Development of Enterprising Competencies Using Problem-Solving Methods

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Abstract: - In this paper the enterprising competencies based on problem-solving methods are developed. At the beginning of the paper are analyzed the concept of problem-solving and some methods to finding the solutions. In the next are presents the strategies of the solutions search for three types of problems: The Classical Logic, The Logical Visual and The Lateral Thinking. In the last part is selected the examples of applications problem-solving for each category presented above.

Key-Words: - Enterprising competences, problem-solving, the logic-problems, the logical visual, and the lateral thinking, examples.

1 Introduction

The methods of searching and finding solutions to the problems represent a touchstone of human intellectual activity. Speaking about "problems", this term represent a situation that appears in real or personal life of the individual which requires knowledge, making decision and action in order to find a solution at problems that you want to solve. These problems and their solutions have acquired a general name the "Problem-solving". Such problems are very different; from mathematics, psychology and medicine, to engineering and computer science, or other fields like social-economic and cultural.

But the ad-hoc problem-solving techniques are used day by day in the personal activity. The problem-solving activity is considered the most complex cognitive intellectual functioning of human brain and represents a process of using a multiple fundamental skills of the brain to shape and control the intelligence [3].

Of historical point of view the methods of type problem-solving are used for thousands of years, particularly in mathematics and over hundred years of psychology, this methods become a link between brain activity and the issue by introspection, by behavioural and simulation. The researchers are agreeing the observation that activity of problem-solving requires: focus, motivation, attitude, emotional control, which means entrepreneurial skills. Solving everyday problems successfully bring enormous benefits such intellectual contribution to the development of intellectual capacity and reasoning helps to maintain the chemical balance of the brain and emotional control. The research of Problem-solving has developed especially in recent decades through two cognitive science schools: the European School and the American School.

The European School focused on the complexity of theoretical problems making full use of computerized scenarios while The American School focused on the study of individual knowledge, and showed that difficulties for problem-solving consist of the following characteristics: they are opaque, inexpressive, complex and unpredictable.

Have developed a lot of strategies for problem-solving, as:

- The abstraction;
- The analogy;
- Brainstorming;
- Divides and conquer;
- Testing hypotheses;
- Lateral thinking;
- The analysis of phases;
- Focus on the objects;
- The morphological analysis;
- Proof;
- Reduction;
- The analysis of roots;
- The sorting through error.

The American School focused on creativity and has developed the creative problem-solving that is the mental process of creating an issue with a solution independent of any implications.

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If the solutions become extensively used is an innovation, and whether it is market oriented representing a new object, a substance, a process, and software is invention. Has also been developed methodology of problem-solving like:

- GROW;
- POCT - plan - do - check-act;
- PTM - Productive - Thinking Model;
- TRIZ (Theory Resen Izobretatelstah Zadaci).

To mention that not all problems are part of the problem-solving. For example, the problems whose solving follows a known algorithm, are resolved on the basis of instructions given, are resolved on the basis of known relationships, have no secret, no apparent contradiction, without challenges and involves the imagination and the creativity etc. not constitute the problem-solving. Based on those presented above it is important to mention some ways based on experiments to approach the problem-solving solutions. They do not represent the solution algorithms, but rather the orientation for testing to reach a solution.

An orientation algorithm approach to problem-solving solutions is shown in Fig. 1.

