THE EFFECTIVENESS OF THE SELF-REGULATED PROBLEM-BASED LEARNING STRATEGY IN DEVELOPING INTERMEDIATE SCHOOL STUDENTS' MATHEMATICAL PROBLEM-SOLVING SKILLS AND METACOGNITIVE THINKING (A VISION INTO THE INPUTS AND OUTPUTS OF THE ENTREPRENEURIAL LEARNING IN MATHEMATICS)

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ABSTRACT

This research explores the effectiveness of the self-regulated problem-based learning strategy as entrepreneurial learning inputs in developing intermediate school students' mathematical problem-solving skills and metacognitive as entrepreneurial learning inputs, in Saudi Arabia. The sample consisted of (59) of the seventh-grade intermediate students who were divided to: an experimental group with (29) students studied by using Self-regulated problem-based learning strategy and a control group with (30) students studied by using the normal method, the research adopted the quasi-experimental design. The research instruments were a problem-solving skills test and a metacognitive thinking scale. The instruments were pre-post-tested on the research sample in the academic year 2020/2021. The results indicated that the students studied by using Self-regulated problem-based learning outperformed the students that studied by using the normal method in problem-solving skills and metacognitive thinking. It means that the entrepreneurial learning inputs should be used as a self-regulated problem-based learning strategy to reach entrepreneurial learning outputs such as developing problem-solving skills and metacognitive thinking. According to the results, the researchers recommended using the self-regulated problem-based learning strategy and providing the necessary capabilities to implement it for teaching mathematics.

Keywords: Metacognitive Thinking, Intermediate School, Problem-solving Skills, Self-regulated Problem-based Learning Strategy, Entrepreneurial Learning.

INTRODUCTION

The current age witness a huge cognitive development, an information revolution, and many achievements in all scientific fields, which led to care about the educational process to prepare students who can adapt, face the challenges of this age, and have the ability to face problems by using scientific way of thinking. As a result of this interest, the concept of

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entrepreneurial education, which has spread widely over the past decades become an effective strategy for developing the educational process, programs, curricula, and educational activities.

Entrepreneurial education cannot be separated from mathematics education and learning because they emphasize the importance of providing the learner with the concepts and the skills to identify opportunities that allow self and professional growth, independence, insight, and self-esteem. They are linked to enhance learners' competencies, the use of knowledge and skills, and the ability to solve problems. For mathematics education to be an entrepreneurial education, the learner's ability to have and develop entrepreneurial knowledge and solve problems should be enhanced. When the learner reaches an entrepreneurial level of knowledge and problem solving, it means reaching a high level of self-efficacy, the ability to organize and manage cognitive processes, and having entrepreneurial behaviors (Guzmán & Santos, 2001; Liñán, 2004; Li & Wu, 2019; Al-Shabibi & Al-Ayasra, 2019).

Principles and standards for school mathematics of National Council of Teachers of Mathematics (NCTM) indicate that, Problem-solving cannot be separated from teaching and learning mathematics, it is not only just a goal to learn it, but a mean to achieve it. Through students learning and engaging in problem-solving, they can gain different ways of thinking and many habits such as perseverance, curiosity, and self-confidence, which is reflected positively on their behavior and life (NCTM, 2000), and developing students' ability to think and solve problems at all study stages through the curricula; one of the main functions of Education. Mathematics has a major role in achieving the previous goal due to its nature (Abu Zina, 2010).

Therefore, Problem-solving cannot be separated from teaching and learning mathematics, it is not only just a goal to learn it, but a mean to achieve it. Through students learning and engaging in problem-solving, they can gain different ways of thinking and many habits such as perseverance, curiosity, and self-confidence, which is reflected positively on their behavior and life (NCTM, 2000), and developing students' ability to think and solve problems at all study stages through the curricula; one of the main functions of Education. Mathematics has a major role in achieving the previous goal due to its nature (Abu Zina, 2010).

Although the main aim of teaching and learning mathematics is to solve problems, there is a deficiency in the problem-solving skill of students in Saudi Arabia, and this has been confirmed by many studies, Such as Asiri (2003), A-Mazhar (2013) also confirms that many studies have shown that there is difficulty in students' performance in problem-solving. These studies recommended the importance of developing their problem-solving skills and caring about teaching methodologies and strategies that can help.

Among the important issues during students' problem-solving are their awareness of the goal of problem-solving, and what they know about the problem, as well as what they need of additional knowledge, and the strategies which can help to reach the appropriate solution; That's mean: students think about their thinking in problem-solving (Khadrawi, 2005), Because of the importance of students planning, monitoring and evaluating their thinking; In recent years, educators have focused on teaching students how to think through developing students' metacognitive thinking (MT) skills (thinking about thinking), which enable a student to express his thinking, become aware of it, and become able to go on the right path, and to well realize what he does doing (Hamada, 2007; Fiero, 1993; Alshahrni & Al-Kawafeha, 2019).

Many studies have linked entrepreneurial education to develop students' metacognitive thinking skills (Ustav, 2016), Because increasing an individual's awareness of his thinking patterns is closely related to achieving better results in critical thinking and metacognition (Ku & Ho, 2010; Magno, 2010; Kyro, 2008; Jouda, 2017), thus the learner's propensity to embark on

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entrepreneurial careers and cultivate the necessary mindset (Haynie et al., 2009). According to Mitchell et al. (2005), metacognitive thinking is a basic requirement for the learners to practice it intentionally in the context of entrepreneurship related to Mathematics, ending with the creation of entrepreneurial expertise.

Fisher (1998) defines MT as: thinking about thinking, the ability to solve problems, answer questions, and focuses on how we think, how we do things, how we find solutions, and analyze the systems, strategies, and techniques we use to think. Tuncer & Kaysi (2013) shows that among the characteristics of MT are the awareness of the individual in terms of his learning the tasks and achievement in memory, as well as his awareness of the effectiveness of his learning style, planning for the success of the learning task, using effective strategies for learning, and allowing an individual to monitor his status by learning knowledge successfully.

Many studies assert the importance of developing MT skills such as Thamraksa (2005); Al-Hafiz & Mohammed (2015). Developing MT skills has a link with developing student's ability to solve problems, that's because the person who can solve a certain problem is an idea generator, a planner, a progress observer, a support to a certain idea to reach a solution, constantly evaluating his ideas and solutions, and having the ability to choose between what is best, by that he is a productive thinker (Obeid & Afana, 2003).

