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The effect of a proposed unit in science based on PISA standards in developing life problem-solving skills among Prep school students

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Abstract: The current study aimed to identify life problem-solving skills that could be cultivated among middle school students, and to develop these skills through the implementation of a proposed unit within the science curriculum, aligning with the standards set forth by the Program for International Student Assessment (PISA). The study sample comprised 49 male and female students in the second preparatory grade at Batita Preparatory Mixed School in Kafr El-Sheikh. Tools employed included a life problem-solving skills test. The researcher utilized both descriptive analytical and experimental approaches, employing a quasi-experimental design.

The findings of the study yielded a list of four key life problem-solving skills: exploration and understanding, representation and formulation, planning and implementation, and observation and reflection. Additionally, a statistically significant difference was observed between the average scores in the pre- and post-measurements of the research tool, with higher scores favoring the post-measurement.

The study recommends the necessity of enhancing science curricula during the preparatory stage, aligning with the standards outlined by the International Program for Assessment (PISA), and emphasizing the development of requisite knowledge, skills, competencies, and attitudes among preparatory stage students.

Keywords: PISA standards - life problem-solving skills.

أثر وحدة مقترحة في مادة العلوم قائمة على معايير بيزا في تنمية مهارات حل المشكلات الحياتية لدى تلاميذ المرحلة الإعدادية

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المستخلص: هدف البحث الحالي إلى تحديد مهارات حل المشكلات الحياتية الواجب تنميتها لدى تلاميذ المرحلة الإعدادية، وتنميتها من خلال تدريس وحدة مقترحة بمنهج العلوم في ضوء معايير البرنامج الدولي للتقييم PISA، وتكونت عينة البحث من (49) تلميذاً وتلميذة بالصف الثاني الإعدادي بمدرسة بطيطة الإعدادية المشتركة بكفر الشيخ، وتمثلت أداة البحث في اختبار مهارات حل المشكلات الحياتية، وتم استخدام المنهج الوصفي التحليلي، والمنهج التجريبي بالتصميم شبه التجريبي ذو المجموعة الواحدة، وأسفرت نتائج البحث عن وضع قائمة بمهارات حل المشكلات الحياتية عددها أربعة وهذه المهارات هي: الاستكشاف والفهم، التمثيل والصياغة، التخطيط والتنفيذ، المراقبة والتأمل. أيضا وجود فرق دال إحصائياً بين متوسطات الدرجات في القياسين القبلي والبعدي لأداة البحث لصالح القياس البعدي.

وأوصى البحث بضرورة تطوير مناهج العلوم بالمرحلة الإعدادية في ضوء معايير البرنامج الدولي للتقييم PISA، وما ينطوي عليه من معارف، ومهارات، وكفاءات، واتجاهات يجب تنميتها لدى تلاميذ المرحلة الإعدادية.

الكلمات المفتاحية: معايير بيزا – مهارات حل المشكلات الحياتية.

Introduction.

Currently, educational developers are focused on cultivating conscientious learners who can positively contribute to the teaching and learning process. These learners should possess the ability to effectively navigate various practical life situations, drawing upon their wisdom and applying the knowledge acquired throughout their years of study to solve encountered challenges. To achieve this, it is imperative to not only update curricula by adding, modifying, or removing content but also to organize it in an engaging manner and adequately train those responsible for its delivery. This approach ensures that the curriculum serves as a foundation for the desired developmental outcomes, ultimately producing individuals who are aware of the challenges around them and adept at utilizing their knowledge and skills to tackle daily life problems, integrating scientific practices seamlessly into their lives.

Yahya Al-Asili and Ahmed Al-Ayasrah (2016) highlighted the intrinsic connection between science and learners' lives, emphasizing the need for education authorities to focus on science curricula and teaching methodologies. These efforts aim to provide learners with educational experiences that foster research, investigation, and problem-solving skills applicable to their daily lives.

Recognizing the pivotal role of science curricula in individual and societal realms, Ihab Fateha (2017) underscored ongoing efforts worldwide to continuously refine and develop educational systems, with particular emphasis on curriculum enhancement. This entails aligning objectives, content, teaching methods, and evaluation practices with contemporary global trends, as stressed by Ayesh Zaytoun (2010).

The Programme for International Student Assessment (PISA) stands out as a significant international benchmark for education reform, as evidenced by its impact on participating countries' educational policies and practices. PISA assesses students' knowledge, skills, and attitudes in reading, mathematics, and science, considering the socio-economic context, learning environments, and methodologies. Notably, PISA emphasizes the application of acquired knowledge and skills to solve novel problems—a vital skill set demanded by the contemporary job market (Breakspear, 2012; Kastberg, 2013).

This test is conducted every three years and measures the knowledge and skills of learners, and the extent of the connection and influence of surrounding factors, whether social, economic, demographic, or even educational variables, on the quality of these skills. Do not ignore the trends whose indicators show the changes occurring in the levels of results, the relationships between variables and test results, and what it highlights at the student, the school, or the educational system as a whole. The evaluation here provides accurate information about the level of progress of the learners' skills and attitudes related to school and home, and their impact on the students' results, and then provides evidence of the possibility of developing educational policies in by the diagnosis of the educational reality derived from the results of these evaluations and the subsequent student questionnaires. And the school as well as teachers and parents and their analysis (Kastberg, Chan, & Murray, 2016, 1).

Due to the disruption caused by the coronavirus pandemic, the 2021 PISA assessment was postponed to 2022, and the Oxford University Center for Educational Evaluation (OUCEA 2021) indicated that the purpose of this study is to produce information about student learning and development, to learn more about how best to support students in mastering Key topics and that the information collected is a vital part of the evidence base about schools, allowing those responsible for evaluating and developing the educational process in every country and every educational system to hold their governments to account for providing their young people with world-class educational systems and enabling them to learn from policies and practices in other countries.

Realistic problems related to daily life or the local community, affecting the student's reality directly or indirectly, and may be related to the curriculum, but their connection to practical life becomes clearer when the learner faces a life problem, he tries hard to find its solution, and to be able to solve it correctly, he should Follow a set of scientific steps, but first his mind should be occupied with that problem and feel it well, so that he can identify it and use the experience and skills he has to solve it (Nabiha Al-Samarrai, 2014, 114).

These educational processes train the student to face life's challenges, give him more experience in applying his knowledge to solve unfamiliar and future problems, contribute to retaining the effects of the learning process for long periods, and enhance his interest in school subjects (Mohamed Abdelreheem, 2022, 36).

Both Mansour Abdel Moneim and Hamdi Mahmoud (2019, 356) pointed out that contemporary trends in curriculum preparation and design seek to focus on the life problems of students through which, using various teaching strategies, develop their thinking skills.

Among the studies that focused on developing life problem-solving skills, including the study of Ali Al-Maliki and Misfer Al-Qarni (2023), the study of Mai Elomary, Fatma Farha, and Amna Shabana (2022), the study of Zhon and Xu (2019), the study of Badr Brik (2018), the study of Fawzi Al-Adawi (2017), the study of Iman Abdel-Wahab (2014), the study of Naji Al-Dhafiri (2013), the study of Wang, Wu, Chen, and Spector (2013), the study of Rasha Abu Qura (2012), and the study of Asma Muhammad, Asmaa Al-Jamal, and Taghreed Imran (2012).

Research problem:

The research problem was summarized as the insufficiency of science curricula in developing life problem-solving skills among prep school students. This problem can be addressed by answering the following main question:

What is the effect of a proposed unit based on the standards of the Program for International Student Assessment (PISA) on the life problem-solving skills of prep school students؟

The following two sub-questions branch out from this question:

1- What are the life problem-solving skills that should be developed among prep school students?

2- What is the effectiveness of teaching the proposed unit in developing prep school students' life problem-solving skills؟

Research hypotheses:

In light of the research problem, the following hypothesis can be formulated:

There is a statistically significant difference at the level of (a ≤ (0.05) between the average scores of students (the research group) in the pre-and post-applications of the life problem-solving skills test in favour of the post-application.

Research aims:

The current research aims to verify the effectiveness of the proposed unit in developing life problem-solving skills among prep school students.

Research importance:

1. **Theoretical importance**: The current research presented a theoretical study on the standards of the Program for International Student Assessment (PISA), life problem-solving skills, and how to develop them among prep school students.
2. **Practical importance**: The current research has benefited from the practical aspect in:
   - Presenting a proposed unit in light of the standards of (PISA), and designing its topics in ways that develop students' life problem-solving skills.
   - Increasing the awareness of chargers of the educational process to the importance of life problem-solving skills in light of the standards of (PISA), and how to develop them among students through the proposed unit.
   - Providing a set of educational tools (teacher's guide, student's book, activity and training book, life problem-solving skills test) and some teaching strategies to develop life problem-solving skills among prep school students.
   - Providing a list of life problem-solving skills that should be included in science curricula for prep school students.

Search limits:

- Objective Limits: The proposed unit is based on the standards of (PISA) entitled: "Water is the Life of the Earth," and the life problem-solving skills, which are: (exploration and understanding, representation and formulation, planning and implementation, monitoring and reflection).
- Human limits: A sample of second-year prep school students, which represented all male and female students in the second year of prep school.
- Temporal limits: The research was applied in the second semester of the 2022-2023 academic year.