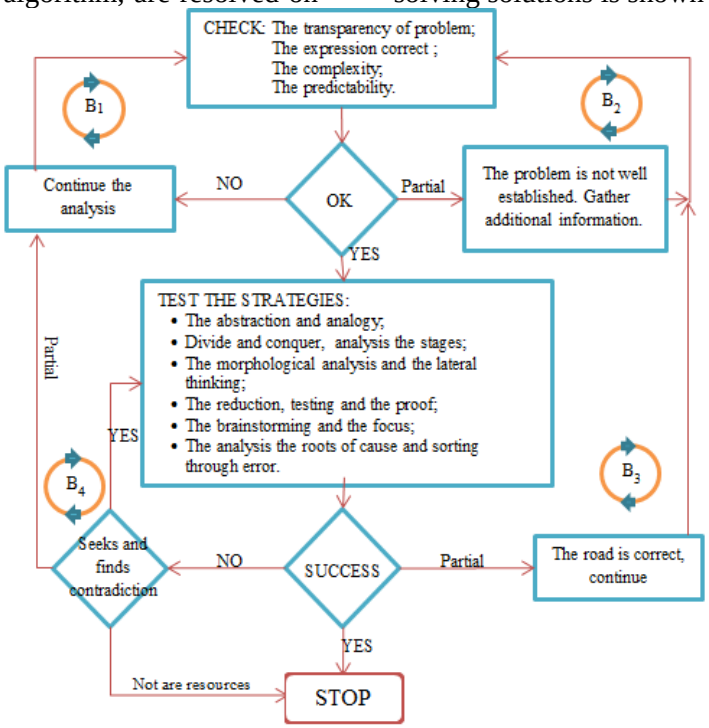

Fig. 1 The orientation algorithm for problem-solving approach

2 The orientation strategies to search the problem-solving solution

As we were saying we need to solve problems in our everyday life, both in educational situations and to workplace.

When solve problems we feel great satisfaction. Problem solving is a science, an art and there is no general method for solving than "successive approximation" that is exploring ways to solve one by one, until a path leads to the solution. It seems we guess the solution and there is a bit of luck involved in solving problems. This is just an appearance because is difficult to image hoe the brain develops neural networks techniques and strategies so the "guessing" is not arbitrary, but is educated [13].

An important class of problems that has fascinated humanity for centuries are those which involving in solving the logic and the ingenuity. There are three basic forms of problems: the classical logic, the logical visual and the lateral thinking.

The first two types of problems involving the deduction that belongs to the left side of the brain but the lateral thinking need to use the ingenuity and creativity by involving the right side of the brain.

The Classical Logic Problems

These are among the easiest and can be thought of as schemes even in the most difficult cases. Elementary mathematics and the logic deduction often provide the solution.

The Logical Visual and Sensorimotors Problems

These are often original artwork, such as puzzles, projects, models, games. These often involve solving not only with a pen and paper and with

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some sensorimotors skills and lateral thinking. To solve these problems there we need not only logical thinking but also the "lateral thinking" for creativity.

The Lateral Thinking Problems

Traditional thinking is linear, in the sense that the progress is made in solving the problem sequentially from one stage to another. Lateral thinking abandons usual reasoning, eliminating inhibitions to find alternatives, often ingenious.

The name "lateral thinking" comes from the ability to use the human brain lateralisation way of processing between the left hemisphere (the exact deductive logic) and the right hemisphere (the analogue random and creative logic).

It is recognized that this problem involves imagination, develop creativity in forming mechanism of thinking in mostly through innovations and inventions. In other words, this means the developing of entrepreneurship.

An entrepreneur has to solve everyday problems and the general principle of the entrepreneurship education is based on the successful problem-solving problems.

In this case we have 5 stages, due to the need to apply the various solutions in case of failure. The steps are listed below in the algorithm of Fig. 2.

Milestones identified in the problem solving process are:

- The understanding and description of the problem;
- The obtaining of ideas for solves;
- The undertake a mapping to find the solution;
- The implementation plan and test solution;
- Trying another idea in case of failure etc.

