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TEACHER TRAINING IN DEVELOPING SKILLS FOR THE FUTURE – A PROBLEM- SOLVING CASE

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Abstract

The world of our children will be even more uncertain than our own. The rapid development of globalisation and communication means that the world will become more and more fragmented, depersonalised and decentralised. Does school prepare our children for the challenges of their futures? Are teachers trained in this direction? More and more research speaks about 21st century competencies and how they should prepare young people for labour market integration. Are these skills really relevant to the future workforce? Are we providing children and students with the best opportunities to develop the skills they need for jobs of the future? The study provides a model that enhances the assessment of problem-solving skills in high school, using the problems of sustainable development. The module demonstrates that changes to the way resources are used are possible, that we have the collective role to overcome the many problems we face. The experimental module has implications for future research on the personal problem-solving process and offers a great reason to be more involved in a powerful education, stimulate thinking and demonstrate the richness and diversity of language across the globe. Our children are organic, they are not machines. Learning should be an expansive, personal and unpredictable journey.

Keywords: Teacher training, sustainable development, experimental module, problem solving. .

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1. Introduction

A general and widely accepted definition of problem solving is given by Reeff in 1999: "Problem solving is goal-directed thinking and action in situations for which no routine solution procedure is available. The problem-solver has a more or less defined goal, but does not immediately know how to reach it. The incongruence of goals and admissible operators constitutes a problem. The understanding of the problem situation and its step-by-step transformation, based on planning and reasoning, constitute the process of problem solving." (p. 48) Most researchers agree with this significance.

Problem-solving skills are becoming more important for high-school teenagers in meeting their future career demands. These high-level cognitive skills may help them face complicated developments in future society, especially problems that can be solved with sustainable development. A problem-solving inventory was adapted to access the variety of abilities before testing the practical module experience with teenagers. It measures perceptions of one's problem-solving skills, also including behaviours and attitudes associated with problem-solving styles. It contains three underlying dimensions: problem-solving confidence, approach-avoidance style and personal control. The study provides a model that enhances the assessment of problem-solving skills in high school, using the problems of sustainable development.

Successfully solving a problem requires a child to coordinate skills across several different domains. Humans who are competent problem solvers can study a problem in detail and think critically about it, determine what needs to be done, generate strategies, evaluate the success of a given strategy and persist in the problem-solving process until a solution is successful.

Problem solving can be either an individual or a group activity. Both types require persistence, focused attention and creativity. Group problem solving also requires effective communication, peer-interaction skills and very often the ability to compromise.

Different learning communities recognize the importance of developing competence to solve problems. Labour market experts, human resource managers, education and training experts include such cross-key/key competencies (Hunt, 1995; Binkley, Sternberg, Jones, & Nohara, 1999). These "core abilities" identified in the US Department of Vocational Training are essentially related to the development of competence to solve problems.

2. Problem Statement

In the educational context, both teachers and curriculum designers agree that teaching and assessment tasks are problem-oriented. On a large scale, the results of international evaluations, such as TIMSS, have revealed important studies on the effectiveness of this type of mathematical and science-based approach to solving problems (Stigler, Gallimore, & Hiebert, 2000). It is therefore not surprising that this competence has a leading role in the PISA tests, where, from the beginning of the testing cycles, the discussions on the transdisciplinary approach with problem-solving have begun. The assessment of the transversal competence mentioned has been implemented since the first PISA cycle in Germany (Klieme, Leutner, & Wirth, 2005).

Some key findings of the PISA 2003 (OECD, 2004) study were: 1. In some countries, 70% of the tested students could solve complex problems, while in others less than 5% proved capable of doing so. In most countries, 10% of the tested students were unable to solve Level 1 problems. On average, in OECD

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countries, half of the tested students could not solve more difficult problems than the basic ones. 2. Problems related to the development of competence to solve problems are different for each country, so their solving is specific. The PISA 2012 study argues that evaluating this problem-solving competence should be an internal problem specific to each country. Also, solving the problems of a team, as a member or leader of the team, is essential for the labour market development and employment. However, the challenges of developing this competence stand in solving collaborative tasks, a goal that international tests are trying to settle (Reeff, Zabal, & Blech, 2006).