Search terms and their definitions:

Standards of the Program for International Student Assessment (PISA):

It can be defined procedurally as specifications organized in light of the requirements of the International Program for International Assessment (PISA) that should be included in science curricula in the prep school stage. These standards amount to (14) fourteen standards, which are: (Knowledge of facts, concepts, ideas, and theories within physical systems & Knowledge of facts, concepts, ideas, and theories within living systems & Knowledge of facts, concepts, ideas, and theories within Earth and space systems & Knowledge of standard methods and procedures for creating scientific knowledge & Knowledge of how to justify our beliefs in science & Explain phenomena scientifically & Prepare and evaluate a scientific investigation & Interpretation of scientific data and evidence & Application of science and technology issues to personal situations & Application of science and technology issues to local and national situations & Application of science and technology issues to global situations & Interest in science and technology & Appreciation of scientific investigation & Environmental awareness).

Life Problem-Solving Skills:

It can be defined procedurally as a set of steps and mental, practical skills that the student is trained to practice during the implementation of science lessons and gives him the ability to solve the problems he faces in his practical life. These skills are: (exploration and understanding, representation and formulation, planning and implementation, monitoring and reflection).

2-Theoretical framework and previous studies

The first axis: PISA Standards

PISA is a term for a global program to evaluate and measure the cognitive and functional skills acquired by students when they approach the end of compulsory education at the age of fifteen years. This study was conducted under the supervision of the Organization for Economic Co-operation and Development (OECD). The evaluation includes tests and questionnaires and focuses on three basic areas: reading, mathematics, and science. This evaluation is held once every three years, and each time the focus is on one of these areas. Its first application was in 2000, when the focus was on reading, as well as in 2009, 2018, and 2003 was on mathematics, also in 2012 and 2021, while in 2006 the focus was on science, as well as in 2015, and the sessions continued to be held on their scheduled dates until they were postponed in 2021 due to the Corona crisis, COVID-19. The evaluation also includes measures of general competencies or cross-curricular areas, such as collaborative problem-solving, financial literacy and creative thinking, which are sub-areas, not mandatory (Mailybaev, et al., 2018, 601-602).

The objectives of developing science curricula in light of the standards of (PISA):

Sherine Abdel Fattah (2016, 55), the Organization for Economic Cooperation and Development (OECD) (2021, 180), Ali Al-Maliki, and Misfer Al-Qarni (2023, 76-77) indicated that the development of science curricula in light of the PISA standards aims to help those in charge of educational science, especially curriculum planners and developers, to enrich science curricula by including the standards of (PISA), to achieve the following goals:

1- More positive participation of learners in their classes, so they become more effective in formulating Scientific questions, answering them, explaining scientific phenomena, and making correct decisions regarding the issues and problems they can identify.
2- Including the content with life problems that affect the learner's life and reality at the personal, local, or global level, thus stimulating his thinking, increasing his knowledge, and developing his skills and practices. Scientific knowledge and his ability to solve problems.
3- Emphasizing the importance of acquiring all types of knowledge, and not limiting it to content knowledge only, but rather the learner's awareness of procedural and epistemic knowledge along with his awareness of content knowledge.
4- Strengthening the links between the fields of science and their integration.
5- Keeping pace with technological development and the diversity of research methods.

6- Make the learner have a positive impact on the development of his community, and be interested in regional and international issues.

Knowledge organization axes in PISA:

The OECD (2016, 23) stated that four main axes were used to evaluate students' scientific literacy in the PISA 2015 study, and scientific literacy in 2015 was used instead of science, to emphasize the paramount importance that the PISA attaches to the application of scientific knowledge in the context of real-life situations. These themes the following figure 1 shows it:

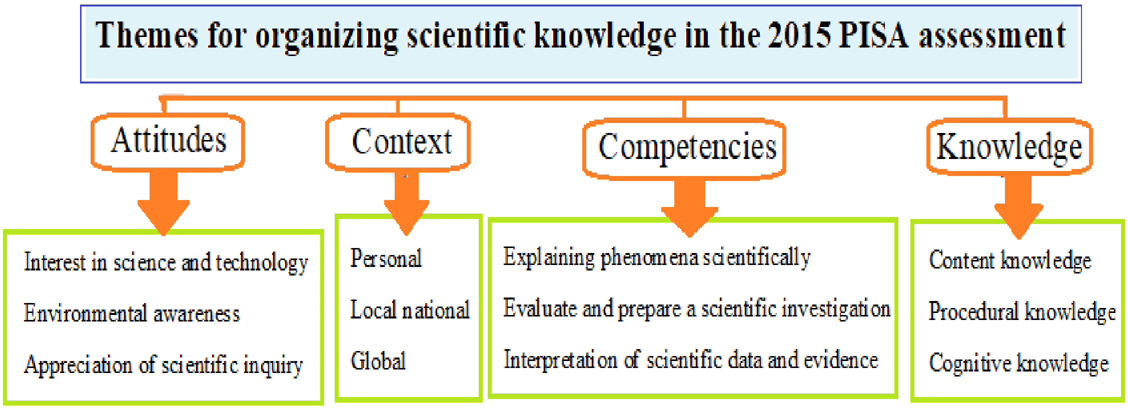

Figure 1: the axes for organizing scientific knowledge in the PISA assessment

The mutual relationships between the four axes of the scientific literacy assessment in PISA 2015:

What the student understands of science, and what he can do, is the idea of evaluating scientific competencies in the program for International Student Assessment (PISA). The competencies were framed as actions in which the level of student's performance can be measured, and for students to be able to perform the three competencies of scientific literacy, they need to possess scientific knowledge in its three sections, and they should also have the desire and inclination to participate, and thus the amount of knowledge students possess affects their performance of the three competencies, and their attitudes and inclinations toward science also determine their level of interest and participation. Measuring students' performance of the three competencies also requires that the student be able to perform those competencies in specific contexts. Personal, local/national and global, contexts are chosen based on the knowledge and understanding that pupils are likely to have acquired by the age of fifteen (OECD, 2017, 25-21).

Scientific knowledge in the 2015 PISA program:

Scientific knowledge involves understanding the nature of the world around us, and for scientific knowledge to be well understood, it is necessary to know all its components, whether science knowledge, which refers to knowledge of content, or knowledge about science with its procedural and cognitive components. Thus, scientific knowledge consists of three interconnected elements, and it can be distinguished into content knowledge, procedural knowledge، and epistemic knowledge.

1- **Content Knowledge**: It is the most common as it includes knowledge of facts, theories and ideas about physical, biological, Earth and space systems. For example, the molecular theory of matter, the mechanism of plants making food, or how day and night alternate, in the international assessment program PISA. This knowledge must be relevant to the student's life and reality and represent an important scientific concept or theory that explains a useful phenomenon that affects the student's reality. It must also be compatible with the age stage of the student. Content knowledge in the PISA assessment represents 54-66% of the total percentage of the scientific knowledge dimension. The distribution of their categories in the PISA assessment is such that physical systems represent 36%, living systems represent 36%, and Earth and space systems represent 28%.

2- **Procedural Knowledge**: It includes knowledge of the procedures that scientists follow to create scientific knowledge, as well as familiarity with the practices and concepts of variables and measurement that are indispensable in experimental research to obtain correct data, and with a high degree of certainty, such as the practices of controlling variables, evaluating and reducing error and uncertainty in measurements, and this knowledge is necessary for conducting scientific investigations, following the steps to solve the problem, and mastering scientific practices. When the student knows that scientific knowledge has different degrees of level of certainty, he can, for example, explain the possible reasons for the difference in speed of light measurements, or justify the disparity in the results of different groups. Procedural knowledge in the PISA 19 assessment represents 31% of the total percentage of the scientific knowledge dimension (OECD, 2017, 29; OECD, 2018, 73).

3- **Epistemic knowledge**: refers to understanding and identifying the basic features of building scientific knowledge, and provides a logical basis for understanding the procedures and practices in which scientists work. When the student possesses epistemic knowledge, they can distinguish between scientific fact and observation, hypothesis and scientific theory, and they can also realize the importance of models as a feature. They are fundamental to science, and they are, like maps, a substitute for an accurate picture of the physical world. They also realize the importance of data and its role in strengthening or refuting hypotheses. They also realize the values of science, such as objectivity, publication, and the role of cooperation and constructive criticism. Epistemic knowledge in the PISA assessment represents 10-22% of the total percentage of scientific knowledge (OECD, 2017, 29-30).

Competencies in the PISA program:

They are as explained by: Sherine Abdel Fattah (2016, 40-41), the OECD (2017, 22-24), and Ali Al-Maliki, And Misfer Al-Qarni (2023, 73) are as follows:

1- **The efficiency of explaining phenomena scientifically:** changes a person's understanding of the world around him through his ability to explain scientific and technological phenomena and develop technologies that support his life, and that is through remembering and using theories, explanatory ideas, facts, and information, which indicates the first element of scientific knowledge is knowledge of the content, which is not sufficient on its own to enable the student to be able to explain phenomena scientifically, but the student also needs to justify how that knowledge was derived through his knowledge of the scientific research procedures used to obtain that knowledge, which refers to the second element of the elements. Scientific knowledge, which is procedural knowledge, and in addition to the level and depth of confidence it carries, comes through understanding the role of this knowledge and its function in justifying new knowledge, which refers to the third element of scientific knowledge, which is epistemic knowledge.