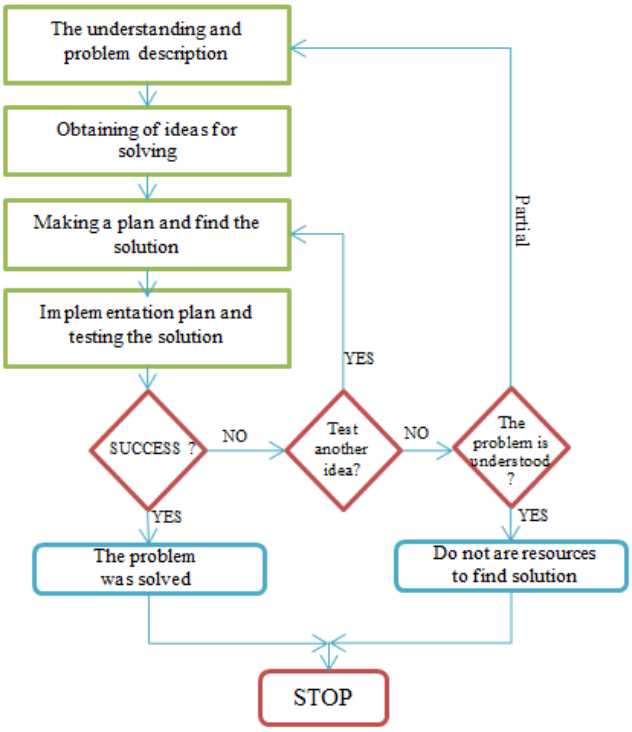

Fig. 2 The algorithm for problem-solving process

The understanding and description of the problem

If not understand the problem cannot be solved and often if you good understand the problem you can see the solution.

Some of the items that help to understand the problem are:

- Rewrite the problem;
- Check the meaning unknown terms, even if they seem familiar;
- Simulate the simple examples for which requires problem.

The obtaining of ideas for solve

After understanding the problem, the next step is to take into account the different ways of solving the problem by relying on previously acquired knowledge. Searching for relevant facts described through words similar to those in problem. Try to remember similar problems solved.

Extract various ideas even incomplete, and of these most likely choose one that could show you the way to solution. Repeat this process for a new idea even in case of failure. Insist in case of failure with iteration as to the beginning this means the understanding the problem.

Even though there is no single method that works for all problems, there are many ideas that you can

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try. The following is a list of useful ideas from the experience of others that if applied can solve the problem or not, but definitely produce gain experience:

- Analyses the relationships between data and unknown conditions or between assumptions and requirements.
- What similar problems have similar or slightly different unknown.
- Make sure you understand well the meaning of terms problem. If you know what the terms are and understand the concepts you see an idea or more ideas for solution without difficulty.
- Divide the problem into a number of separate sub-problems, this method brings simplifications in our minds;
- Seek to reach some intermediate targets.
- Check that you have used or not all data and assumptions. Otherwise often chosen path is incorrect.
- If you try an idea and hypothesis produces inconsistent then we must change hypothesis (deny). Appearance of a conflict is always a good thing to succeed.
- Simplify the problem, if possible, taking advantage of the symmetries that exist often. If the first attempt fails do not be discouraged, try one with different ideas. This way you gain experience, skills and improving techniques to find the solution.
- Another method is the approach work backwards, start from what is required and what is sought is assumed. Then check that the result might be true antecedent. If the antecedent is found, then it goes from antecedent history until the assumptions are met and thus solve the problem.

The undertake a mapping to find the solution

It is based on applying ideas extracted from the analysis of the previous stage. It starts with the idea most likely based on the person's individual skills.

The following skills are essential for solving the problem-solving type: the analytical ability, the lateral thinking, the initiative, the logical reasoning and the persistence. The logical and systematic treatment is the best solution if you have sufficient academic knowledge and already have of applied technical solutions.

In difficult situations using the lateral thinking, new ideas are needed to solve the problem. Since not everyone has these skills is important teamwork, this is a key component in solving problems.

The implementation plan and test solution

This is the stage that can lead to success or not. In case of failure to enters the loop test other ideas.

It is insisted in applying all the ideas resulting from the second step and even looking for other ideas. If you have exhausted all possibilities "the lateral thinking" is hoping to understand better the problem and redefine it.