School is probably the most important institution that can provide immense populations the levers needed to develop and transfer the knowledge, skills, attitudes that are so necessary for the development of the sustainable community. Although at an early stage in Romania, sustainable education is the critical point on which stakeholders should continually reflect, improving their existing practices and making others more suited to the needs of society, but which are strongly focused on the sustainable economy. The teacher's dilemma is to develop types of skills that are easy to transfer from one domain to another, since it is the task of the students to select information, their access points being multiple. Half of the jobs we know in OECD countries can be performed through digital technologies. The challenge is not the possession of information, but precisely what can be done with it. In the context described, it is imperative to enhance the thinking and adaptation skills to develop a sustainable future of creativity, to develop decision-making exercises and teamwork methods, to collaborate, to develop strategies for processing information and the ability to recognize their potential for creating new ways of working through the restructuring of school curricula, working methods in the classroom, as well as the entire learning experiences offered in educational institutions. Education recipients must become active citizens of society, be trained to solve real-life problems (not just those within the "micro-society" of lessons) through interdisciplinary and transdisciplinary training, by developing critical thinking, effective communication skills, as well as social and emotional skills that help people live and work together etc. Such an investment in education, if regarded in the cyclical spirit, would return to society in the form of citizens who participate effectively and innovate in the country's economic development. The restructuring of educational policies in the field, the responsible management of existing resources and the close cohesion of the decision-makers of society determine medium and long-term performance within sustainable development and implicitly a society with fewer "problem" elements, such as poverty, pollution, school dropout and social problems. Sustainable schools are an important part of societies.

Education for sustainable development can provide people (teenagers) with the practical skills that will enable them to live a sustainable life and continue learning after they leave school, such as the ability to use multiple perspectives to understand another person's viewpoint or the ability to analyse values underlying different positions.

2.1. The module "Exploring future perspectives"

The PISA 2012 describes the processes involved in problem solving, which have been adapted to this module (OECD, 2014):

1. Exploring and understanding
2. Representing and formulating
3. Planning and executing

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4. Monitoring and reflecting

1. Exploring and understanding the problem: the main objective is to build mental representations of each source of information to be solved. This involves exploring the problem situation (observation, direct interaction, data collection, identifying the boundaries and obstacles) and understanding the information discovered during the interaction with the problem situation (demonstrating the understanding of relevant concepts)

2. Representing and formulating hypotheses: the objective is to build a coherent mental representation of the problem situation by selecting the relevant information and mentally integrating it into prior knowledge. This may involve representing the problem through tables, graphs, symbolic or verbal representations. The formulation of hypotheses involves the identification of relevant factors in the problem description and the links between them, as well as the organization and the critical evaluation of the obtained information.

3. Planning and executing: setting objectives (clarifying primary and secondary objectives), developing a strategic plan to reach them (including measures to be taken) and carrying out a plan.

4. Monitoring and reflecting: monitoring progress from the initial to the final stage, performing a meta-evaluation of the process, detecting unexpected events and taking remedial action when necessary, reflecting on the solutions found from multiple perspectives, critically assessing hypotheses and alternative solutions, supplementing information through necessary clarifications.

Each of the problem-solving processes is based on one or more reasoning skills. In understanding a problem situation, it is necessary to distinguish between facts and opinions; in formulating a solution, one may need to identify relations between variables; in selecting a problem-solving strategy, one may need to consider the cause-effect relationship; in communicating the results (the final solution), one may need to organize information in a logical way. The types of reasoning associated with these processes are stages in the development of competence to solve problems: inductive, deductive, correlational, analogic, combinatorial or multidimensional reasoning. These are not mutually exclusive and are often used in a gradual approach to problem-solving, data collection or testing potential solutions before implementing the final solution.

3. Research Questions

This core competence, problem-solving, can be a solution for active citizens to develop skills for analysing a problem. However, taking teenagers outside the classroom requires careful planning of the learning activities and attention to the health and safety risks that might be faced. So, we can ask:

What is the approach to problem-solving competence?

Is interdisciplinary teaching a solution for the development of student problem-solving skills?

Is modular delivery an effective strategy for the development of student problem-solving skills?

4. Purpose of the Study

The aim of the study is to demonstrate that education for sustainable development can be a good context to develop skills for the 21st century, especially in a school system.

So, research assumptions have been developed in the following directions:

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1. Subjects in the Economic Experimental Group 1, who will follow the activities of the program "Exploring future perspectives", will have statistically significantly higher results in the Problem-Solving Inventory (PSI) - Heppner and Peterson Questionnaire than the control group.

2. Subjects in the Economic Experimental Group 1, who will follow the "Transforming Minds" program activities, will have statistically significantly higher results in the Problem-Solving Inventory (PSI) - Heppner and Peterson Questionnaire than at pretest.

5. Research Methods

Heppner and Peterson developed the Problem-Solving Inventory (PSI) that assesses perceived problem-solving competence, including behaviours and attitudes associated with problem-solving styles.