2- **Efficiency in evaluating and designing scientific research:** For the student to be able to criticize scientific results and investigations to evaluate them, as well as distinguish scientific questions from others, he must know the main features of scientific research well, starting with knowing the things that must be measured, passing through the variables that must be controlled or changed, and how to collect data. Accurately, as well as the ability to evaluate the quality of the data due to his certainty that this data is not always accurate. Finally, he must recognize the importance of making use of previous research and constantly follow up on scientific developments in the field of scientific research, in awareness of the cumulative nature of science, taking into account well that the results of any study involve a degree of uncertainty. It may be biased, for example, so for the student to be able to achieve this competency, he should be able to have both procedural and epistemic knowledge, in addition to content knowledge to varying degrees.

3- **Efficiency in interpreting data and evidence scientifically**: Through the student's ability to understand and interpret the meaning of the basic forms of scientific data and evidence in their own words, or with graphs, models, or any other possible representations. Concluding also requires the student's familiarity with how to access information, impose hypotheses, and evaluate existing scientific conclusions. Based on evidence, or using evidence to evaluate an alternative conclusion, and using mathematical or computer tools to analyze, simplify, and represent data in different ways, all of this requires the student to understand the procedures used to obtain information, which refers to procedural knowledge, In addition to being able to criticize and argue to judge whether it is appropriate or not, and then being able to choose the best hypothesis, which refers to epistemic knowledge, and determining the best explanation requires knowledge of science, which refers to knowledge of the content.

Contexts in the PISA program:

Contexts in the PISA program are not a separate area of assessment. Rather, the knowledge and competencies that fifteen-year-old students are expected to acquire are assessed in personal, local/national, or global contexts. The differences in languages and cultures between participating countries are respected, and contexts are chosen in light of their relevance to the lives and needs of learners. In the 2015 PISA assessment, the context assessment required providing evidence of the student's use of the three competencies required for scientific literacy in specific situations within a personal, local, national, or global context; The following were addressed: health and disease, natural resources, environmental quality, risks, and the limits of science and technology in either a personal context, where assessment items focus on situations related to the student, his family, or colleagues, or in a community context (local/national), or a global context that includes life in the whole world.

Attitudes in the PISA program:

Perhaps one of the most important reasons that may encourage students to engage in scientific discussions is that they have motivation and that they have an interest and passion for science and technology. The student accepts to acquire scientific and technological knowledge so that he can apply it later, develop his self-efficacy and benefit from it personally, at the local, national, or global level. This is an important measure of the expected results of good compulsory education.

The PISA framework expanded in 2006 to include measuring students' attitudes toward scientific and technological issues by involving its questions within the scientific literacy test, as well as through the student questionnaire; However, this led to the observation of negative aspects that were avoided in 2015, measuring attitudes in both ways together increased the length of the test, and many discrepancies were observed between the students' results that measured their attitudes toward interest in science and gender differences, and their results in the questionnaire (Drechsel, Carstensen and Prenzel, 2011, 75).

- **Interest in science and technology:** Fernando M. Reimers, et al. (2019, 20-21) pointed out stressed the need for curricula to keep pace with scientific and technological developments that increase students' interest in science and technology to become active citizens through arming them with the knowledge and skills necessary to face the challenges of practical life.
- **Environmental awareness:** Ali Al-Shuaili (2011, 173) expressed environmental awareness as the totality of what the teacher tries to impart to his students in terms of knowledge, behaviors, and positive attitudes towards the environment. Abdul Sadiq Al-Mubarak (2015, 5) also referred to it as the knowledge, skills, and behaviors that students possess that enable them to be aware of what surrounds them of the components of the environment, its issues and their sense of how to deal with them، and its preservation.

Environmental issues are considered to be of a high degree of importance because they are closely linked to the survival of humanity and the continuation of life on the surface of the Earth. Therefore, caring for the environment, understanding its basics, and developing awareness and responsibility towards it are among the contemporary and urgent trends in science education.

- **Evaluating scientific methods of investigation:** Belief in experimental evidence is a basis for rational belief, which is considered the basic value of scientific research and scientific literacy. The extent to which students appreciate scientific methods of scientific investigation is assessed through scientific methods for collecting evidence, logical and creative thinking, their critical responses, and how to communicate their conclusions during their scientific dealings with life problems (OECD, 2017, 39).

Standards of (PISA):

The PISA standards were addressed among five requirements that should be met by students at the end of the preparatory stage through a review of the literature and previous studies, including: (Bybee, 2010, 21; Thomson, et al., 2013, 8; OECD, 2013, 102; Thomson, et al., 2016, 16; OECD, 2017, 20-39) as follows:

1- **Possessing scientific knowledge about science**: which is knowledge of the content with all the facts, concepts, ideas and theories it contains within physical systems, living systems, Earth and space.

2- **Possessing scientific knowledge about science**: in its two forms, which are procedural knowledge and epistemic knowledge, which, in addition to content knowledge and knowledge of both science and scientific technology, represent the weapon that enables the student to balance the potential benefits and risks of applying scientific knowledge to himself and his society.

3- **Three competencies are**: explaining phenomena scientifically, evaluating and designing scientific inquiry, interpreting data and evidence scientifically, and mastering skills that require special cognitive processing and support scientific inquiry, in addition to knowledge of scientific concepts and theories and how to achieve progress and address life situations that require various levels of cognitive demand using these sciences.

4- **Appropriate presentation of competencies from the context perspective**: through the successful use of the three competencies in specific situations in personal, local, national, and global contexts, and not being limited to school science contexts.

5- **Positive attitudes toward scientific issues,** such as interest in science and technology, appreciation of scientific investigation, and environmental awareness.

Requirements for preparing science curricula in light of the PISA standards:

When preparing science curricula in light of the PISA standards, specific changes should be made in the vision, goals, and teaching methods as determined by the Glaze study (2018, 2–7) as follows:

1- The content of science teaching must be linked to the interests of students and their daily lives, so that what is taught becomes consistent with the reality of science, and thus the vision of teaching science changes, so that the focus is on exploration, research, and problem-solving skills, and students practice science in cooperation, not competition, and engage in meaning, not just knowledge.

2- Students should indulge in research, exploration, and creativity in solving their life problems through modern teaching methods centered on the student's positivity in developing his knowledge and skills.

3- It is useful for all members of society to strive to understand science and its related technologies so that the goals of education can be achieved with everyone's help.

Cognitive demand:

One of the major new features of the PISA 2015 framework is the identification of levels of cognitive demand within the assessment of scientific knowledge and across the framework's three competencies. Davis and Buckendahl (2011, 329) pointed out that what is meant by cognitive demand is the type of mental processes required, not the extent of difficulty.

The OECD (2017, 40–42) indicated that cognitive demand in the PISA international assessment is determined by assessing competencies and reporting them across the range of pupil ability. The grid provides a framework for mapping the elements in the two dimensions of knowledge and competencies; the elements can also be mapped using a third dimension, also based on the classification of the depth of cognitive demand, as explained in Figure 2 below:

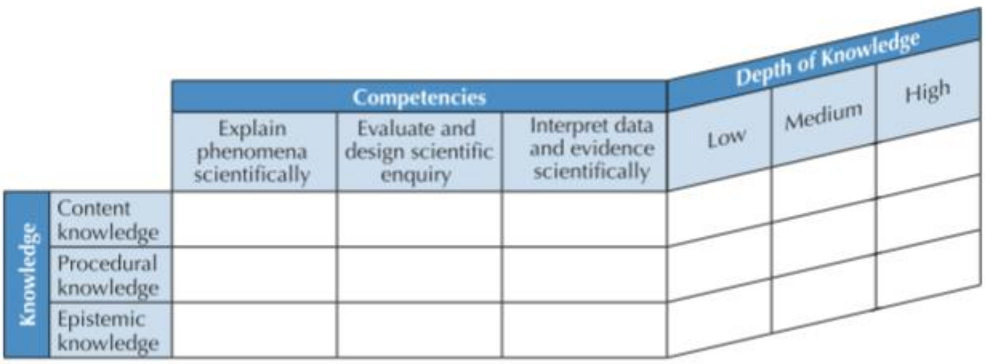

Figure 2: Levels of cognitive demand in PISA assessment (OECD, 2017, 41)

Thus, items that require merely recalling one piece of knowledge make the cognitive requirement low; even if that part of the knowledge is very complex, the elements that require comparisons, evaluation, and providing various justifications and thus require recalling more than one part of the knowledge are classified as high in cognitive demand. Therefore, the difficulty of any element is a combination of the degree of complexity, the required cognitive processes, and the demand for the knowledge that falls within its scope, and the elements of cognitive demand can be classified as follows:

- **Low**: Involves performing a one-step procedure (remembering a fact, term, principle, concept, or Selecting one piece of information from the table or graph).

- **Medium**: Involves using conceptual knowledge and applying it to describe or explain phenomena, and then choosing appropriate procedures that involve performing a two- or more-step procedure (organizing and presenting data, interpreting and using data sets or graphs).
- **High**: Involves developing a plan or series of steps to deal with a problem (analyzing complex information or data, evaluating evidence, reasoning, stating why, and giving a variety of sources).

Test unit in PISA:

The test unit in PISA 2015, as explained by the OECD (2017, 42), consists of a set of questions preceded by stimulus material. This stimulus material may be fixed, which is a brief written paragraph, or text accompanying a table, chart, graph or drawing. Schematically, or the stimulus material may be unstable, such as animation and interactive simulations, and this unit structure is relied upon to facilitate the use of realistic contexts that reflect the complexity of real-life problems as much as possible, where one problem is used and many questions are asked about it, with a separate score assigned to each question about the rest of the questions— this is an advantage of efficient use of test time instead of wasting time asking separate questions for a large number of different problems.