3 The applications of type "Problem-solving"

As shown by researchers, the human brain "appreciates" the issues described linguistically, harmonious, captivating, artistic or emotional. Human sensors turn them into "paternal impulses" after which they will be memorized, processed and abstracted by neural networks of the cortex [3].

If a problem is defined in an abstract and arid way you might to be less favoured for processing and encoding to the brain areas. On the other hard if the problem has many unknowns and becomes very complex, the brain "does not like" because of so-called "the complex of complexity". In this case the abstraction brings simplification and escape of "the complex of complexity".

The Classical Logic Problems

Monica is 19 years greater than his son of David. After 17 years Monica will have double age to David. At that time John is 3 times greater than David, and his sister Roxana is 27 years old. When David will be half the age Roxana, John will be 28 years. How old are the 4 characters?

It is a logical problem type where the ages increase with passage of time.

Monica and David, denote the two characters with M and D, so we will get two equations:

M=D+19; M+17=2(D+17);

Result: D=13 and M=20.

In continue will be denote the following characters, I and R, and T for the time. And obtain the equations: I=3D; 3I+T=28; I+T=(R+T)/2, result I=3; T=25; R=27.

The Logical Visual and Sensorimotors Problems

From this category form part the projects, the modelling and simulation, laboratory work, the entertainment problems (crosswords, puzzles, Lego). Every project has elements of problem-solving, and before being applied must be modelled and simulated what again involves elements of problem-solving, finally is realized the part of prototype which also involves elements of problem-solving, what means that the human brain involves the part human sensorimotors.

In recent decades the game called LEGO has produced a revolution in the gaming and now came

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into education. LEGO name comes from an expression of Danish origin, which means "play well". Due to these building blocks interconnected "bricks" all the world plays in Danish.

A remarkable development occurred by integrating the bricks programmable Lego called Lego Mindstorms NXT 2.0.

This application is made robot "Inventorbot" that can perform complex movements and even can sing a song. The robot moving his body returns and welcomes by lifting of the hat and sing. The robot uses two sensors: the light sensor and the touch sensor and the software is developed using the neural network that is downloaded in controller for the application that follows.

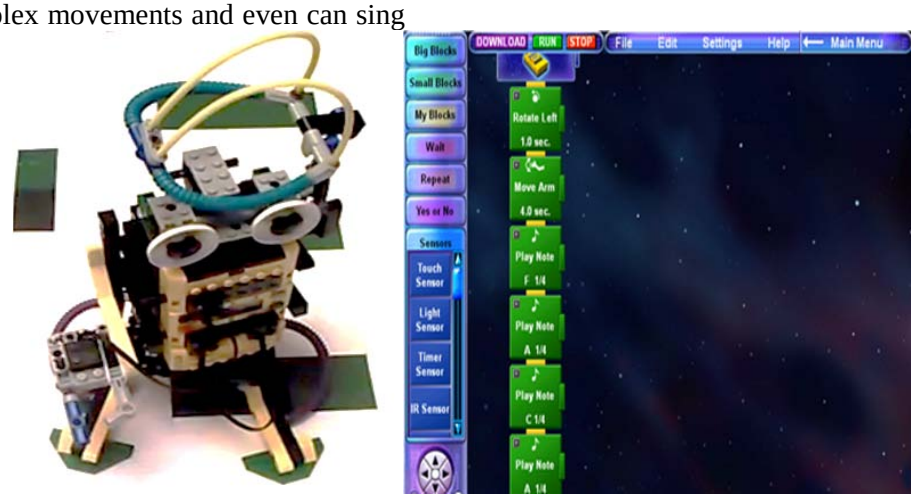

Fig. 6 The shape and programming of the robot

As shown by, this kind of problems calls to the ability of the human brain lateralization at the right hemisphere that has meanings of the ingenuity, the imagination and creativity. We present two examples reviewed and based on "the lateral thinking".

A puzzle with numbers, we know that 2 multiplied by 2 produce the same result as the 2 plus 2, i.e. 4, as shown in the picture.