The PSI is an instrument with 35 items directed to measure the way in which individuals generally react to everyday personal problems. The term 'problem' refers to personal aspects, such as choosing a career path, feelings or the decision of separating from someone important in life. The instructions require the respondents to appraise what they believe it is true in the case of every item. In the next stage, they are required to self-assess on a Likert scale (between 1, as strongly agree, and 6, as strongly disagree) and to choose the value that corresponds to the degree to which they agree or disagree. The PSI and its scales are anchored in such a way that the lowest scores should reflect the highest perception of their ability to solve problems.

In our study, we included 56 teenagers from economic high schools, 28 students distributed in the experimental group and 28, in the control group, all enrolled in the 9th grade. The economic experimental group participated in 8 activities belonging to the experimental module "Exploring future perspectives". All groups of students (economic experimental group and economic control group) were tested before and after the experimental stage, describing the results obtained by referring to the related chapter. In terms of gender, 16 subjects in the experimental group were male and 12 female, while in the economic control group, 15 subjects were male and 13 female. It was not possible to compare the research results with the gender variable, as the subjects were, in a first stage, tempted to distort statements in both the questionnaire and the focus groups, given that, on questionnaires, it was necessary to state the subject's gender. To eliminate this risk and obtain data as close as possible to school reality, it was decided to fill in the questionnaires in anonymous terms.

In order to establish internal consistency and confirm the factors, we analysed the results of the whole sample. To establish the confidence coefficient (test-retest) and validate the PSI, we took into consideration the results of the participants during the two sessions. We did not assess the participants who did not show creditability to the examiner or those who were not present in the second session. The participants were examined individually or in small groups and their anonymity was kept. No time limit was imposed.

To analyse the quantitative data obtained in the experimental research, the SPSS (Statistical Package for Social Sciences) version 2.0 was used. The statistical hypothesis testing was performed using the Kolmogorov-Smirnov or Shapiro-Wilk test, the Mann-Whitney U test, the Wilcoxon test, Anova Multiple Measures, post-hoc test, t-test for independent samples. The Mann-Whitney test (or Wilcoxon-Mann-Whitney) is sometimes used in clinical experiments to compare the effectiveness of two treatments. It is an

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alternative to the t-test if the data do not have a normal distribution. While the t-test is relevant for the population average, Mann-Whitney is commonly used for population medians. The test can detect differences in form and spread, as well as the median. The Wilcoxon test is a non-parametric bivariate test used to identify the statistical significance of identified differences for variables derived from dependent samples (repeated measurements or measured variables of the same respondents) measured by ordinate scales, regardless of the type of distribution. ANOVA test repeated measurements. Despite the name, it is also a statistical test used to determine the difference significance in the difference between three or more (dependent or independent) samples measured on a proportional scale.

6. Findings

We analyse the posttest results obtained after checking the normality of the distribution using the graphical (subjective) and statistical (Kolmogorov-Smirnov and Shapiro-Wilk) methods. In the Posttest Problem-Solving Table – Tests of Normality, we have the results obtained in the Kolmogorov-Smirnov test (28) = 0.189, p = 0.000 and the Shapiro-Wilk test (28) = 0.901, p = 0.001. For the control group, the results obtained in the same tests are K-S = 0.141, p = 0.007, and for S-W = 0.963, p = 0.003. As the results in both tests are statistically insignificant, the variable is not normally distributed.

Table 01. Posttest Problem-Solving Table – Tests of Normality

	Kolmogorov-Smirnov			**Shapiro-Wilk**		
	Statistic	**Df**	**Sig.**	**Statistic**	**Df**	**Sig.**
posttest control group	.141	28	.007	.963	28	.003
posttest experimental group	.189	28	.001	.901	28	.001

Posttest Ranks Table shows that the subjects in the experimental group have a higher average than those in the control group (42.46 - 14.54); it follows that the students in the experimental group who have attended the module “Exploring future perspectives” get better results in the Problem-Solving Inventory (PSI) - Heppner and Peterson Questionnaire, compared to the students in the control group, who have not participated in the experimental module.

Table 02. Posttest Ranks Table

Subject	**N**	**Mean Rank g**	**Sum of Ranks**
posttest control group	28	14.54	407.00
posttest experimental group	28	42.46	1189.00
Total	56		

We calculate the r-coefficient size using the formula = √ (`) (6.410 x 6.410) / 56 = 0.856.

Given the effect size r = 0.856 (according to Cohen’s criteria, 1988), the effect of the experimental module had a strong effect on the students in the experimental group regarding their performance on the Problem-Solving Inventory (PSI) - Heppner and Peterson, which means that they have developed problem-solving skills.