The test unit in PISA 2015 requires reliance on the three forms of scientific knowledge as well as the use of the three scientific competencies, but in each item, one competency is evaluated with one of the forms of scientific knowledge. When including questions and motivational materials, care should be taken that they be in a clear style and simple language, as their goal is not to evaluate knowledge. Reading or mathematics.

The second axis: life problem-solving skills:

Providing students with life problem-solving skills has become the focus of attention in curricula based on the philosophy of learning outcomes. Acquiring students with knowledge and sciences without being able to possess the skills to employ them to confront life problems is considered a not-insignificant gap in our curricula. Developing life problem-solving skills is one of the most important steps to fixing curricular problems and then bringing our curricula to a distinguished level capable of producing learners capable of confronting life's problems and dealing with them consciously and wisely.

The concept of life problem-solving skills:

Is that life problem-solving skills are among the important intellectual functions and are considered the most complex, and there is no doubt that students need to possess them in order to be able to see the life problem from different angles, make correct decisions regarding possible solutions to it, and thus become able to compete in global competition (Aydogdu, Guven, & Aka, 2012, 15; Temel, 2015, 642).

Saber Jalal (2016, 13), Monir Hasan, and Asmaa Thabit (2023, 167) referred to it as expressing the student's ability to identify the elements of the problem, consciously realizing its dimensions, being aware of the relationships between them, and reformulating them to conclude hypotheses that he employs and link them to his previous knowledge, all the way to the correct solution to the problem and to evaluate the correctness of the solution.

A core competency that requires intelligent exploration of the changing world around us and future expectations. Preparing students only to meet current expectations will not be effective for them when the time comes to use it in their private and professional lives. To achieve ambitious human goals, strategies are needed to acquire knowledge about problems that need solutions and to creatively employ that knowledge (Csapo & Funke 2017, 15).

PISA defined it as the student's ability to immediately adapt the cognitive processes and skills he possesses with realistic solutions to new, innovative problems whose solution method is not immediately clear and which are linked to the school curricula, so that he is able to engage effectively in addressing the problem cognitively and solving it individually or collaboratively, without forgetting the motivational aspect that shapes the student's desire to solve these problems (OECD, 2012, 30; OECD 2013, 122; OECD, 2017, 134).

Life Problem-Solving Skills can be defined procedurally as a set of steps and mental and practical skills that the student is trained to practice while implementing science lessons and that give him the ability to solve the problems he faces in his practical life. These skills are: exploring and understanding; acting and formulating; planning and implementing; observing and reflecting.

The importance of developing life problem-solving skills:

Abdul Rahim Othman (2014, 161–162) and Mostafa Abdeltawab (2023, 249) indicated that developing life problem-solving skills increases learners' love for the academic subject and their sense of happiness and self-confidence through their active participation in activities. This increases their ability to think and conclude while practicing the steps to solve it.

Hamza Al-Jabali (2016, 18) believed that training students in life problem-solving skills as a method of learning helps them identify aspects of the problem by analyzing it conceptually.

Muhammad Abdel Rahim (2022, 36) also believed that it trains the student to face life situations, gives him more experience in applying his knowledge to solve unfamiliar and future problems, also maintains the effect of learning for long periods, and develops his attitudes towards the academic subject.

When a student faces a new problem that he has not encountered before, he cannot use the cognitive content he has learned to solve it, but he can use the skills he has acquired to understand the problem and create a model to solve it, and through his interaction with a specific segment of the environment, he is able to explore how it responds and behaves. The knowledge gained from this interaction can then be used to build a model, generalize the new knowledge, and later use it to solve the actual problem (Csapo & Funke, 2017, 26).

Life problem-solving skills are a weapon for students that prepare them to face the problems that surround them in all aspects of life. It is important that educational curricula are linked to the social lives of students and seek to develop their life problem-solving skills so that they can face the challenges of daily life and employ the knowledge they acquire to deal with them. Effectively with situations and new problems.

Factors affecting solving life problems:

De Cock (2012, 3) saw that the student's knowledge construction, as well as the nature of the problem referred to, are the two factors influencing the solution of the problem. Lin and Singh (2013, 5) also pointed to Piaget's individual constructivist model of knowledge construction, as the method of organizing the student's knowledge in his mind and its use and the way of linking different concepts are essential factors influencing the solution of the problem, as well as in distinguishing between students who are experts in solving problems and students with low abilities.

Moreno (2010, 11) explained that solving problems depends on how students handle four processes, namely: attention, retention, production, and motivation, where it is necessary to attract the student's attention and arouse his interest to recall knowledge, as well as interest in what will be learned in order to the information to be transmitted to working memory, then comes the role of retaining information in long-term memory through encoding the information, and then comes a stage of production and motor activity; Learned procedures are broken down into smaller steps, and training opportunities and feedback are shown directed by the teacher, and finally motivation, which is indispensable for the students to be able to reproduce what they have learned.

Learning life problem-solving skills and evaluating them is a necessity and indispensable for students to be able to join the labor market and apply what they have acquired in real-life situations (Aydogdu, Guven, & Aka, 2012; Angawi, 2014; Temel, 2015; and OECD, 2013).

Students in the preparatory stage should be well prepared so that they can keep up with the challenges of the twenty-first century. Providing knowledge and information to students through content is not as important as the level and organization of this content that enable students to use it to overcome the difficulties involved in life problems; therefore, the importance of practicing life problem-solving skills in teaching science (OECD, 2014, 29).

The problem-solving assessment in PISA focuses on general cognitive processes, not the ability to solve problems related to academic subjects. It has been scientifically proven that individuals who are able to solve problems with high efficiency when they encounter problems outside the scope of their expertise are able to deal with them due to their mastery of general cognitive processes, their possession of life problem-solving skills, and their motivation to deal with new and unfamiliar life problems.

Classification of life problem-solving skills:

1- Classification explained by Zubaida Muhammad (2013, 127) includes raising the problem, defining it, collecting information, developing hypotheses and selecting the most appropriate ones, testing the selected hypotheses, arriving at a solution to the problem, generalizing the results, and finally employing generalizations in interpretation.

2- Classification by Shute, Wang, Zhao, and Moore (2016, 108) includes analyzing the data of the problem and potential constraints, planning the solution, using the available materials and tools efficiently and effectively, and monitoring and evaluating progress in the solution.

3- John Dewey's classification, as referred to by Medhat Abu Al-Nasr (2017, 146) includes five skills that begin with anxiety when facing a problem, then identifying and understanding it, gathering information about it, developing hypotheses, and testing hypotheses, all the way to confronting the problem and solving it correctly.

4- Manal Al-Baroudi's hexagonal classification (2019, 90) begins by identifying the problem and understanding its nature and components, then linking the elements of the problem and previous experiences, proposing possible solutions, planning to find solutions, choosing the solution and testing it, generalizing the results, and finally transferring the acquired experience to new situations.

5- The four-fold classification mentioned in PISA 2012 expresses the cognitive processes for solving problems. It begins with exploration and understanding of the information provided, then representation and formulation by creating drawings, tables, symbols, or phrases to describe the problem and formulating hypotheses about the relationships and relevant factors between them. Planning and implementation involve setting goals and sub-goals, implementing the sequential steps specified in the plan, and finally monitoring the progress achieved, responding to comments, and thinking about the solution or information provided with the problem or the adopted strategy (OECD, 2014, 31).

In the following lines, the classification of life problem-solving skills will be clarified in light of the PISA standards with further clarification (OECD, 2010, 20-21; OECD, 2014, 25-44; OECD, 2017, 132-138) as follows:

First Skill: Exploring and Understanding

This skill can be described as the skill through which the student can reach the basic components of the problem and correctly determine the relationship between those basic components. This skill includes exploring the problem situation by observing it, examining it, identifying its basic components, interacting with it, and making it the focus of his mental attention. Emotionally, trying to search for logical solutions to it, and extracting the information contained in the problem, or that is revealed while dealing with the problem, which can be extracted from figures, tables, or graphs, and searching for new information that can help as much as possible in solving the problem, and identifying Obstacles and restrictions that are likely to hinder him from achieving the proposed solutions, and then demonstrate understanding of the information provided, and discovered through intellectual and emotional interaction with, in group work the student should discover the viewpoints and capabilities of his team members, and understand the role assigned to each member, in order to create a common ground through which communication can be achieved successfully, taking into account the rules of engagement that govern teamwork, with the need to emphasize respect for the other's opinion, and to create an atmosphere of mutual understanding and understanding, which prepares them to be practitioners of the values of teamwork. The problem, too,

Second Skill: Representing and Formulating

This skill can be described as the skill through which the student can formulate the problem in a simple manner with clear phrases and sentences that help him solve it in a simpler way. It includes selecting information, organizing it, integrating it with previous information, and using tables or graphs. Or symbols to represent aspects of the problem and build a coherent mental representation of all its components to help to summarize it in a simpler form without disturbing its content, and then formulate precise, measurable scientific hypotheses about the relevant factors in the problem and the relationships between them, and neutralize unwanted extraneous factors. In collective work, negotiations must be made in order to reach the building of a common representation that expresses the meaning of the problem must be identified and described, and the tasks that must be accomplished must be described. The team must be well organized by describing the role of each member and establishing a protocol for effective communication as well as rules of engagement.