Consider another pair of numbers (a and b), which when multiplied to give the same result as when added together [10].

$$a + b = c$$

$$a \times b = c$$

$2 + 2 = 4$ $\square + \square = \square$

$2 \times 2 = 4$ $\square \times \square = \square$

The first relationship is the sum S of numbers, the second is the product P theirs, so the solution is given by equation known: $x^2 - \mathrm{S} * \mathrm{x} + \mathrm{P} = 0$, is $x^2 - c * \mathrm{x} + \mathrm{c} = 0$.

From the resulting equation provided $c \geq 4$ and solution $(a, b) = \frac{\mathrm{c} \pm \sqrt{\mathrm{c}^2 - 4c}}{2}$, that when is obtain the solution:

$$(a, b) = \frac{5 \pm \sqrt{5}}{2} = (3.618, 1.382)$$

The Lateral Thinking Problems

a) We present a problem which screen to be magic [6].

The classroom teacher announces that it will instantly calculate an amount of 7 numbers of 6 digits each.

He calls the audience 2 numbers then also put a number, then alternately a number from him and another from the audience. Finally without delay write the result of the amount. Here are two examples:

The student - 1	475623	123456
The student - 2	892354	654321
The teacher - 1	524376	876543
The student - 3	775316	345672
The teacher - 2	107645	654327
The student - 4	326142	356763
The teacher - 3	673852	345678
The result:	**3775313**	**3356760**

To trigger the lateral thinking must analyse the problem for to find the possible contradictions. The first contradiction relates to the impossibility of making such a calculation in about 5 seconds. Only to read the 49-digit need approximately a minute. Analysing the first example we not see great thing only as all the digits of the student 3 appear in the result. Looking at the second example we find that the teacher chose the first number of the same kind with the student one and the same for the second

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case. Here is the second contradiction. Teacher chooses numbers as student and gives them no chance.

Now trigger the lateral thinking, the teacher put the numbers so that their sum to give us 9. The result will always start with the number 3 plus a number of the student minus 3. The number what is not gathers is the number on that teacher not at used.

b) This is a problem that uses the playing cards, the type "magic". Consider a deck of 52 cards [9].

It prompted for a neutral person to cut the cards and take a card from the deck without telling its value. The magician then shows books to prove that they are not scribbled or arranged. It stores the value of the last card and on based this card results that card were taken from the pack. Then the magician look at the person who had the card and after a small amount of concentration he says the value.

This problem is based on organizing of the cards in a circular loop on colours in the following order, from 4 to 4 (Tr, Cu, Pi, Ca). It considers the order of: 1 = as, 11 = Jack, 12 = Queen, 13 = King, the rest of the books having numbers with the 4 colours: clubs (Tr), hearts (Cu), spades (Pi), diamonds (Ca). The arrangement is done as in the table in the figure, then all groups of 4 overlap. If the last card is 5 Tr, the book that is taken out from the package will be (5 +3) = 8 Cu. After Tr follows Cu.

Nr gr.	Clubs	Hearts	Spades	Diamonds
1.	1	4	7	10
2.	13	3	6	9
3.	12	2	5	8
4.	11	1	4	7
5.	10	13	3	6
6.	9	12	2	5
7.	8	11	1	4
8.	7	10	13	3
9.	6	9	12	2
10.	5	8	11	1
11.	4	7	10	13
12.	3	6	9	12
13.	2	5	8	11

4 Conclusion

The concept of problem-solving and the methods of searching and finding solutions to the problems we can meet in different areas require the handling strategies for the problem-solving. This paper analyses this strategies and establishes the stages of the identified in the problem-solving, offering the examples of application for different categories of problems, like the classical logic problems, the logical visual and sensorimotor problems and the lateral thinking problems.

A lot of other problems can be imagines, for different kind of situation to use in education in order to develop the enterprising competences and skills.

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