Kanai, 2016). Metacognition refers to the ability of students to apply previously acquired knowledge and experience to design a framework to operate learning-related activities (Royanto, 2012; Yusoff et al., 2021; Yusuf & Widyaningsih, 2020). An essential aspect of metacognition is metacognitive regulation. Metacognitive regulation refers to the skill set of individual monitoring, allowing students to understand controlling cognitive tasks. Students with high procedural knowledge can automatically apply their skills (Marschark M, 2012; Srinivasan, 2019). Students with higher

procedural knowledge can arrange different strategies in sequence and apply them effectively. Individual knowledge of when and why to put their cognitive strategies into action is referred to as conditional knowledge (Gong et al., 2018; Zabelina & Silvia, 2020).

Metacognitive students are considered an integral part of the constructivist classroom. They get the opportunity to interpret their point of view in social settings and become able to monitor and regulate their learning progress (Abdelrahman, 2020; Al-Azzemy & Al-Jamal, 2019; Sukarno & Widdah, 2020). So that the RPP 5E developed can be used to teach high school students where students will get the opportunity to face knowledge construction and gain insight to understand and organize their thinking adequately. In the 5E-metacognitive lesson plans, a teacher must take essential steps to promote positive attitudes among students and cultivate thinking rather than memorizing. With the help of this metacognitive awareness plan, students' self-efficacy and academic achievement can be developed to a large extent. The content validity of the plans was also higher, indicating that educational experts have supported the lesson plans in the Indian context. So, this RPP has broad implications for teachers, student teachers and education stakeholders.

4. CONCLUSION

Based on the results of data analysis, the lesson plans that have been developed have good content validity. It can be said that RPP 5E (Engage, Explore, Explain, Elaborate, Evaluate) can be used to teach high school students. Applying this lesson plan can allow students to face knowledge and gain insight to understand and organize their thinking adequately.

5. ACKNOWLEDGMENT

We are thankful to the selected experts for their creative suggestions for developing and validating the lesson plans. We are especially thankful to Prof. S. C. Panigrahi, CASE, M. S. University, Baroda for his valuable time in finalizing the lesson plans. We are also thankful to our institution Gangadhar Meher University, Amruta Vihar, Sambalpur, for providing essential opportunities and scope to undertake this research.

6. REFERENCES

Abdelrahman, R. M. (2020). Metacognitive awareness and academic motivation and their impact on academic achievement of Ajman University students. *Heliyon*, *6*(9). https://doi.org/10.1016/j.heliyon.2020.e04192.

Ahmad, I. (2018). Teacher Cognition and Grammar Teaching in the Saudi Arabian Context. *English Language Teaching*, *11*(12), 45–57. https://doi.org/10.5539/elt.v11n12p45.

Akbari, M., Bahadori, M. H., Milan, B. B., Caselli, G., & Spada, M. M. (2021). Metacognitions as a predictor of online gaming in adolescents: Psychometric properties of the metacognitions about online gaming scale among Iranian adolescents. *Addictive Behaviors*, *118*. https://doi.org/10.1016/j.addbeh.2021.106904.

Al-Azzemy, A. F. T., & Al-Jamal, D. A. H. (2019). Evaluating cognitive, metacognitive and social listening comprehension teaching strategies in Kuwaiti classrooms. *Heliyon*, *5*(2). https://doi.org/10.1016/j.heliyon.2019.e01264.

Al-Harthy, I. S., Was, C. A., & Isaacson, R. M. (2010). Goals, efficacy and metacognitive self-regulation: A path analysis. *International Journal of Education*, *2*(1). https://doi.org/10.5296/ije.v2i1.357.

Al-Samarraie, H., & Hurmuzan, S. (2018). A review of brainstorming techniques in higher education. *Thinking Skills and Creativity*, *27*. https://doi.org/10.1016/j.tsc.2017.12.002.

Alqahtani, M. A. (2015). *The effect of think-aloud strategy to improve reading comprehension of 6th-grade students in Saudi Arabia*. Master's Thesis, State University of New York.

Arsy, H. I., Prasetyo, A. P. B., & Subali, B. (2020). Predict-Observe-Explain Strategy with Group Investigation Effect on Students ' Critical Thinking Skills and Learning Achievement. *Journal of Primary Education*, *9*(1), 75–83. https://doi.org/10.15294/jpe.v9i1.29109.

Belland, B. R., Kim, C., & Hannafin, M. J. (2013). A framework for designing scaffolds that improve motivation and cognition. *Educational Psychologist*, *48*(4), 243–270. https://doi.org/10.1080/00461520.2013.838920.

Bilik, Ö., Kankaya, E. A., & Deveci, Z. (2020). Effects of web-based concept mapping education on students' concept mapping and critical thinking skills: A double blind, randomized, controlled study. *Nurse Education Today*, *1*(1). https://doi.org/10.1016/j.nedt.2019.104312.

Bybee, R. . (1993). *Instructional model for science education in developing biological literacy*.

Calafato, R. (2020). Learning Arabic in Scandinavia: Motivation, metacognition, and autonomy. *Lingua*, *246*, 102943. https://doi.org/10.1016/j.lingua.2020.102943.