Third Skill: Planning and Executing

Through this skill, the student is able to plan to solve the problem using specific, executable procedures to reach the correct solution. This skill includes developing a plan or adopting a specific strategy to reach a solution to the problem and then implementing it. This requires a complete clarification of the general goal and defining sub-goals. And using his previous and current experiences and knowledge to develop a flexible plan to solve the problem and think about possible solutions while insisting on implementing that plan to reach the correct scientific solution to the problem. In teamwork, one must communicate with team members to build the plans and procedures that will be implemented and work to implement the rules of engagement that have been agreed upon. It is necessary to constantly encourage other team members to complete their tasks.

Fourth Skill: Monitoring and Reflecting

It is for the student to constantly monitor his progress in solving the problem. This skill includes continuous conscious monitoring of the progress that has been made, answering questions or responding to comments, benefiting from feedback, and thinking about the solution, the information provided, or the strategies used to solve the problem. In group work, one should monitor and try to improve the common understanding, monitor the effectiveness of the role of each team member, monitor the results of the procedures on a regular basis, evaluate the extent of success in solving the problem, and benefit from feedback.

Advantages of learning based on life problems:

Learning based on solving life problems is an educational methodology in teaching science and technology in which real or imaginary examples are used in teaching activities to enable students to learn through practical or actual experience as an alternative to being limited to theoretical knowledge. Learning becomes meaningful and linked to real-world problems. (Rahayu, Chandrasegaran, Treagust, Kita & Ibnu, 2011, 1441; Rose, 2012, 800; Putter-Smits, Taconis & Jochems, 2013, 439).

Arends and Kilcher (2010, 32) explained that problem-based learning is a student-centered educational approach. The content of the curriculum and the steps of the lesson are organized around a real-life problem through which the students reach a solution through their activities and interactions with their colleagues and develop their skills in solving life problems.

Muhammad Hindi (2010, 210–211) pointed out the importance of bringing life problems into the classroom, linking them to the academic content, discussing them to suggest appropriate solutions, and then choosing the most appropriate solution. The problem-based learning strategy depends on the student answering specific questions revolving around the problem: (What do I know? what do I need to know? and what are the procedures followed to discover what I would like to know?).

The primary goal of education is to help students learn how to think and use it to solve their life problems. This is through the harmony that occurs between the production of ideas and their evaluation, which results in a combination of the two types of creative and critical thinking. Therefore, it is expected that education in twenty-first century schools will be based on problem-solving in all its fields (Wanger, 2018, 119).

It is worth noting that problem-based learning, especially those real problems that affect the student's reality and life, works to build knowledge and skills through the students' practice of thinking and intentional observation of relationships, which results in learning naturally and as self-directed learners as they develop the desire to research, explore, know, formulate their needs, and their ability to use available resources to meet their needs grows.

In order to develop life problem-solving skills among middle school students through the science curriculum developed in light of PISA, this requires that the curriculum be built and designed using teaching approaches that emerge from educational philosophical theories, including the realistic approach that depends on the effectiveness and positivity of the learner in reaching a solution to the life problems presented to him that require him to think, benefit from his previous experiences, and search for new information to explore. The problem, understanding its aspects, representing it and formulating it in a clear way to implement a plan that includes activities and organized procedures to solve the problem, and then contemplating the procedures he implemented and the results he reached to evaluate his performance in order to benefit from mistakes and enhance the positives in order to achieve learning that will have a lasting impact on the learner's life.

Most studies aimed to measure the effectiveness of a proposed program, a proposed developed unit, a proposed developed program, a teaching strategy, an educational model, or a proposed electronic educational tool as an independent variable for developing life problem-solving skills as a dependent variable, as Rasha Abu Qura's study (2012) measured the impact of employing the Cort program. The study by Iman Abdel Wahab (2014) measured the impact of the problem-based learning strategy. The study by Fawzi Al-Adawi (2017) measured the impact of a proposed program based on inquiry. The study by Badr Brik (2018) measured the impact of a program based on a model produced for inquiry levels. The study by Dwivedi Srivastava (2021) measured the impact of the developed student leadership program; the study of Naji Al-Dhafiri (2013) measured the effectiveness of the Marzato model; and the study of Hon & The study of Wang, Wu, Chen, and Spector (2013) measured the effectiveness of an electronic learning tool, and the current study agreed with previous studies in dealing with life problem-solving skills as a dependent variable but differed with it in the independent variable, as the effectiveness of the proposed unit Water Life "Land" was measured in light of the PISA standards for developing life problem-solving skills, while the study of Mai Al-Omari, Fatima, Farha, and Amna Shabana (2022) aimed to determine the effect of the degree of practice of solving life problems on academic achievement.

The study populations and samples varied, as most studies dealt with prep school students, and the study sample was second-year prep school students, such as the study of Naji Al-Dhafiri (2013), the study of Iman Abdel-Wahab (2014), the study of Fawzi Al-Adawi (2017), and the study of Badr Brik (2018); it was in other studies of third-year prep school students, such as the study of Bassam Ibrahim (2004) and the study of Muhammad Abdel Rahim (2022); The current study agreed with those studies, as the study population represented a sample of second-year prep school students, while some other studies dealt with secondary school students as a study population, such as the study by Rasha Abu Qura (2012), and the study by Davidi & Srivastava (201), and other studies dealt with higher educational stages such as the study of Wang, Wu, Chen & Spector (2013) in which the study sample represented (35) students at the Faculty of Medicine, and the study by **Zhon & Xu** (2019) which was applied to (11) male and female graduate students at the Continental University in Peru, the study of Mai Al-Omari and Fatima Farha, and Amna Shabana (2022) also dealt with, fourth grade students, assisted by their teachers in answering the questionnaire.

Moreover, most studies were similar in the research methods they used, as most studies used the experimental method with a design with two control and experimental groups, such as the study of Rasha Abu Qura (2012), the study of Wang, Wu, Chen & Spector (2013), the study of Iman Abdel Wahab (2014), and the study Fawzi Al-Adawi (2017), Badr Barik's study (2018), and Dwivedi & Srivastava's (2021) study; While other studies used the quasi-experimental approach with a single group design, such as the study by Naji Al-Dhafiri (2013), the study by **Zhon & Xu** (2019), The current study agrees with the studies used the experimental approach with a single-group design, and the study of Mai Al-Omari, Fatima Farha, and Amna Shabana (2022) used the descriptive analytical approach to analyze the results of the questionnaire that was applied with the help of teachers to fourth-grade students.

The materials and tools that were used in previous studies varied, as some studies used tests only as research tools, such as the study by Rasha Abu Qura (2012), which used two tests, one to measure scientific concepts and the other to measure problem-solving skills, in addition to a content analysis form and a teacher's guide to explain the unit teaching strategy. The study of Iman Abdel Wahab (2014), which used a test to measure problem-solving skills in addition to the teacher's guide as an educational tool, as well as the study of Muhammad Abdel Rahim (2022), in which he used a test to measure living statistical concepts and another test to measure life problem-solving skills in addition to a list of skills and a list of concepts, the proposed unit booklet, and the teacher's guide as teaching materials, and the study of Mai Al-Omari, Fatima Farha, and Amna Shabana (2022) used only the questionnaire that was applied to students with the help of teachers, while other studies used its tools, which are tests and scales, in addition to educational materials, such as the study of Wang, Wu Chen & Spector (2013) which used a questionnaire to collect information about learners' perceptions of the learning environment and its strategies, a test to measure students' content knowledge, another to measure life problem-solving skills in addition to the electronic program based on imagination, and Naji Al-Dhafiri's study (2013) in which an achievement test in scientific concepts was used, and a measure of life problem-solving skills in addition to the teacher's guide for teaching the unit, and the study of Fawzi Al-Adawi (2017) in which an achievement test in science was used, a measure of creative problem-solving skills, and another measure of students' attitudes toward science and scientists, in addition to the educational materials that were represented in the proposed program based on the investigation, the teacher's guide, and the activity booklet, and Badr Brik's study (2018) in which he used a test to measure students' acquisition of scientific concepts, and another to measure the ability to solve problems, and a measure of attitude toward science, in addition to the educational materials that were represented in the proposed program based on the Whiting model of investigative levels in the acquisition of scientific concepts , the teacher's guide, the activity booklet, the study by Zhon & Xu (2019) in which they used the learning readiness scale, a test to measure academic performance, and another to measure life problem-solving skills in addition to the situational design model, and the user guide as educational materials, and the study by Dwivedi & Srivastava (2021) in which they used test to determine conceptual knowledge, and a measure of behaviors in solving life problems, in addition to the developed unit booklet and the teacher's guide as educational materials. The current study agreed with previous studies in which the study tools and materials varied.