To present the results, we will calculate the median, this being more suitable for non-parametric tests, the posttest variable, in each of the two conditions of the group variable. Therefore, for the

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experimental group, the median = 123.5, and for the control group, the median = 69. Thus, the results show that there are significant differences between the groups (U = 1, Z = -6.410), the students in the experimental group 1 obtaining significantly higher results (median = 123.5000 in the Problem-Solving Inventory (PSI) - Heppner and Peterson Questionnaire vs. students in the control group (69.0000 -median), and the effect size shown by this research is r = 0.865, which, according to Cohen's criteria (1988), reveals a strong effect of the module "Exploring future perspectives" on the results obtained in the problem-solving questionnaire.

For the second hypothesis, comparing the obtained results, we note that the results in the Kolmogorov-Smirnov test = 0.004, p = 0.163, and in the Shapiro-Wilk test = 0.963, p = 0.411. As the results of both tests are statistically insignificant, it follows that the variable is normally distributed. Since the posttest data analysed for the other hypotheses were not normally distributed and the sample was small-sized, we applied the nonparametric Wilcoxon test.

Table 03. The Wilcoxon Test Table

		N	Mean Rank	Sum of Ranks
posttest problem solving - pretest problem solving	Negative Ranks	0[a]	.00	.00
	Positive Ranks	28[b]	14.50	406.00
	Ties	0[c]		
	Total	28		

a. posttest problem solving < pretest problem solving
b. posttest problem solving > pretest problem solving
c. posttest problem solving = pretest problem solving

Wilcoxon Test Statistics (Table 04) shows the results of the comparative test. As Z = -4.624 and p = 0.001, there are significant differences between the development level of problem-solving competencies measured before the intervention and those measured after the intervention. To see the meaning of the difference, we analyse the values in the Sum of Ranks column and we will relate them to the highest sum of ranks. In our case, the high value is 406.00 and corresponds to positive ranks, i.e. situations where the posttest ranks are higher than the pretest (after and before) ranks.

Table 04. Wilcoxon Test Statistics

	Posttest problem solving Pretest problem solving
Z	-4.624[b]
Asymp. Sig. (2-tailed)	.001

b. Based on positive ranks

We also calculate the effect size (applying the formula used in previous situations) and the median values for each of the two paired variables (√ (`) (4.624 x 4.624) / 28 = 0.763).

In order to verify whether the problem-solving competence (organized with other sub-competences) of the subjects is more developed after the intervention compared to the previous situation, we have applied the Wilcoxon test. The obtained results indicate that the experimental intervention, i.e. the activities developed in the "Transforming Minds" program, have had a significant effect, resulting in significant differences between the posttest and pretest variables, z = -4.624, p = .0001, the competence to solve

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problems being more developed after the intervention in the subjects of the experimental group. The effect size is r = 0.763, which highlights a strong effect of the experimental intervention on the problem-solving development, as measured by the Problem-Solving Inventory - Heppner and Peterson Questionnaire, which means that we reject the null hypothesis.

7. Conclusion

The international community of nations has recognized the fundamental human right to education and, since the year 2000, it is one of the sustainable development goals. But, when considering the whole process and the conditions on which education is based, we can deduce that it should be recognized as a catalyst for development, with a transformational potential. Education is not an end in itself, but a means of achieving a global sustainable development agenda, which is proven by much cross-sectorial research on the importance of starting development with an emphasis on education.

Education is the first step in building an active society with responsible citizens. The goal of sustainable education can be developed around the idea of lifelong learning, in the context of the information explosion and the need to develop transferable competencies in any field. If every person possessed these competencies, then the world's problems could solve automatically. School, in short, is the best hope for humanity and has the most effective means in the search for sustainable development. To promote the sustainable development goals, a curriculum reorientation to sustainability would be the first step. This will require a review of the content objectives and topics, as well as learning and evaluation cycles that can help students to capitalise on the diversity of learning experiences in personal, educational and career choices. This module may be part of the compulsory curriculum structure or may be included into the school-provided curriculum, prefacing and preparing the theoretical and practical approaches developed within the school through related subjects or subjects in other curricular areas. The particular features of such an approach is that it develops logical and critical thinking; cultivates respect and self-respect, in parallel with the acceptance of pluralism under its many aspects; creates information management skills at high standards and communication skills; creates opportunities for collaboration, thus developing social skills; customises the act of learning by giving the student the possibility to perceive, organize and represent the informative material; helps students discover their affinities, talents, aspirations; prepares students to capitalise on the diversity of learning experiences in personal, educational and career choices.

As can be seen, the results obtained after the modular program piloting are encouraging, although its limits are obvious: the small number of subjects included in the research, the teaching done with specialised teachers, the transdisciplinary experience of the researcher, the relatively short pilot time, the culture the school organization that allows for relatively small impact changes, teacher mentality cumulated with didactic habits, teaching patterns.

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