PROBLEM SOLVING COMPETENCIES IN HIGHER EDUCATION

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Abstract

The aim of the present empirical pilot study was to reveal the personal competency set involved in problem solving as a sub-skill of emotional intelligence in the case of higher education students and teachers. The research tools involved TTI TriMetrix® Personal Report (Comp) questionnaires regarding HARTMAN value profile. Teachers' competencies were examined to find out about their applicable skills when facing educational challenges that they have not been prepared for during teacher training. In the case of students, the questionnaires aimed to discover the extent to which creative problem solving or divergent thinking contributes to the development of successful career socialisation. The sample of the questionnaire survey comprised of 34 students studying at a Hungarian higher education institution and 21 teachers teaching at the same institution. The research results justified the original research hypothesis i.e. the higher the emotional knowledge capacity of the teacher and the student, the higher the possibility to become efficient and to successfully tackle circumstances in a 21st century society. The research results might contribute to both teacher training and to the establishment of an up-to-date curriculum model to develop emotional competencies and creative thinking for higher education students. Further research is needed to justify the hypothesis on samples involving a larger number of participants.

Keywords: problem solving, emotional competencies, creative thinking, critical thinking.

1 INTRODUCTION

The world of work has recently changed due to the effects of globalisation. Nowadays, a successful career does not mean a stable lifelong situation with a rising position at the same company. In the modern society, career involves several periods of changing work roles and experiences in several organisations. The criterion for success is not advance on the hierarchy ladder but an inner feeling of achievement. A further speciality of the recent dynamic changes is that the same individual may simultaneously work for several organisations. This requires the employee to acquire new career competences such as the ability to learn constantly and to adapt, openness, cooperation, networking and interpersonal competencies [1]. Therefore professional knowledge is not enough for a successful career any more. Tubutiene regards the career management cycle as a problem solving process. The increasing market influence in the knowledge society on higher education requires universities to prepare students for constantly changing workplaces and lifelong learning by providing them with career competences that support their competitiveness in the labour market. The problem-based learning concept advocated by Tubutiene emphasises the switch from teaching to learning in higher education. As career goals change, career competences need to be renewed.

Work performance required by the modern economy and society of the 21st century does not only mean carrying out the task. Task performance based on competence integrates gaining and conveying information and knowledge as well as immediate utilisation of the new knowledge based on assuming individual responsibility.

2 LITERATURE REVIEW

2.1 Competency

A competency is a state of being prepared that enables an individual to act effectively in different situations, it includes a set of abilities, skills, motives and attitudes [2]. The competencies that affect several areas of literacy are called key competencies. A problem refers to a situation in which one wishes to reach a certain goal, however, the way to reach the goal is hidden. Somfai describes

problem solving as finding the hidden way to reach a given goal. In this sense problem solving competency is the ability of an individual to use cognitive processes in real situations overarching several fields of science in which the process of solution is not unambiguous and the knowledge used to solve the problem comes from several fields of science. Apparently, problem solving competency as a basic ability is considered an essential indicator of the efficiency of educational systems. In a survey carried out among school principals and teachers in Hungary in 2005, problem solving was ranked as the second most important competency out of 17 [2]. Developing problem solving skills is also listed in the Hungarian national curriculum as one of the most important tasks of teachers based on creative thinking i.e. generating new ideas and on critical thinking i.e. considering and choosing from alternatives. The Bologna process taking place in higher education also describes the key competencies on which the direction and content of education is built.

The concept of competence comprises up-to-date knowledge about the development and functioning of personality which

- regards competence i.e. the ability to act effectively as one of the most important features of personality,
- differentiates various basic forms of competence and deems each of them necessary. These are the following:
    - cognitive,
    - personal and
    - social competencies [3].
- does not content with developing explicit knowledge but considers developing competencies an essential part of education.

From the above competences problem solving competency and creativity as a form of divergent thinking were selected for the purposes of this paper. In postmodern business organisations the possibility of new situations and problems occurring has increased. Mechanically applicable schemes, techniques or routines to be used for problem solving are not automatically available. At the same time, recently wide-spread structural change often induces work organisation solutions that not only enable individuals to make independent decisions but presuppose having adequate competencies. Teachers, service providers, traders, administration staff and even students most often find themselves alone in their relationships with customers and clients and they have to find solutions to particular problems in such situations on their own [4]. As problem situations are usually open they offer a variety of solutions to choose from. An individual's problem solving ability presupposes a series of mental processes and competencies (personal, social and method competences) playing a role in cognition described by Nagy [3].

2.2 Problem solving

According to Pólya [5] who investigated the process of problem solving, the problem solving thinking process can be divided into several phases:

- Understanding the task. This often means rephrasing the problem.
- Making a plan and working out a proposal for solution. In this phase the solution possibilities are narrowed, the feasibility of the solutions is evaluated and an order of the steps to be taken is set up.
- Carrying out the solution i.e. solving the problem.
- Reconsidering and checking the solution. If the attempt has not been successful, the individual starts the problem solving process again from the first phase.