Most previous studies agreed in their results, as they emphasized the effectiveness of the study units, programs, strategies, and developed educational models that they used in developing the dependent variables they targeted, including problem-solving skills, such as the study of Iman Abd. Al-Wahab (2014), and confirmation of the effectiveness of employing the CORT program in the study of Rasha Abu Qura (2012) in developing scientific concepts and life problem-solving skills, and the study of Fawzi Al-Adawi (2017) in developing students' attitude towards science and scientists, and the creative solution to problems, and the study of Badr Brik (2018) in developing scientific concepts, problem-solving skills, and the attitude towards science, and the study of Dwivedi & Srivastava (2021) in developing conceptual knowledge, and behaviors related to life problem-solving skills, and the study of Naji Al-Dhafiri (2013) in developing scientific concepts and problem-solving skills, and the study of Zhon & Xu (2019) in developing life problem-solving skills and academic performance, also explained that they are not directly linked together, and the study of Muhammad Abdel Rahim (2022) in developing living statistical concepts and life problem-solving skills, and the study of Wang Wu Chen & Spector (2013) in developing knowledge content and life problem-solving skills. The results of the current study agreed with previous studies on the effectiveness of the proposed units "Water," "Live," and "Earth" in developing life problem-solving skills among prep school students. Other studies also found that the degree of students' practice of problem-solving skills is moderate. They also confirmed that there is no correlation between the degree to which students practice problem-solving skills and their academic achievement, as in the study of Mai Al-Omari, Fatima Farha, and Amna Shabana (2022).

3-Search procedures:

To answer the research questions and test the validity of the hypothesis, the following procedures were followed:

1- Reviewing educational research related to the research topic and benefiting from it in preparing the theoretical framework and research tools.
2- Preparing a list of life problem-solving skills based on PISA standards that should be included in the prep school science curricula, and analyzing the content in light of them using the content analysis form, the formulation of whose items was based on the list of PISA standards that was prepared in addition to previous studies that dealt with how to construct the analysis form items, and after ensuring their validity and reliability, they were used to analyze the content of the six science books for the three grades of the preparatory stage, where the numbers and percentages of the performance indicators achieved, the average frequency of their appearance, and their percentage out of the total of each element were calculated of the curriculum (objectives, content paragraphs, educational activities, evaluation), the results of the analysis indicated a weak representation of PISA standards in the prep school science curricula, which required preparation of a proposed unit based on PISA standards.
3- Preparing the proposed experimental unit based on the PISA standards entitled "Water is the Life of the Earth," including the expected learning outcomes scientific content; educational methods teaching methods and suggested evaluation methods.
4- The following two research methods were used:
   - **The descriptive and analytical method** in order to determine the theoretical framework, extrapolate previous research and studies related to the research axes, and analyze them.
   - **Experimental approach with a one-group quasi-experimental design** in order to implement the experimental treatment and identify the effectiveness of the proposed unit in developing scientific practices among second-year middle school students.
5- Preparing research materials, which include the following: a list of life problem-solving skills that should be developed among prep school students; the teacher's guide; the student's book; and the activities and exercises book for the proposed unit.
6- Preparing the research tool, which consists of a life problem-solving skills test, and the following steps were adhered to:

A. **Determining the purpose of the test:** The test aims to measure the skills of second-year prep school students in solving life problems in light of PISA standards and to benefit from those skills in engaging in cognitive processing to understand and solve new situations they face in their practical lives through science.

B. **Determine the classification on which the test is based**: The test is based on the criteria of PISA.

C. **Determining test skills:** The life problem-solving skills test includes four skills: the skill of exploration and understanding, the skill of acting and drafting, the skill of planning and implementation, and the skill of observation and contemplation.

D. **Determine the type of test vocabulary**: The test vocabulary was determined to be similar to the PISA 2015 test, as it included simple and complex multiple-choice questions and questions with a constructive response that included short answers with specific statements.

a. The first type of multiple choice questions consists of an introduction to a life problem statement presented in the form of an incomplete sentence, a picture, a graph, or a table, and four scattered alternatives, where the student carefully reads the introduction so that he can choose the correct alternative, or the one he thinks the most appropriate of the alternatives given.

b. The second type is a complex multiple-choice question, where the question consists of an introduction to a life problem statement presented in the form of an incomplete sentence, a picture, a graph, or a table, and three scattered phrases, where the student carefully reads the introduction and phrases so that he can make a correct decision about the question. His agreement or disagreement with the validity of each of them.

c. The third type of open-ended structural response question is the end, where the question consists of an introduction to a life problem statement presented in the form of an incomplete sentence, a picture, a graph, or a table, and the student is asked to answer in simple words or a brief sentence to explain, justify, or infer the correct answer.

E. **Writing the test vocabulary**: The life problem-solving skills test vocabulary was written on the proposed unit for second year prep school students after determining the types of questions that would be formulated, as well as formulating them in light of the PISA test question models. The test in its initial form included 50 questions, meets the specifications of the PISA test, and covers the percentage distribution of scientific knowledge elements among the three systems, which are: 36% physical systems, 36% living systems, 28% earth and space systems, and covers life problem-solving skills. The table of specifications has been organized. The technical aspects of the test explain the various aspects that were taken into account when formulating the test items in terms of scientific knowledge and systems, competencies, the context of presenting the competency, cognitive depth, and the type of life problem-solving skill to which the item belongs; also, the relative weight of each topic of the unit lessons was taken into account, and the specifications of the Life Problem-Solving Skills test according to the percentage distribution of scientific knowledge elements across the three systems are clarified in Table 1 below:

Table 1: Number of questions according to the percentage distribution of scientific knowledge elements across the three systems

s	scientific knowledge	Total questions	Systems		
			Earth and space	living	Physical
1	Content	30	8	11	11
2	Procedural	13	5	4	4
3	Epestimic	7	1	3	3
4	The total	50	14	18	18
Percentage		100	28	36	36

It is clear from the previous table that the test acts according to the specifications of PISA in terms of distributing the elements of scientific knowledge among the three systems, as the number of questions on content knowledge reached thirty questions distributed among the three systems, so that the physical system included eleven questions and the living system included eleven questions also, while the Earth and Space system includes eight questions. The number of questions on procedural knowledge was thirteen, distributed among the three systems, so that each of the physical and living systems included four questions, while the Earth and Space system included five questions, and the number of questions on epistemic knowledge was Seven questions were distributed among the three systems, so that each of the physical system and the living system included three questions, while the Earth and Space system included only one question, and thus the number of questions on the physical system was eighteen, as well as in the living system, while the number of questions on the Earth and Space system was Fourteen.

The specifications of the life problem-solving skills test clarified according to the percentage distribution of the elements of scientific knowledge and competencies are in the following table 2:

Table 2: Number of questions according to the percentage distribution of elements of scientific knowledge and competencies

s	scientific knowledge	Total questions	Efficiency		
			Explaining phenomena	Evaluation and design of scientific	Interpretation of data and evidence
1	Content	30	15	6	9
2	Procedural	13	4	4	5
3	Epistemic	7	3	2	2
4	The total	50	22	12	16
	Percentage %	100	44	24	32

It is clear from the previous table that the specifications of the life problem-solving skills test took into account the percentages of distribution of elements of scientific knowledge and competencies, as the test contained twenty-two questions belonged to the competency of explaining phenomena scientifically, with 44% of the test questions, fifteen questions belonging to content knowledge, four questions for procedural knowledge, and three questions for epistemic knowledge; The test also contained twelve questions within the competency of evaluating and designing scientific research, with a percentage of 24% of the test questions, of which six questions belong to content knowledge, four questions belong to procedural knowledge, and two questions of epistemic knowledge; While the competence to interpret data and evidence scientifically was represented by sixteen questions, representing 32% of the test questions, content knowledge was represented by nine questions, procedural knowledge by five questions, and epistemic knowledge by two questions, thus the test Life Problem-Solving Skills, taking into account the percentage distribution of elements of scientific knowledge and competencies in the PISA test.

The percentages of cognitive demand in the PISA test were also taken into account when preparing the vocabulary for the solving skills test, as shown in table 3 below:

Table 3: Number of test questions and percentages according to cognitive demand

s	Cognitive demand	Questions numbers	Total questions	Relative weight%	Total marks
1	low	42 ،26 ،13 ،12	4	8	4
2	Middle	48 ،46 ،45 ،41 ،37 ،36 ،33 ،31 ،30 ،29 ،24 ،20 ،16 ،15 ،9	15	30	15
3	High	،23 ،22 ،21 ،19 ،18 ،17 ،14 ،11 ،10 ،8 ،7 ،6 ،5 ،4 ،3 ،2 ،1	31	62	31
	The total		50	100	50

It is clear from the previous table that the specifications of the life problem-solving skills test take into account the percentages of cognitive demand in PISA, as the test contained four questions with low cognitive demand that require recalling one part of knowledge at 8% of the test questions; fifteen questions of medium cognitive demand, in which scientific concepts and their applications are used to describe or explain a scientific phenomenon, at a rate of 30% of the test questions; And thirty-one items with high cognitive demand that require recalling more than one part of knowledge to make comparisons, provide justifications, evaluate an action, or express an opinion about it, with a percentage of 62 of the test, and thus the test of life problem-solving skills takes into account the percentage of cognitive demand in PISA. The percentages of problem-solving skills in PISA were also taken into account when preparing the items for the life problem-solving skills test, and the distribution of the test questions on life problem-solving skills was explained in Table 4 as follows:

Table 4: Distribution of the Test Questions on Problem-Solving Skills in Life

s	life problem-solving skills	Questions numbers	Total questions	Relative weight%	Total marks
1	Exploration and understanding	،40 ،38 ،37 ،36 ،30 ،29 ،26 ،13 ،12 ،8 ،5 ،2 ،1 47 ،46 ،44 ،42 ،41	18	36	18
2	Representing and formulating	،33 ،32 ،28 ،25 ،24 ،23 ،21 ،16 ،14 ،11 ،6 ،3 48 ،45 ،43 ،39 ،35 ،34	18	36	18
3	Planning and executing	50 ،49 ،27 ،19 ،18 ،17 ،7 ،4	8	16	8
4	Monitoring and	31 ،22 ،20 ،15 ،10 ،9	6	12	6
The total			50	100	50

It is clear from the previous table that the life problem-solving skills test contained eighteen questions that measure the skill of exploration and understanding, 36 of the test questions, as well as the skill of representing and formulating. While the skill of planning and executing represented eight items, representing 16%, and the skill of monitoring and contemplating represented six items, representing 12% of the total test questions.