Many studies have also confirmed the effectiveness of strategies based on constructivist theory to improve students' skills in many of the educational process outcomes. Among these strategies is the problem-based learning (PBL) strategy, in which the student builds his knowledge. The learning process occurs through real problems that students cooperate to solve it, which leads to reach the solution by themselves (El-Gendy, 2003).

The PBL strategy has three phases: Tasks, Cooperative Groups, and Sharing. Teaching in this strategy begins with a task that includes a situation that makes the students feel that there is a problem, after that encouraging them to search for solutions to this problem through working in groups. The teaching process in this strategy concludes with the participation of the groups with each other in what has been reached (Zaitoun, 2007; Denewar, 2016). It is noted that the PBL strategy reflects the idea of self-regulated learning (SRL), through the student's quest to detect a solution to the problem and to help them acquire the ability to think.

Self-regulation of learning has great importance in many fields of learning, through it the individual learns how to learn, how to process the information he accesses to achieve understanding and organize it, and how he can solve learning problems (Roeser & Peck, 2009; Zeitoun, 2003). Many studies assert the importance of Self-regulation strategies and their effectiveness in increasing achievement, developing motivation towards learning and problem-solving skills such as (Baker et al., 2009; Gad, 2012; Al-Darabkeh, 2018; Al-Qahtani & Ibrahim, 2018), as the student has a positive role in acquiring knowledge, and is a participant, self-motivated and an observer towards achieving his goals. From the above it is clear that SRL includes many behaviors that the students perform to lead them to achieve their goals successfully, and allow them to plan well for what they would like to do, to constantly monitor their performance towards achieving their goals, to control their feelings during teamwork, and to acquire the skills to control focus and attention when acquiring knowledge and to have the ability to choose appropriate strategies that help in implementing different cognitive tasks.

Self-regulation of learning is fundamental to problem-solving. Where Zimmerman (1990) emphasizes that self-regulation of learning enables the students to notice aspects of their behavior, which makes him able to judge on his progress towards achieving the goals that were set according to his own standards and then modify the behavior according to those goals. The

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basic processes that are used in SRL include planning, time management, a sense of self-efficacy, and goal-directed, organizing, self-recitation, strategically coding information, building a motivating work environment, and using resources effectively. It is also one of the basic processes that improve students' performance when solving problems.

Youssef (2015) sees that the PBL strategy is highly associated with SRL; as it goes through stages that can be integrated with the stages of self-regulation; In teaching, it depends on students facing a specific problem and through solving it, students must do certain steps and self-regulated procedures to reach appropriate solutions to this problem.

Many studies have confirmed the importance of using the PBL strategy such as Al-Saadi (2011) which found the effectiveness of using the PBL strategy in the achievement of Mathematics for scientific fifth-grade students and their attitude towards it, Sefen (2015) which found the effectiveness of using the *"Wheatly"* PBL strategy in developing Second year preparatory school students' reflective thinking and the ability to solve algebraic equations and inequalities and attitude towards them, and Al-Jumaily (2018) which found the effectiveness of using PBL strategy in achievement among intermediate school students.

Many studies have also shown the importance of using SRL strategies, such as Al-Banna (2013) which found the effectiveness of a suggested strategy in the light of SRL in developing third-year preparatory school students' self-regulation skills and achievement in mathematics. Al-Harbi (2015) found the effect of a strategy based on SRL in developing the numerical sense for first-grade intermediate school students in Saudi Arabia, and Ahmed (2016) found the effectiveness of a program based on SRL strategies in developing achievement, mathematical thinking, and attitude towards self-learning.

RESEARCH PROBLEM AND QUESTIONS

The results of Trends in International Mathematics and Science Study (TIMSS) showed that the results of second-grade intermediate students in Saudi Arabia in mathematics tests are lower than the average of international performance, and that through all the participations from 2003 to 2015, as the following table showed (Al-Shamrani, 2009; Center of Research Excellence in Science and Mathematics Development, 2011; Martin et al., 2016; Mullis et al., 2020):

Table 1
FINDINGS OF STUDENTS' PARTICIPATION AT THE SECOND INTERMEDIATE GRADE STUDENTS IN MATHEMATICS TESTS IN TIMSS

Participation year	Performance average	Average of international performance	ranking	Number of participating countries
TIMSS-2003	332	476	43	45
TIMSS-2007	329	500	46	48
TIMSS-2011	394	500	37	45
TIMSS-2015	368	500	39	39
TIMSS-2019	394	500	37	39

The findings of many previous studies such as (Al-Rawahi, 2017; Mohammed, 2018; Mosalem, 2019; Al-Darabkeh, 2018; Al-Qahtani & Ibrahim 2018) have been confirmed the necessity of using a suitable strategy in teaching Mathematics and neglecting this aspect may be a reason for decreased problem-solving skills and MT.

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The importance of developing problem-solving skills and MT through teaching, and the effectiveness of a PBL strategy, as well as self-regulation of learning in teaching Mathematics which was mentioned before, so the problem of this research represented in the weakness of intermediate school students' mathematical problem-solving skills (MPSS) and meta-cognitive thinking, The purpose of this research is to explore the effectiveness of self-regulated problem-based learning (SRPBL) strategy in developing intermediate school students' MPSS and MT.

The current research tries to find the answer of the following question: What is the effectiveness of the Self-Regulated Problem-based Learning (SRPBL) Strategy in developing intermediate school students' MPSS and MT? This question branches out into the following:

1. What is the effectiveness of the SRPBL Strategy in developing intermediate school students' MPSS?
2. What is the effectiveness of the SRPBL Strategy in developing intermediate school students' MT?

RESEARCH HYPOTHESES

To answer the questions of the research, the following hypotheses were formulated:

1. There is no statistically significant difference at ($\propto \leq 0.05$) between mean of scores obtained by the control group and the experimental group in the post-performance of problem-solving skills test, that's due to the difference in teaching strategy (the normal method - the SRPBL strategy).
2. There is no statistically significant difference at ($\propto \leq 0.05$) between mean of scores obtained by the control group and the experimental group in the post-performance of MT scale, that's due to the difference in teaching strategy (the normal method - the SRPBL strategy).