Cigdemoglu, C., Arslan, H. O., & Cam, A. (2017). Argumentation to foster pre-service science teachers' knowledge, competency, and attitude on the domains of chemical literacy of acids and bases. *Chemistry Education Research and Practice*, *18*(2), 288–303. https://doi.org/10.1039/c6rp00167j.

Contreras, K., Arredondo, C., Díaz, C., Inostroza, M. J., & Strickland, B. (2020). Examining differences between pre- and in-service teachers' cognition when lesson planning. *System*, *91*. https://doi.org/10.1016/j.system.2020.102240.

Dike, J. W., Mumuni, A. A. O., & Worokwu, C. (2017). Metacognitive teaching strategies for secondary school students' academic performance. *International Journal of Computational Engineering Research*, *7*(1).

Filgona, J., Sababa, L. K., & Iyasco, M. D. (2016). Effect of brainstorming learning strategy on junior secondary school student's academic achievement in social studies in Yola educational zone, Adamawa state, Nigeria. *International Journal of Progressive Science and Technologies*, *3*(2). https://doi.org/10.9734/BJESBS/2016/29057.

Gandolfi, E., Soyturk, I., & Ferdig, R. E. (2021). Evaluating U.S. gamers' metacognitions about digital entertainment: Validation of Metacognition about Online Gaming Scale in the U.S. context. *Journal of Affective Disorders*, *259*. https://doi.org/10.1016/j.jad.2021.08.133.

Gawrycka, M., Kujawska, J., & Tomczak, M. T. (2021). Self-assessment of competencies of students and graduates participating in didactic projects – Case study. *International Review of Economics Education*, *36*. https://doi.org/10.1016/j.iree.2020.100204.

Gong, Y., Hu, X., & Lai, C. (2018). Chinese as a second language teachers' cognition in teaching intercultural communicative competence. *System*, *78*. https://doi.org/10.1016/j.system.2018.09.009.

Gul, F., & Shehzad, S. (2012). Relationship between metacognition,goal orientation and academic achievement. *Procedia - Social and Behavioral Sciences*, *47*, 1864–1868. https://doi.org/10.1016/j.sbspro.2012.06.914.

Güss, C. D. (2018). What is going through your mind? Thinking aloud as a method in cross-cultural psychology. *Frontiers in Psychology*, *9*(AUG), 1–11. https://doi.org/10.3389/fpsyg.2018.01292.

Ikram, M., Purwanto, Parta, I. N., & Susanto, H. (2020). Exploring the potential role of reversible reasoning: Cognitive research on inverse function problems in mathematics. *Journal for the Education of Gifted Young Scientists*, *8*(1), 591–611. https://doi.org/10.17478/jegys.665836.

Karam, S., Nagahi, M., Dayarathna (Nick), V. L., Ma, J., Jaradat, R., & Hamilton, M. (2020). Integrating systems thinking skills with multi-criteria decision-making technology to recruit employee candidates. *Expert Systems with Applications*, *160*(113585), 1–16. https://doi.org/10.1016/j.eswa.2020.113585.

Kostyrka-Allchorne, K., Cooper, N. R., & Simpson, A. (2017). The relationship between television exposure and children's cognition and behaviour: A systematic review. *Developmental Review*, *44*, 19–58. https://doi.org/10.1016/j.dr.2016.12.002.

Koumy, A. S. A. (2017). Effects of student self-assessment on knowledge achievement and academic thinking. *Educational Resources Information Centre. The USA*. https://doi.org/10.2139/ssrn.2365149.

Loh, K., & Kanai, R. (2016). How has the Internet Reshaped Human Cognition? *Neoruscientist*, *1*(1), 506–520. https://doi.org/10.1177/1073858415595005.

Lopez-Belmonte, J., Marin-Marin, J. A., Soler-Costa, R., & Moreno-Guerrero, A. J. (2020). Arduino Advances in Web of Science. A Scientific Mapping of Literary Production. *IEEE Access*, *8*, 128674–128682. https://doi.org/10.1109/ACCESS.2020.3008572.

Marschark M, K. H. (2012). Educating deaf children: Language, cognition, and learning. *Deafness and Education International*, *14*(1). https://doi.org/10.1179/1557069X12Y.0000000010.

Mauliate, H. D., Rahmat, A., & Wachidah, S. (2019). Evaluation the Lesson Plan of English Language Learning in Junior High School, Seraphine Bakti Utama West Jakarta. *International Journal of Scientific Research and Management*, *7*(07), 1078–1086. https://doi.org/10.18535/ijsrm/v7i7.el02.

Meher, V., Baral, R., & Bhuyan, S. (2020). A meta-analysis on the effectiveness on the effectiveness of metacognitive strategies and interventions in teaching and learning. *I-Managerial Journal on Educational Psychology*, *14*(4). https://doi.org/10.26634/jpsy.14.4.17969.

Memiş, A. D., & Kandemir, H. (2019). The Relationship Between the Study Habits and Attitudes and Metacognitive Reading Comprehension Self-Awareness, Reading Comprehension, Reading Attitudes. *World Journal of Education*, *9*(4), 133. https://doi.org/10.5430/wje.v9n4p133.