A. **Specifying the test instructions**: This is on the first page of the test booklet, where a space is left to write the student's name and his class, followed by specifying the purpose of the test, the time to take it, the number of questions, and the number of pages, then including a set of instructions and guidelines that the students should follow.

B. **Designing the test correction key**: The test correction key was designed with three parts, showing all questions, the correct answer, and the marks of every question.

C. **Design of the answer sheet:** In order to rationalize environmental resources as one of the positive behaviors of environmental friendship and protect it from the risk of depleting its resources and to facilitate the process of correction and monitoring of grades, an answer sheet was designed for each student in light of the correction key that was designed, and the answer space was left empty in front of each word of the questions.

D. **Verifying the validity of the test**: The validity of the content was confirmed by determining the extent to which the test represents the aspects that it measures, by preparing a table for the specifications of the life problem-solving skills test, indicating the number of questions and the life problem-solving skill that each question measures, taking into account achieving Specifications of PISA standards in terms of the test vocabulary's coverage of aspects of scientific knowledge and their percentage, and their representation of the three systems, taking into account the test vocabulary's representation of the three competencies, and the context of presenting the competency in each system, also taking into account the test vocabulary's representation of the three levels of cognitive demand, and it was confirmed From the apparent validity of the test through the honesty of the arbitrators, the test was presented in its initial form to a group of professors from colleges of education specializing in curricula and methods of teaching sciences to find out their opinions on the test, and in light of their observations, the required modifications have been made to ensure that the test has the elements of validity.

E. To ensure the apparent validity and content validity of the test for solving life problems, the test was tested on an exploratory sample (other than the experimental sample) consisting of thirty male and female students in the second year of prep school to verify the clarity of the test instructions and the meanings of its vocabulary, and the students did not express any relevant comments.

F. **The reliability of the test was confirmed** using Statistical Packages for Social Science (SPSS) V26. The test reliability result was 0.973, which is an acceptable value that is reassuring that the test is considered appropriate for the application.

G. **For the test time**, by calculating the average test time for the exploratory sample, the time that was applied to the research group in the actual application of life problem-solving skills tests pre- and post-test was adopted as ninety minutes for the entire test.

H. **Calculating the validity of the internal consistency of the test**: The internal consistency of the test expresses the extent to which each question relates to the skill to which it belongs. The validity of the internal consistency of the test was verified by calculating the Pearson correlation coefficient between the score of each question and the total score of the life problem-solving skill to which it belongs using SPSS V26. The values of the correlation coefficients of the first life problem-solving skill (the skill of exploration and understanding) with its vocabulary and its significance are explained in Table 5 as below:

Table 5: Correlation coefficients between the question score and the total score for the first skill

s	Question number	Pearson correlation coefficients	Significant value	s	Question number	Pearson correlation coefficients	Significant value
1	1	**0.514	0.004	10	36	**0.740	0.000
2	2	**0.569	0.001	11	37	**0.797	0.000
3	5	**0.666	0.000	12	38	**0.653	0.000
4	8	**0.601	0.000	13	40	**0.782	0.000
5	12	**0.587	0.001	14	41	**0.710	0.000
6	13	**0.626	0.000	15	42	**0.714	0.000
7	26	**0.572	0.001	16	44	**0.706	0.000
8	29	**0.709	0.000	17	46	**0.588	0.001
9	30	**0.696	0.000	18	47	**0.718	0.000

****The correlation is significant at the 0.01 level**

It is clear from the previous table that all Pearson correlation coefficients between the first skill questions and the total scores of the first skill are statistically significant at a significance level of 0.01, for all the first skill questions, where the minimum correlation coefficients were 0.514 and the upper limit was 0.797, and thus internal consistency is achieved for all first skill questions.

The values of the correlation coefficients of the second skill of solving life problems (representation and formulation) with its vocabulary and significance are explained in Table 6 as below:

Table 6: Correlation coefficients between the question score and the total score for the second skill

s	Question number	Pearson correlation	Significant value	s	Question number	Pearson correlation	Significant value
1	3	**0.584	0.001	10	28	**0.673	0.000
2	6	**0.563	0.001	11	32	**0.753	0.000
3	11	**0.666	0.000	12	33	**0.793	0.000
4	14	**0.640	0.000	13	34	**0.865	0.000
5	16	**0.648	0.000	14	35	**0.882	0.000
6	21	**0.497	0.005	15	39	**0.773	0.000
7	23	**0.569	0.001	16	43	**0.723	0.000
8	24	**0.704	0.000	17	45	**0.595	0.001
9	25	**0.521	0.003	18	48	**0.586	0.001

****The correlation is significant at the 0.01 level.**

It is clear from the previous table that the Pearson correlation coefficients between the questions of the second skill and the total scores of the second skill are statistically significant at a level of significance of 0.01 for all questions of the second skill, where the minimum correlation coefficients were 0.497 and the upper limit was 0.882, and therefore all questions of the second skill are internally consistent.

The values of the correlation coefficients of the third skill (planning and executing) with its vocabulary and significance are explained in Table 7 below:

Table 7: Correlation coefficients between the question score and the total score for the third skill

s	Question number	Pearson correlation coefficients	Significant value	s	Question number	Pearson correlation coefficients	Significant value
1	4	**0.936	0.000	5	19	**0.802	0.000
2	7	**0.796	0.000	6	27	**0.903	0.000
3	17	**0.802	0.000	7	49	**0.909	0.000
4	18	**0.752	0.000	8	50	**0.895	0.000

****The correlation is significant at the 0.01 level.**

It is clear from the previous table that the Pearson correlation coefficients between the third skill questions and the total third skill scores are statistically significant at a significance level of 0.01 for all the third skill questions, where the minimum correlation coefficients were 0.752 and the upper limit was 0.936, and thus internal consistency is achieved for all questions of the third skill.

The values of the correlation coefficients of the fourth life problem-solving skill (monitoring and reflecting) with its vocabulary and significance were clarified in Table 8 as below:

Table 8: Correlation coefficients between the question score and the total score for the fourth skill

s	Question number	Pearson correlation coefficients	Significant value	s	Question number	Pearson correlation coefficients	Significant value
1	9	**0.813	0.000	4	20	**0.775	0.000
2	10	**0.805	0.000	5	22	**0.824	0.000
3	15	**0.780	0.000	6	31	**0.903	0.000

****The correlation is significant at the 0.01 level.**

It is clear from the previous table that all Pearson correlation coefficients between the questions of the fourth skill and the total scores of the fourth skill are statistically significant at a significance level of 0.01 for all questions of the fourth skill, where the minimum limit of the correlation coefficients was 0.775 and the maximum limit was 0.903, so all The questions of the fourth skill are internally consistent with the skills of observation and reflecting, and therefore the test of life problem-solving skills with its four skills is characterized by true internal consistency.

A. **Calculating the constructive validity of the test**: The constructive validity of the test was calculated to measure the extent to which the test objectives were achieved, the extent to which each skill relates to the total test score, as well as the correlation between each question in the test and the total test score using SPSS V26., and all Pearson correlation coefficients were obtained between the total scores of each skill, the total score of the test is statistically significant at a level of significance 0.01 as the correlation coefficient between the total score of the exploration and understanding skills and the total score of the test reached 0.834, as well as the correlation coefficient for the skill of representing and formulating was 0.933, the skill of planning and executing was 0.829, and the skill of monitoring and reflecting was 0.848, and the Pearson correlation coefficients between the score of each test question and the total score of the test is statistically significant at a level of significance 0.05 where the minimum of the Pearson correlation coefficients reached 0.370, and the maximum reached 0.841 which indicates that the constructive validity of the test has been achieved.

B. **Calculating the ease and difficulty coefficients of the test is**: To exclude very easy or very difficult vocabulary. The ease and difficulty coefficients ranged between 0.2 and 0.8, which is considered an appropriate indicator of the degree of ease and difficulty of the test questions.

C. **The coefficient of discrimination for the test**: The values of the coefficient of discrimination for the test of life problem-solving skills ranged between 0.31 and 0.88, and according to the Ebel (1972) standard, a question is good if its discrimination coefficient reaches 0.3, and therefore it is acceptable and appropriate for application.

1. Choosing the research group from the students of the second year of preparatory school at Betita Prep School in Kafr El-Sheikh Governorate, the selection was by lot for class 2a, and their number reached 49 male and female students.
2. Applying a pre-test of Life Problem-Solving Skills to the research group.
3. Teaching the proposed unit "Water is the Life of the Earth" in light of PISA standards to the students of the research group according to the time plan that was prepared during the second semester.
4. Applying the research tool to the research group again after completing teaching the proposed unit.

4-Research results.