RESEARCH OBJECTIVES

1. Recognizing the effectiveness of the SRPBL Strategy in developing intermediate school students' MPSS.
2. Recognizing the effectiveness of the SRPBL Strategy in developing intermediate school students' MT.

RESEARCH SIGNIFICANCE

The importance of the current research lies in the following:

1. Integrating PBL strategy with some SRL strategies and presenting them as one of the teaching strategies that help in developing problem-solving skills and MT.
2. Directing the researchers in the field of mathematics education to the future; to provide them with some recommendations and suggestions that may open the way for other future studies, to develop mathematics teaching by integrating SRL strategies into PBL strategies.
3. It benefits mathematics teachers by providing them with a teacher's guide for the topics included in chapter seven (Geometry: Polygons) from the mathematics textbook for the intermediate first grade at the second semester by using a SRPBL strategy.
4. Educational supervisors may direct their attention to hold training courses for teachers on how to use the SRPBL strategy.
5. Curriculum designers and planners may be directed to integrate SRPBL strategies into the mathematics curriculum for the intermediate stage, which may achieve effective learning.

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RESEARCH DELIMITATIONS

The current study was limited to the following:

1. Chapter seven (Geometry: Polygons) of the mathematics textbook for the seventh-grade intermediate students in the second semester.
2. Problem-solving skills: understanding and analyzing the problems skill, planning to solve the problem skill, carrying out the solution skill, and evaluation and verification of solving the problem skill.
3. MT skills: Planning, monitoring, and evaluation.
4. A sample of seventh-grade intermediate students in governmental schools in Jubail.

DEFINITION OF TERMS

First: SRPBL Strategy

PBL strategy: It is one of the educational strategies that emerged from the thought of constructivism; this strategy applies the ideas of constructivist theory in the field of science and mathematics teaching, and its designer is Grayson Wheatly, who is considered one of the biggest advocates' supporters of modern constructivism. He believes that in this strategy, students create a meaningful understanding through the problems presented to them, so they work in small groups to find solutions to the problem. This strategy consists of three phases: tasks, cooperative groups, and sharing (Zaitoun, 2007).

Self-regulated strategy: Rashwan (2006) defines self-regulated strategy as *"it is an active constructive process in which a student sets goals, plans, directs, organizes, and controls his knowledge, motivation, behavior, and the context in which learning takes place in order to achieve those goals."*

The operational definition of SRPBLS: It is a strategy based on integrating some SRL strategies into PBL strategy. It begins by presenting a real problem facing the student, analyzing it, and working to find its appropriate solutions through the knowledge and skills that are gained. It can be done through three phases: Learning tasks, collaborative groups, and sharing, through it a student uses the appropriate strategies of cognitive self-regulation, metacognitive, motivational, and behavioral strategies to process learning tasks through each stage.

Second: Problem-Solving Skills

"It is a set of processes performed by individual using the information and knowledge he has previously learned, and the skills he has acquired, to overcome a situation in a new and unfamiliar way, to control it, and to reach a solution for it" (Al-Ayasra, 2013).

The researchers define it operationally as: a set of organized mental and procedural processes that the student uses in the intermediate school when solving a problem in Mathematics, and it is determined by the degree that the student obtains in the problem-solving skills test prepared by the researcher, which includes the following skills: understanding the problem, planning to solve the problem, carrying out the solution, and verifying the solution.

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Third: Metacognitive Thinking

Al-Jarrah & Obeidat (2011) defined it as: the individual's awareness of his cognitive processes, and his construction to it, employing this awareness in managing these processes through using a set of skills, such as: planning, monitoring, evaluation, decision-making, and choosing appropriate strategies**.**

The researchers define it operationally as: mental processes that the student creates a plan and use appropriate strategies to solve a problem in Mathematics, and self-monitoring when carrying out this plan, the strategies and working to improve them, and it is determined by the degree that the student obtains in the MT scale prepared by the researcher, which includes three dimensions: planning, monitoring, and evaluation.

THEORETICAL BACKGROUND

Theme One: The SRPBL Strategy as Entrepreneurial Learning Input

Traditional learning strategies often contrast with the needs of entrepreneurial education. The process of transferring the knowledge and skills presented with the traditional learning strategies used is often weakened, in contrast to the use of constructivist-based learning strategies (Mintzberg & Gosling, 2002). Entrepreneurial learning is an occupationally oriented learning approach aimed at providing the learner with the knowledge and skills required for the job market, it is often experimental in which students practice a real entrepreneurial learning process (Kyrö, 2008). This creates a challenge for finding creative learning strategies coping with the requirements and expectations of the objectives of mathematics education as a requirement for entrepreneurship to develop entrepreneurial competencies and skills such as mathematical problem-solving skills, metacognitive thinking and entrepreneurial behavior (Ustav, 2016). The SRPBL Strategy is a compound strategy of two variables that has the power to enhance entrepreneurial learning inputs, the PBL Strategy and SRL strategy; They are related to personal growth, creativity, independence, initiative-taking, and action and performance orientation for the learner to become a leader in learning especially *"learning Mathematics"* (Mwasalwiba, 2010).

First: PBL Strategy

Wheatley (1991) defines a PBL strategy as: it is a kind of learning that helps students understand the content they are learning through real problems, build a meaningful understanding, and thus develop their confidence in the ability to solve problems.

Wojtanowski (2011) defines it as: it is one of a constructivist theory strategy that implemented through group work and makes meaningful learning by linking and integrating prior knowledge with what has recently been learned; As it begins with presenting a real task (problem) to the learner, and he analyzes it and works to find appropriate solutions to it, through his knowledge and skills. This strategy consists of three main elements: tasks, small groups, and sharing.

Zaitoun (2007); EL-Shahat (2012); Al-Masry (2017); Al-Afoun & Makawoun (2012); Abdel Wahid (2018) indicated that the stages of the PBL strategy are summarized as the following:

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Learning tasks: Learning tasks (which are the problem) are the core and foundation of a PBL strategy that focuses on key concepts of a certain branch of knowledge, through it students are directed to build effective ways of thinking about a topic; Therefore, the success of the strategy is linked to the selection of learning tasks by teachers with great care. The following is a detail for this stage:

1. The tasks include a thought-provoking situation for the student, which makes people stand in front of it trying to understand it.
2. The appropriateness of the tasks selected for each learner according to his level of knowledge.
3. Encourages learners to make decisions, as the tasks selected have more than one way to be solved.
4. Encourages learners to do research and investigation as they use their cognitive skills to process problems involved in learning tasks.
5. Encourages learner to ask questions constantly, Such as: *"What would happen if...?"*
6. Trying to solve a problem and understand the task helps to have interest through the learning process.
7. Encouraging learner to discuss, debate, and allows exchanging opinions and ideas about the problem.