Molin, F., Haelermans, C., Cabus, S., & Groot, W. (2020). Do feedback strategies improve students' learning gain?-Results of a randomized experiment using polling technology in physics classrooms. *Computers & Education*, *175*. https://doi.org/10.1016/j.compedu.2021.104339.

Palennari, M. (2016). Exploring the correlation between metacognition and cognitive retention of students using some biology teaching. *Journal of Baltic Science Education*, *15*(5), 617–629. https://doi.org/10.33225/jbse/16.15.617.

Royanto, L. R. (2012). The Effect of An Intervention Program based on Scaffolding to Improve Metacognitive Strategies in Reading: A Study of Year 3 Elementary School Students in Jakarta. *Procedia - Social and Behavioral Sciences*, *69*(Iceepsy), 1601–1609. https://doi.org/10.1016/j.sbspro.2012.12.105.

Sart, G. (2014). The Effects of the Development of Metacognition on Project-based Learning. *Procedia - Social and Behavioral Sciences*, *152*, 131–136. https://doi.org/10.1016/j.sbspro.2014.09.169.

Schoenfeld, A. H. (2016). Learning to Think Mathematically: Problem Solving, Metacognition, and Sense Making in Mathematics (Reprint). *Journal of Education*. https://doi.org/10.1177/002205741619600202.

Sholihin, M., Sari, R. C., Yuniarti, N., & Ilyana, S. (2020). A new way of teaching business ethics: The evaluation of virtual reality-based learning media. *The International Journal of Management Education*, *18*(3). https://doi.org/10.1016/j.ijme.2020.100428.

Srinivasan, K. (2019). Snake and Ladder Games in Cognition Development on Students with Learning Difficulties. *Indian Journal of Dental Advancements*, *10*(4), 160–170. https://doi.org/10.5866/2018.10.10160.

Sukarno, & Widdah, M. El. (2020). The Effect of Students' Metacognition and Digital Literacy in Virtual Lectures During The Covid-19 Pandemic on Achievement in The "Methods and Strategies on Physics Learning" Course. *Jurnal Pendidikan IPA Indonesia*, *9*(4), 477–488. https://doi.org/10.15294/jpii.v9i4.25332.

Tamboer, P., & Vorst, H. C. M. (2015). A new self-report inventory of dyslexia for students: criterion and construct validity. *Dyslexia (Chichester, England)*, *21*(1), 1–34. https://doi.org/10.1002/dys.1492.

Tsai, Y., Lin, C., Hong, J., & Tai, K. (2018). The effects of metacognition on online learning interest and continuance to learn with MOOCs. *Computers & Education*, *121*. https://doi.org/10.1016/j.compedu.2018.02.011.

Utami, D. (2015). Pengaruh Metode Brainstorming Terhadap Kemampuan Berpikir Kritis Pada Pembelajaran IPA. *Jurnal Pendidikan Dasar*, *6*(2), 232. https://doi.org/10.21009/jpd.062.05.

Walkington, C., Woods, D., Nathan, M. J., Chelule, G., & Wang, M. (2019). Does restricting hand gestures impair mathematical reasoning? *Learning and Instruction*, *64*. https://doi.org/10.1016/j.learninstruc.2019.101225.

Wu, T. T., & Wu, Y. T. (2020). Applying project-based learning and SCAMPER teaching strategies in engineering education to explore the influence of creativity on cognition, personal motivation, and personality traits. *Thinking Skills and Creativity*, *35*(January), 100631. https://doi.org/10.1016/j.tsc.2020.100631.

Wu, W. H., Kao, H. Y., Wu, S. H., & Wei, C. W. (2019). Development and evaluation of affective domain using student's feedback in entrepreneurial Massive Open Online Courses. *Frontiers in Psychology*, *10*(MAY). https://doi.org/10.3389/fpsyg.2019.01109.

Yüksel, H. S., & Gündüz, N. (2017). Formative and Summative Assessment in Higher Education: Opinions and Practices of Instructors. *European Journal of Education Studies*, *3*(8), 336–356. https://doi.org/10.5281/zenodo.832999.

Yusoff, Hisyam, M., Azra, A., & Fatimah. (2021). Metacognitives And Morals : The Qur ' an As A Guide Research Article Metacognitives And Morals : The Qur ' an As A Guide. *Turkish Journal of Computer and Mathematics Education*, *12*(4), 659–664. https://doi.org/10.17762/turcomat.v12i4.550.

Yusuf, I., & Widyaningsih, S. W. (2020). Implementing e-learning-based virtual laboratory media to students' metacognitive skills. *International Journal of Emerging Technologies in Learning*, *15*(5). https://doi.org/10.3991/ijet.v15i05.12029.

Zabelina, D. L., & Silvia, P. J. (2020). Percolating ideas: The Effects of Caffeine on Creative Thinking and Problem Solving. *Consciousness and Cognition*, *79*(February). https://doi.org/10.1016/j.concog.2020.102899.