To answer the first research question, which stipulates: What are the life problem-solving skills that should be developed among prep school students? A list of life problem-solving skills that should be developed among prep school students was prepared in light of PISA standards through their availability in the prep school science curricula in light of extensive examination and analysis of relevant sources. The list was presented in its initial form to a group of arbitrators and experienced professors of curricula and methods of science teaching and mentors. After implementing the required amendments, the list was approved in its final form, and it consisted of four skills: the skill of exploration and understanding, the skill of representing and formulating, the skill of planning and executing, and the skill of monitoring and reflicting. These skills were clarified with the performance indicators expected of students, and the There were twenty-four performance indicators, which are explained in the following table:

Table 9: List of life problem-solving skills

life problem-solving skills	Performance indicators
Exploration and understanding	Explores the basic components of the problem. Interprets preliminary information about the problem and discovered information. Searches for information that he believes will help him solve the problem. Determines information that will help him solve the problem. Explains the graphs, pictures, and shapes involved in the problem. Identifies the obstacles encountered during the problem-solving process. Explores his team's perspectives and capabilities in solving the problem. Explains the different roles of the work team in problem-solving procedures
Representing and formulating	Selects information, organizes it, and integrates it with his previous information. Formulates the problem in a simple way that helps him solve it in a simpler way. Uses diagrams, shapes, symbols, or words to represent aspects problem, and show the relationships between them. Formulates hypotheses about relationships between variables in a scientifically correct manner. Describes the tasks each team member is assigned to accomplish. Describes and organizes roles and sets rules for completing tasks.
Planning and executing	Determines the general goal and sub-goals of the problem. Creates a plan to help him solve the problem. Executes the plan to reach the optimal solution. Comunicates with his team members to implement problem-solving actions. Follows the rules of teamwork strictly.
Monitoring and reflecting	Monitored His progress in solving the problem constantly. Benefits from feedback and responds to comments. Reflects on the solutions, steps, and strategies he followed to solve the problem. Monitors and fixes common understanding of his team. Evaluates success in solving the problem.

To verify the validity of the research hypothesis, which stated: "There is a statistically significant difference at the level of (a ≤ 0.05) between the average scores of students (the research group) in the pre- and post-applications of the life problem-solving skills test in favor of the post-application,", the data were processed statistically using SPSS V26 as follows:

1- Calculated The difference between the average scores of the research group's students in the pre- and post-applications of the life problems solving skills test and the results of applying the (t) test are presented in Table 10 as below:

Table 10: (t) values and the significance of the difference between the average scores of the research group to test life problem-solving skills

life problem-solving skills	Application	N	Mean	Std. Deviation	(t) value	Significant
Exploration and understanding	In pre-test	49	14.583	5.7403	25.468	0.000
	In post-test	49	46.918	7.6841		
Representing and formulating	In pre-test	49	18.714	7.1560	19.127	0.000
	In post-test	49	46.224	8.1426		
Planning and executing	In pre-test	49	8.816	3.4651	17.106	0.000

life problem-solving skills	Application	N	Mean	Std. Deviation	(t) value	Significant
	In post-test	49	20.082	4.6102		
Monitoring and reflecting	In pre-test	49	6.04	2.922	14.152	0.000
	In post-test	49	15.16	3.804		
The test as a whole	In pre-test	49	48.153	13.5528	24.370	0.000
	In post-test	49	128.388	22.3353		

By extrapolating the results presented in the previous table, the (t) value ranged between 14.152 and 25.468, all of which are statistically significant, and it is clear that there is a statistically significant difference between the pre- and post-applications in favor of the post-application for all life problem-solving skills and for the test as a whole. The post-application averages increased compared to the pre-application average scores for all skills and the test as a whole, and this was explained graphically as in figure 3 below:

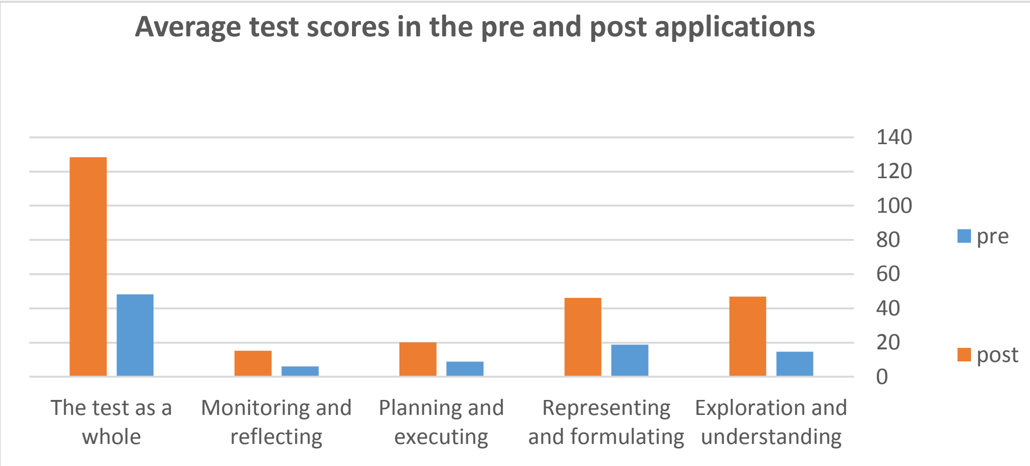

Figure 3: Average scores in the pre- and post-applications of the life problem-solving skills test

Thus, the results support the research hypothesis, so it is accepted, which states: "There is a statistically significant difference at the level of (a ≤ 0.05) between the average scores of students (the research group) in the pre- and post-applications of the life problem-solving skills test in favor of the post-application."

2- To judge the effectiveness of the proposed unit in developing life problem-solving skills, the following steps were taken:

a. The modified ratio gain score for the life problem-solving skills test was calculated using SPSS V26, and it is explained in table 11 as below:

Table 11: Adjusted gain percentage for the life problem-solving skills test

life problem-solving skills	The average score for the treatment group	N	Mean	Total score	Ratio gain score
Exploration and understanding	In pre-test	49	14.583	54	1.42
	In post-test	49	46.918		
Representing and formulating	In pre-test	49	18.714	54	1.29
	In post-test	49	46.224		
Planning and executing	In pre-test	49	8.816	24	1.21
	In post-test	49	20.082		
Monitoring and reflecting	In pre-test	49	6.04	18	1.27
	In post-test	49	15.16		
The test as a whole	In pre-test	49	48.153	150	1.32
	In post-test	49	128.388		

It is clear from the previous table that the black modified gain ratio ranged between 1.21 and 1.42 for the four skills, and the skill of exploration and understanding had the highest value, followed by the skill of representing and formulating, then monitoring and reflecting, then planning and executing, while it reached 1.32 for the test as a whole, and this indicates the effectiveness of the proposed unit to develop life problem-solving skills among the treatment group.

b. The Eta square and the effect size were found for each of the four skills that the test measures, as well as for the test as a whole, and the results are explained in Table 12 below:

Table 12: Effect size of the experimental unit for developing life problem-solving skills

s	life problem-solving skills	Degree of freedom	(t) value	Eta-Square (η2)	Effect size
1	Exploration and understanding	48	25.468	0.93	7.35
2	Representing and formulating	48	19.127	0.88	5.52
3	Planning and executing	48	17.106	0.86	4.94
4	Monitoring and reflecting	48	14.152	0.81	4.09
5	The test as a whole	48	24.37	0.93	7.04

It is clear from the previous Table 12 that:

- The eta square (2η) values ranged between 0.81 and 0.93 for the test skills and reached 0.93 for the test as a whole, which thus exceeds 0.14, which is the value that indicates the educational importance of the results of psychological and educational research. This means that the percentage of the total score variance of the treatment group ranged between 93% and 81%, which is due to the effect resulting from the proposed unit.
- The effect size of test skills ranged between 4.09 and 7.35, and for the test as a whole reached 7.04. These values indicate the influence of the independent variable on the dependent variable, which indicates the clear impact of the proposed unit based on PISA standards and its effectiveness in developing the treatment group's life problem-solving skills.

Accordingly, the second question has been answered, which states: What is the effectiveness of teaching the proposed unit in developing prep school students' life problem-solving skills?

Summary of results:

The results of the research can be summarized in the following points:

1. The life problem-solving skills that should be developed among prep school students consist of four skills with twenty-four performance indicators.
2. There is a statistically significant difference at the level of (0.05) between the averages of the grades of students (the research group) in the pre- and post-applications of the test to measure the ability to solve life problems in favor of the post-application.

Research recommendations:

In light of the results of current research, the following is recommended:

1. Incorporating PISA standards into the content of other curricula is important because of its importance and its role in preparing learners to engage effectively in practical life.
2. Enriching science teacher preparation programs and courses with PISA standards, life problem-solving skills, strategies and methods for teaching them, and the foundations for evaluating them and training them on how to employ them and link them to the students' reality.
3. Urging students to participate actively and to enhance their participation, even if it is simple, so that their motivation for more participation increases, and thus improves performance and develops their skills in solving their life problems.
4. Publishing and implementing educational programs in classroom and extracurricular school programs and activities that develop the life problem-solving skills of students.

Proposed studies and research:

1. Developing science curricula in light of PISA standards is important for developing science practices.
2. Preparing a training program for science teachers in light of PISA standards and studying its impact on developing skills.

3. Digital training programs to provide science teachers with the skills to prepare lessons that develop the life problem-solving skills of their students.

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