Cooperative Groups: The PBL strategy adopts the principle of cooperative learning; Students are divided into many groups, each group includes three students or more, The work is carried out among students in each group in a cooperative manner; As they exchange ideas, discuss to find possible solutions to the learning task represented in the form of a problem, and through small groups severally, including planning to solve the problem, carrying out this solution, positive sharing among the members of the same group, and appropriate use of social skills required for collaborative work.

Sharing: At the end of learning using the PBL strategy, the groups share what they have been reached with each other, discussing each other. This stage comes after each group has reached its own solution. These discussions take place under the supervision and organization of the teacher; the class turns into one large group.

Second: Strategies for SRL

Self-regulation of learning involves an interaction between the learner and the learning environment around him. As it helps him to control and organize his behaviors, his knowledge, and his emotions to achieve learning goals, then he can improve his performance, and can achieve tasks or solve problems he faces.

Zimmerman (1990) defined SRL as: an organized cognitive mental process, in which the learner is active; as he participates in the learning process, to achieve the goal of the educational process. Pintrich (2000) defined it as: a purposeful and active process that helps the learner to set his educational goals, monitor and regulate his cognitive, motivational and behavioral characteristics, and Zimmerman (2008) defined it as: a directed processes and self-beliefs that help the learner transform mental abilities; For example: converting verbal readiness into an academic skill, such as writing, it meaning that it is a form of repetitive activity that the learner does to acquire academic skills.

Al-Husseinan (2017) indicates that SRL is an active mental process associated with cognitive and metacognitive processes, in which the learner relies on the use of different strategies to improve and develop his method of acquiring knowledge. Considering the learner at the center of the educational process, the teacher can train his/her students on these strategies. It

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has components related to the learner's self, his motivation, the educational material, and the environment surrounding him and it aims to improve the educational process.

The Importance of SRL

The importance of SRL lied on the level of learning that makes the learner show more awareness of his responsibility in making meaningful learning, and it also prepares the learner to be an observer to his performance, and views educational problems and skills as a challenge that he wants to face and enjoy learning through it (Al-Sulaiti, 2017; Mohamed, 2017; Mohamed & Adel, 2019).

Martínez-Vicente & de la Fuente (2004) indicated that the behavior that the student acquires from SRL is important in improving learning efficiency and students' performance in educational tasks, where learning and performance are better for students who use SRL strategies.

SRL has also many academic benefits. Torrano-Montalvo (2004) proved that students who apply SRL strategies have change and success more easily than others. They use these strategies to achieve their educational goals, and then they carry a set of qualities that help them achieve this success, and they have the awareness of using cognitive strategies. They plan, monitor, and direct their efforts, evaluate themselves, manage their time and effort, choose a suitable work environment, and take the initiative to participate in academic tasks. In addition, SRL helps students to be mentally active while teaching to learn more, and thus to achieve higher grades on tests to complete their studies.

There have been many classifications of SRL strategies as a result of researchers' orientations and their different theoretical backgrounds. The most prominent and widespread of these classifications are Pintrich's classification. The following is an explanation of SRL strategies used in this research, as indicated by Pintrich (1999); Wolters et al. (2005); Rashwan (2006):

Cognitive Strategies

They are strategies that are represented in the methods that are used by the student in learning, understanding, and remembering new knowledge, and linking it to previous knowledge. These cognitive strategies range from simple memorization strategies that help in remembering to deep strategies that help in reading, arithmetic, inference, and problem- solving, such as: recitation, organization, transformation, expansion and mastery, and critical thinking.

Metacognitive Strategies

They are strategies that refer to a student's awareness of cognitive processes, observation of his cognitive actions, and organization mechanism for his knowledge during problem solving, and help him to organize his performance to make appropriate decisions to achieve learning goals. These strategies include two main components:

a. Knowledge about knowledge: It means what the individual knows about his knowledge, and it consists of three types of knowledge: declarative knowledge, procedural knowledge, and conditional knowledge.

b. Organizing knowledge: It includes three components: planning and objective setting, self-monitoring, and self-evaluation.

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Resource Management Strategies

These strategies refer to the activities that organize the learning material, and the internal and external resources that help the student achieve his goals, such as: searching for information, keeping records, time management, peer learning, environmental control, self-talk about mastery, and self-rewarding.

SRPBL Strategy

In light of what was presented previously, the research finds that through PBL strategy, the student must organize himself while solving the problem, and that the problem presented should be motivated to manage him to do his best to solve it, commensurate with his abilities, and use self-regulated processes for learning at each stage of problem-solving stages.

Thus, it enhances the learner's entrepreneurial learning competencies represented in building knowledge, skills, attitudes, problem-solving, and metacognitive thinking that affect the desire and the ability for entrepreneurial performance to create new value (Kraiger et al., 1993; Fisher et al., 2008; Sánchez, 2011).

The researchers define SRPBL strategy as an entrepreneurial learning input as: it is a strategy based on integrating some SRL strategies into PBL strategy. It begins by presenting a real problem facing the student, analyzing it, and working to find its appropriate solutions through the knowledge and skills that are gained. It can be done through three phases: Learning tasks, collaborative groups, and sharing, through it a student uses the appropriate strategies of cognitive self-regulation, metacognitive, motivational, and behavioral strategies to process learning tasks through each stage.

Figure 1 shows the integration and employment of self-regulatory strategies for learning in problem-based strategy stages as entrepreneurial learning inputs. Table 2 shows the role of teacher and student in SRPBL strategy

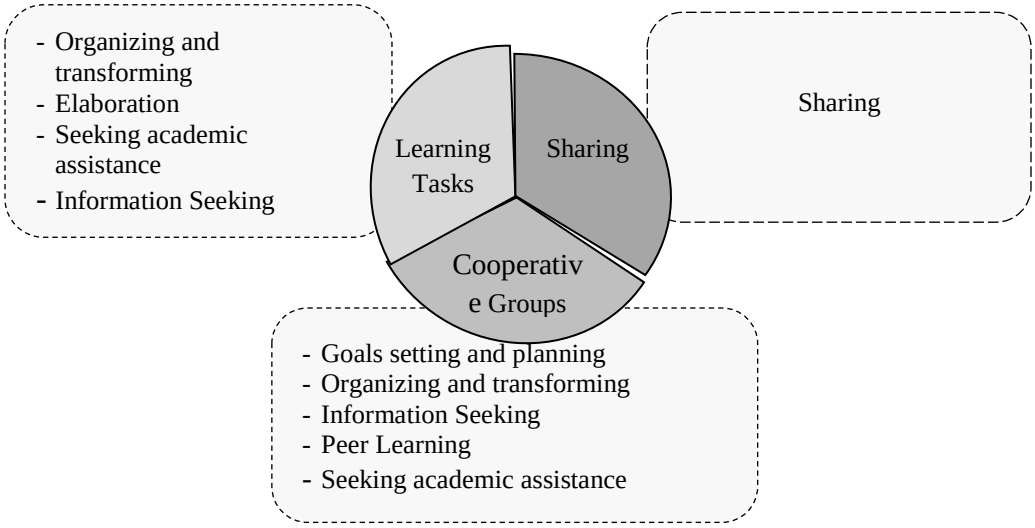

FIGURE 1
INTEGRATION OF SELF- REGULATED LEARNING STRATEGIES INTO THE PHASES OF PBL STRATEGY AS ENTREPRENEURIAL LEARNING INPUTS

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Table 2
TEACHER'S AND STUDENTS' ENTREPRENEURIAL ROLES IN THE SRPBSS PHASES

SRPBSS phases as Entrepreneurial Learning Inputs		Teacher's and Students' Entrepreneurial roles
PBL Strategy Phases	**SRL Strategies**	
Learning Tasks	- Organizing and transforming - Elaboration - Seeking academic assistance Information Seeking	- Teacher: poses a learning task (problem) to students - Teacher: motivates students and helps them to understand the problem and use their knowledge to solve it. - Students: exploring the problem and asking questions about it. - Students: summarizing and organizing the main ideas in the learning task and take notes about them. - Students: Seeking information that helps to solve the problem. - Students: Seeking assistance from the teacher for help with the solution
Cooperative Groups	- Goals setting and planning - Organizing and transforming - Information Seeking - Peer Learning - Seeking academic assistance	- Teacher: divides the students into small groups. - Teacher: clarifies the learning task and its instructions - Group: takes notes about the problem and the goal to be reached. - Group: asks questions about the ambiguous and difficult points of the problem. - Group: seeks appropriate solutions and its procedures. - Group: seeks help from peers to overcome the difficulties. - Group: Gathering the necessary information to solve the problem. - Group: implements the solution plan and writes down the solution.
Sharing	- Self-evaluating - Keeping Records - Seeking academic assistance - Self-consequences	- Group: presents their solution and how they find it - Group: evaluates the other groups' solutions and determines the best solutions. - Teacher: gives his observations and explanations about the solutions of the different groups. - Group: writes down the most important notes about solutions and keep them for use later. - Group: Self-consequences according to their work in light of class reward rules.

Theme Two: Problem- Solving Skills as Entrepreneurial Learning Outputs

Entrepreneurial learning aims at creating the learner's entrepreneurial mindset; this entrepreneurial mind is motivated by the ability to be educated, adaptable and curious looking for new opportunities to invest learning in a field such as *"Mathematics"*, seeking for solving the problems and reaching multiple solutions to the problem, reinforcing behaviors and problem-solving procedures that enable the learner to respond to the changing goals and problems and changing the solutions when dealing with complex problem. Therefore, enhancing problem-solving skills represents one of the entrepreneurial learning outputs that students aim to reach because the entrepreneurial student should be a reasonable adventurer in problem-solving and should be able to think and perform based on reasonable decision-making processes, and able to

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reflect, create meaning and clarify the reasons behind the choice of problem-solving methods and strategies used regardless of the success or failure of these methods and strategies in reaching the solution, in addition to the ability to retain the experience, knowledge and skills required to solve problems (Blakemore & Frith, 2005; Johansson Sköldberg et al., 2013). The development of students' problem-solving skills is considered one of the important indicators for evaluating the entrepreneurial learning outputs, as it gives the students the ability to face their future with confidence, and helps them understand how to relate to the real world, and their future (Neck & Green, 2011; Welsh et al., 2016).

Problem-Solving Concept

Problem-solving is one of the activities that develop an individual's ability to organize his stored knowledge and use it in new situations in order to reach specific goals, Zaitoun (2009) defines it as: It is a mental representation that involves a series of organized steps that an individual follows in order to reach to a solution to a problem.

Al-Atoum et al. (2005) defined problem-solving skills as: it is a thinking process that requires an individual's mental effort when faced with a strange or unclear situation that has not a prior solution; so that he employs his previous experiences and current knowledge; To reach the solution and achieve the desired goals.

Problem-Solving Skills

Problem-solving skills are one of the most important skills that must be focused and developed in individuals. Because it helps in logically managing the conflicts that the individual is exposed to enable him to reach the most appropriate decisions for the situation and enable him to face difficult situations instead of standing in front of them unable to act (Haider, 2016). Problem-solving skills have been categorized into four main skills: understanding the problem, creating a plan, carrying out the plan, and reviewing (Pulia, 1965), accordingly, Ali (2018); Hassab Allah (2005); Al-Natour (2013) indicated that the sub-skills of problem-solving include:

1. **The skill of understanding and analyzing the problem:** including sub-skills, such as: reading the problem correctly, understanding the meanings and terminology included in the problem, determining the given information in the problem, distinguishing the words that define what is required, determining the goal of the problem, and determining the information needed for the solution.
2. **The skill of planning to solve the problem**: including sub-skills; such as: choosing the appropriate arithmetic operations, translating the problem into a mathematical image or a symbolic equation that can be used, determining the steps of the problem, linking the data to what is required within the framework of a concept, theory or previous experience, determining the unknown then representing it in a model such as a drawing, mathematical equation or scheme, and identifying one or more strategies for the solution then choose the most appropriate ones.
3. **The skill of carrying out the solution**: which includes several skills, such as: performing calculations, arranging the steps of problem- solving according to the goal, and the correct writing of the problem's solution.
4. **The skill of evaluating and verifying the solution of the problem**: which includes several skills, such as: reviewing the steps for problem- solving, verifying the correctness of the calculations, writing the achieved solution, justifying the method of deducing the solution, and suggesting other solutions if possible.

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Third Theme: Metacognitive Thinking as Entrepreneurial Learning Outputs

The concept of metacognitive thinking: The concept of metacognition is related to the learner's ability to think about the knowledge he has acquired and how to control it, but before that, he must be aware of his practices in certain situations, the mechanism of his learning optimally, and to what extent it has been learned. It means that the learner should be aware of the task, then the strategy, then the performance (Abdel Salam, 2006; Al-Arnoosy et al., 2019; Abdel Wahed, 2018). Oniel & Abeidi (1996) indicated that MT is: several steps and procedures practiced by an individual to realize the cognitive processes that are used in educational situations achievements, direct, evaluate and organize cognitive activities and processes.

Saeed (2008) defined it as: the learner's ability to plan and be aware of the processes, steps and strategies that are chosen to solve the problems he faces, and the ability to evaluate the efficiency of his thinking. Schraw & Dennison (1994) indicate that MT is the learner's ability to learn, understand and control the educational process, and it also allows him to plan and make sequences in cognitive processes and monitor their learning which directly leads to improve their performance.

Schraw & Dennison (1994) indicate that metacognitive thinking is the learner's ability to learn, understand and control the educational process and it allows the learner to plan, sequence cognitive processes, and monitor his learning, which leads to improve his performance directly.

According to Mitchell et al., (2005); Schraw & Dennison (1994) that metacognitive thinking is a high-level cognitive ability that expresses the learner's ability to influence, understand and control his own learning processes, and it is essential for the learner to build entrepreneurial decisions in learning situations and problem-solving. Thus, they viewed the development of cognitive thinking skills as the most important entrepreneurial learning outputs; it allows the learner to consciously plan and carry out the appropriate procedures to achieve a specific goal, such as *"solving Mathematical problem"*, and also represents a part of the self-regulatory behavior when facing mathematical problems (Sheorey & Mokhtari, 2001; Efklides, 2008).

According to entrepreneurial learning, metacognitive thinking is a part of a larger and more comprehensive framework for executive performance, and an important component of the cognitive system that is particularly relevant to mental control processes (Haynie, 2007). In general, Metacognitive experience is an important metacognitive resource that can provide inputs that activate Metacognitive Thinking skills, controlling action and behavior (Ustav, 2016; Wahyuni, 2020).

Metacognitive thinking skills: Several models and classifications of MT skills that the learner must acquire have been derived; therefore, the educational process will be successful and valuable. Views differ in determining them, but they agreed that there are three basic skills, as Abu Jadu & Nofal (2017); Abu Nada (2013); Abu Riash (2006) stated as the following:

1. **Planning skill:** It means choosing suitable plans and identifying the resources that will affect the performance. It also includes the presence of specific goals for the individual. Whether it is determined by the student or others and has a plan to achieve these goals. Possessing this skill has great importance on all personal, social, economic, and political levels, and it includes the following sub-skills: (1) Determining the goal and feeling that there is a problem, (2) Selecting the processes and implementation strategies, (3) Following up on the processes and their sequence, (4) Knowing the errors and obstacles, (5) Predicting the desired results.

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2. **The skill of organization and self-monitoring:** at this stage, self-mechanisms are provided to monitor the extent to which objectives are achieved. Beyer (1998) indicates that the sub-skills that include the skill of organization are as the following: (1) Maintaining the goal in memory, (2) Maintaining the sequence of processes, (3) Knowing the time to achieve the sub-goal, (4) Make the decision to move to the next process, (5) Choosing the appropriate next process along with the context, (6) Discovering errors and obstacles, (7) Knowing how to handle errors and overcome obstacles.
3. **Evaluation skill:** It relates to the learner's achievements and reviewing the strengths and the weakness in the thinking of learner's thinking. Beyer (1998) emphasized that the sub-skills included in the evaluation skill are as follows: (1) Evaluating the extent to which the objectives have been achieved, (2) Judging the accuracy and adequacy of the results, (3) Evaluating the extent to which errors or obstacles have been handled, (4) Judging the adequacy of the plan and its implementation.
4. **From the above:** there are three basic skills for MT: planning, organizing or self-monitoring, and the skill of evaluation. Each skill of them includes many sub-skills.

RESEARCH METHODOLOGY

This research aims to explore the effectiveness of a SRPBL strategy in developing MPSS and MT; therefore, the researchers followed the experimental research, which has a quasi-experimental design with two groups: experimental group and control one. The following Figure 2 shows the experimental design of the research.

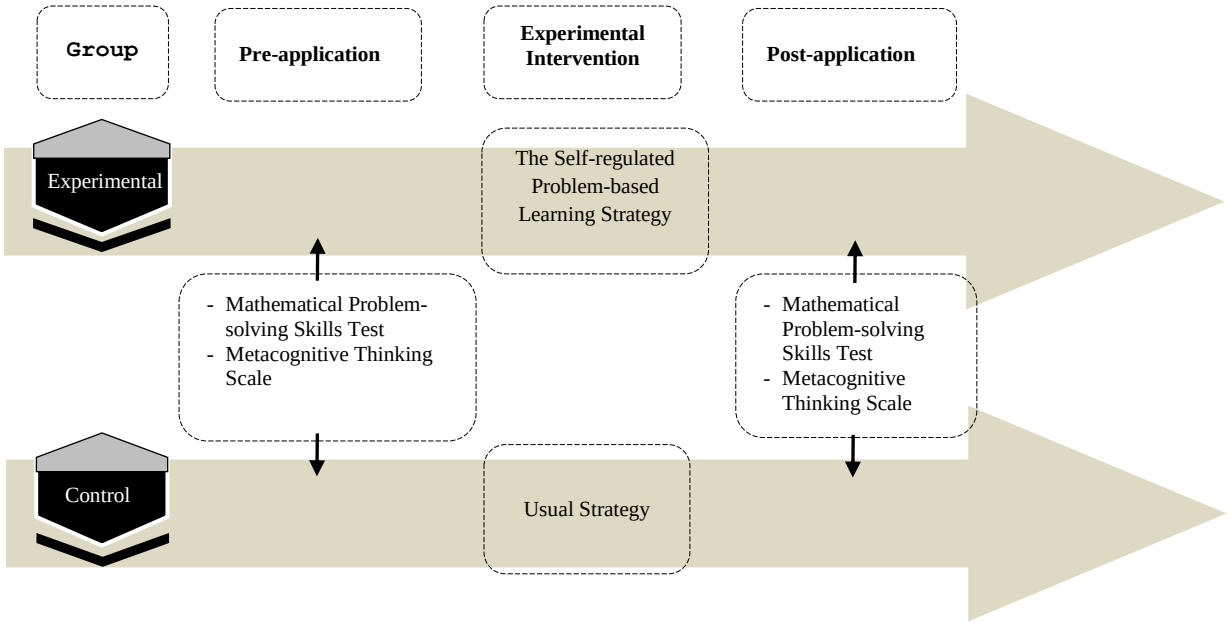

FIGURE 2
THE STEPS OF A RESEARCH EXPERIMENT

RESEARCH SAMPLE

The sample of the research consists of (59) students from seventh intermediate students in Jubail. The research sample was chosen intentionally, and then the research groups were randomly selected to represent one experimental (29) student and the other control group (30) student.

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RESEARCH INSTRUMENTS

MPSS Test

After reviewing previous studies in the field of MPSS, the following skills were identified: (understanding the problem, planning to solve the problem (making a plan), carrying out the plan, and verifying the solution (look back at the completed solution).

A test was prepared by the researchers, it was composed of 6 mathematical problems considering the lessons of chapter seven (Geometry: polygons) from the mathematics textbook for the intermediate seventh grade at the second semester, each problem was followed by four questions to assess the four MPSS.

The maximum score of each question is 2 and the minimum is 0 according to a student's answer. The validity of the test was measured by administered it to a panel of jury members (experts in teaching mathematics, experts in measurement and evaluation) with the aim of judging. Furthermore, feedback collected from the pilot study with a sample of (50) students registered in the 1st grade of intermediate school helps to improve the quality of the test, and the internal consistency of the test was verified by computing the Pearson Correlation Coefficient (PCC), table 3 demonstrates the results.

Table 3
PCC BETWEEN EACH QUESTION OF THE MPSS TEST AND THE TOTAL SCORE OF ITS MPSS

Understanding the problem		Planning to solve the problem		Carrying out the plan		Verification of the solution	
Ques.	PCC	Ques.	PCC	Ques.	PCC	Ques.	PCC
1	0.739**	2	0.696**	3	0.791**	4	0.788**
5	0.768**	6	0.736**	7	0.821**	8	0.732**
9	0.756**	10	0.766**	11	0.706**	12	0.767**
13	0.783**	14	0.778**	15	0.764**	16	0.801**
17	0.794**	18	0.597**	19	0.651**	20	0.749**
21	0.742**	22	0.7**	23	0.583**	24	0.784**

Note: **p significant at < 0.01

In the pilot study, the reliability of the test was verified by using the Cronbach's alpha method, it was found that it is equal (0.919). The reliability coefficients for each skill using Cronbach's alpha were as follows: (0.867) for understanding the problem, (0.797) for planning to solve the problem, (0.814) for carrying out the plan, and (0.842) for verification of the solution.

MT Scale

The scale was built based on some studies and scales in the field of MT such as: Shamout (2017); Debono center for thinking teaching (2011), and Moabera (2012) to identify MT.

In its final form, the scale consists of the following dimensions: planning, monitoring, and evaluation. The scale was designed inconsistent with a 5-point Likert scale (from 1 *"Never"* to 5 *"Always"*). The first section of the scale contained instructions for helping students when using it. The validity of the scale was measured by administered it to a panel of jury members (experts in teaching mathematics, experts in measurement and evaluation) with the aim of judging. Furthermore, feedback collected from the pilot study helps to improve the quality of the

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scale; The internal consistency of the MT scale was measured by computing the PCC. Table 4 displays the results.

Table 4
PCC BETWEEN EACH DIMENSION OF THE MT SCALE AND THE SCALE SCORE

The dimension	PCC
Planning	0.829**
Monitoring	0.758**
Evaluation	0.679**
Note: **p significant at <0.01	

The Cronbach's Alpha Coefficient (CAC) was used to verify the reliability of the scale was, to compute the reliability of the scale dimensions and the overall scale. Table 5 displays the results.

Table 5
CAC FOR THE DIMENSIONS OF THE MT SCALE AND THE OVERALL SCALE

The dimension	Number of Items	CAC
Planning	10	0.845
Monitoring	9	0.821
Evaluation	8	0.834
The overall scale	27	0.883

TEACHING PROCEDURES USING SRPBL STRATEGY

Teacher Guide

After reviewing the research that dealt with augmented reality technology, such as Youssef (2015); Al-Anboury (2015); and El-Harbi (2015) the teacher's guide was designed to help the teacher to teach the lessons of chapter seven (Geometry: polygons from the mathematics textbook for the intermediate first grade at the second semester using SRPBL strategy. The teacher's guide included the following: (an overview of the SRPBL strategy – the teaching timeline of the lessons of chapter seven (Geometry: polygons) – lesson planning). The lessons were designed considering the phases of the SRPBL strategy described previously.

Student's Activity Book

The student's book consists of two sections: The first: explains the phases of the SRPBL strategy and what the students will do in each phase. The second: composed of eighteen worksheets, two or three for each lesson.

The teacher's guide and the student's book were administered to a group of jury members (experts in teaching mathematics) to evaluate its content validity. The feedback collected from them helps in improving the quality of the teacher's guide and the student's book.

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RESULTS AND DISCUSSION

The Effectiveness of the SRPBL Strategy in Developing the Seventh-Grade Intermediate Students' MPSS

To validate the first hypothesis of research, and answer the first question, A T-Test of the Independent Samples was used to analysis the difference between the scores of the experimental group with students studied by using SRPBL strategy and a control group with students that studied by using the normal method. Table 6 shows the results of the post-performance of the problem-solving skills test.

Table 6
T-TEST OF INDEPENDENT SAMPLE FOR THE PROBLEM-SOLVING SKILLS POSTTEST SCORE

Group	N	M	SD	df	t	η^2	Effect size
experimental	29	41.17	2.83	57	16.03	0.818	Large
control	30	21.43	6.02				

Table 6 demonstrates that the difference between mean of scores of students studied by using SRPBL and students studied by using the normal method in the post-performance of problem-solving skills test was a statistically significant, as *"t"* value (16.03) was significant at (0.01). The effect side of eta- squared (η^2) was (0.818) and this value indicated the SRPBL strategy managed to develop intermediate school students' MPSS, Accordingly, the first hypothesis couldn't be accepted.

The previous result can be explained in the light that problem-solving skills are formed because of a learner's need to answer a certain question, or when he has a desire to reach a goal. To reach to the desired goal, the learner takes into account a number of steps that lead to solve the problem (Abu Jadu & Nofal, 2017). Through self-regulation of learning, the student can observe aspects of his behavior, and judge on his progress towards the goal he sets for himself according to his own criteria, and then Modifies his behaviors to fit his pre-set goals (Zimmerman, 1989), As well as Wheatley strategy, which is concerned with content learning through real and meaningful problems, and requires procedures from the learner in written or oral form (Al-Bashish, 2017), and then all of the above helps to deal well with different mathematical problems.

The previous result agrees with what Bani Hamad (2009) stated that the learners who studied with a problem-solving method have higher ability to solve the mathematical problem than their peers who were taught in the traditional way. The results of this research also agree with the studies of Al-Alkoumi (2019); Sefen (2015). The study of Ho (2004) dealt with the PBL strategy or SRL strategies as an independent variable for developing the ability to solve mathematical problems and achievement in the mathematics course. It also agrees with the studies that found the effectiveness of different teaching strategies in developing MPSS, such as: Al-Shafei (2010); Al-Atwi (2011); Al -Natour (2013); Lee et al. (2020).

In light of this result, the SRPBL strategy represents a powerful input to reach entrepreneurial learning outputs such as developing problem-solving skills; This is because it is related to personal growth, creativity, and independence (Mwasalwiba, 2010), and it enhances the entrepreneurial mindset of the learner who has problem-solving skills such as searching for problems, searching for multiple solutions to the problem, defining solution procedures, changing solutions, reflecting the solutions, constructing meaning, as well as retaining the

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experience, knowledge, and skills required to solve problems (Johansson Sköldberg et al., 2013; Welsh et al., 2016).

The Effectiveness of the SRPBL Strategy in Developing the Seventh-Grade Intermediate Students' MT

To validate the second hypothesis of research, and answer the second question, A T-Test of the Independent Samples was used to analysis the difference between the scores of the experimental group with students studied by using SRPBL strategy and a control group with students that studied by using the normal method. Table 7 shows the results of the post-performance of the MT scale test.

Table 7
INDEPENDENT SAMPLE T-TEST FOR MT POST-TEST SCORE

Group	N	M	SD	df	t	η^2	Effect size
experimental	29	121.83	5.68	57	9.11	0.593	Large
control	30	88.07	19.14				

Table 7 demonstrates that the difference between mean of scores of students studied by using SRPBL and students studied by using the normal method in the post-performance of the MT scale was a statistically significant, as *"t"* value (9.11) was significant at (0.01). The effect side of eta- squared (η^2) was (0.593) and this value indicated that the SRPBL strategy managed to develop intermediate school students' MT skills; accordingly, the second hypothesis couldn't be accepted.

The previous result can be explained in the light of what Costa & Kallick (2003) mentioned that the setting an educational strategy, the teacher's retention of it during the period of teaching and learning, and his reflection on the effectiveness of this strategy that he worked to employ in the educational situation, in terms of the positive and desirable changes of student behavior is considered one of the most important reasons for developing MT.

The previous result can also be explained in the light that SRL aims to provide a description of how and why self-regulated processes are chosen to reach the result, build responses as a result of using certain strategies, focus on what motivates the learner to use self-regulation, and identify the processes used to achieve self-awareness and achieve tasks and academic goals (Missildine, 2004).

The result can also be explained in the light of the educational situation that accompanies the PBL strategy yields many positive aspects; including increasing the ability to think, developing problem-solving skills, self-learning and self-monitoring, raising student's self-confidence level, developing positive relationships between students, and decreasing behavioral problems (Al-Bashish, 2017).

This result agrees with what Abu Alia (2003); Song (1998); King (1992) stated that training on effective strategies and integrating them with educational content would improve students' MT.

The current research agrees with the findings of the studies that investigate the effectiveness of different teaching strategies and methods in developing MT skills, such as: Fireo (1993); Yasser (2007); Mahmoud (2012); Aal Casey & Al Qahtani (2018); Omar et al. (2018).

This result also confirms that the SRPBL strategy represents a powerful entrepreneurial learning input to reach entrepreneurial learning outputs such as developing metacognitive

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thinking; this is because it allows the learner to plan, sequence cognitive processes, and monitor his learning, which leads to improve his own performance, and these elements represent a part of the self-regulated behavior when the learner faces mathematical problems (Schraw & Dennison, 1994; Mitchell et al., 2005; Efklides, 2008; Torrano Montalvo & González Torres, 2004), and thus the SRPBL strategy constitutes metacognitive experience as an important metacognitive resource that can provide inputs to activate metacognitive thinking skills (Ustav, 2016; Pekrun et al., 2005; Principles, 2000).

RECOMMENDATIONS

The results obtained from the present research may lead to reconsider the following:

1. Relying on the self-regulated problem-based learning strategy as Entrepreneurial Learning Input when teaching Mathematics to intermediate school students because of its significant impact on developing Mathematical problem-solving skills and metacognitive thinking as Entrepreneurial Learning Outputs.
2. Holding training courses for teachers on how to use self-regulated problem-based learning strategy.
3. Urging researchers and those who are interested in curriculum and instruction to investigate the effectiveness of the self-regulated problem-based learning strategies on other variables.
4. Creating different educational situations that allow students to practice problem-solving skills and help they develop their metacognitive thinking as Entrepreneurial Learning Outputs.

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