The following passages describe some important psychological characteristics of problem solving. About research in problem solving thinking Lénárd [6] stated that "A complete picture can only be gained by considering the individual and his/her environment simultaneously, in other words, by studying the upper nerve function, experiences, behaviour and achievements simultaneously". Problem solving in general presupposes the following interactions:

- problem or task,
- problem solver or subject,
- situational circumstances or environment where the problem occurs,
- processes and activities from encountering the problem to solving it,
- the product of the problem solving activity, the solution [7].

Even simple factual issues can be problematic [8]. In such cases one can reach the item in question by thinking if the connection network between the information elements is dense. Some authors regard problem solving and thinking as synonymous concepts or like Baron [9] believe that any thinking task can be regarded as problem solving.

Hiebsch [10] states that knowing what method to use and being able to use it appropriately already refers to productivity. However, the question arises if it is sufficient to develop superior intellectual abilities exclusively when practice undoubtedly requires knowledge that cannot be understood. For problem solving activities it is a requirement to own applicable knowledge, experiences as well as thinking and action schemes. One cannot just “guess” the right answer. The reason why the problem exists is that currently available knowledge is not enough to solve the problem situation [11].

2.3 The role of affective factors in problem solving

It has been observed that the steps of problem solving are similar independently of the content of the problem. Classical theories regarded problem solving as a passive, reproductive, step-by-step process. However, this model needed to be changed radically in light of the information processing model of human cognition in the 1970s. As a new element the process of problem solving is also influenced by the environment i.e. the information coming from the environment as well as disturbing factors and feedback [2]. Kontra [11] also asserts that linear models of problem solving do not demonstrate the dynamic and cyclical exploratory aspects of the process. He emphasises the need for integrating affective factors as cognitive factors on their own were not sufficient to explain the results of the students in problem solving in his research. Therefore, he suggested including creativity and flexibility among factors related to problem solving. What Kontra means by flexible thinking is integrating the problem situation, whose role in problem solving is also reinforced by Fisher [12]. (1999).

Looking at gifted students with high academic risk taking levels i. e. students who were eager to try again after failure, Tay et al. [13] found a positive correlation with problem solving skills. Also as part of the process of problem solving collecting and categorizing information are mentioned [2] as skills to be developed in schooling. Further elements of problem solving are eliciting previously gained knowledge of the students and predicting or guessing [2].

2.4 Creativity in problem solving

A large number of the descriptions of problem solving are convergent, linear models, thus they cannot capture the dynamic nature of the process. Therefore, in the rest of this study the relationship of flexible, creative, relatively “free” thinking i.e. divergent thinking and problem solving thinking is described.

Barkóczi [14] pointed out that more creative individuals are not necessarily better problem solvers than less creative individuals with the same age range and educational level. However, more creative people can utilise better the relevant declarative information given to the problem previously. That is the reason why more creative people can solve more problems. Kontra [11] found that more creative pupils had better grades in Mathematics i.e. they were better problem solvers. Surprisingly, he found no similar connection in secondary school. Also Kontra pointed out that flexible thinking led to better problem solving in primary school and again in secondary school it did not. Ömeroglu et al. [15] also attribute children’s success in problem solving to emotional factors beside cognitive ones. Among emotional factors they include effort, self–esteem, stress, anxiety, ambiguity, patience, interest, success orientation and a wish to please parents. Creative thinking together with communication skills, vocabulary capacity and numerical skills are included among cognitive factors leading to problem solving.

According to Guilford [16] creativity is manifested in divergent thinking. Divergent thinking enables individuals to reach more and more possibilities through associations while approaching the problem situation from several sides and solving it. In other words, divergent thinking involves interconnecting elements that are usually considered to be independent of each other or not matching. Thus divergent thinking is reflected in:

- being sensitive to problems,
- an easy flow of thinking that is manifested in forming connections between words and thoughts rapidly,
- flexible thinking, which makes it possible to vary solutions expediently,

- personalised thinking, which lies in the ability to find unusual and creative solutions.

Chavez-Eakle [17] establishes connections between creativity and personality pointing out that personality has a significant influence on the realisation of creativity. She also asserts that creative thinking integrates mental functions and life experience thus contributing to creative problem solving. She calls attention to prioritising personality formation in education as personality formation is structured after adolescence is completed. This leaves a possibility for higher education to contribute to personality forming as well and to enhance students' creativity which is "the foundation for art, science, philosophy and technology" [17]. Chavez-Eakle applied the Torrance Test of Creative Thinking and the Temperament and Character Inventory to her sample and found that the personality profile correlating with a high creativity index included the following characteristics: high exploratory excitability, low harm avoidance, high persistence, high self-directedness and high cooperativeness. "This means that highly creative individuals display exploratory behaviour when encountering novelty, are optimistic, they are tolerant of uncertainty, they pursue goals with intensity, display responsibility, are directed to their goals, are able to utilise resources, are self-accepting and congruent and they display empathy, tolerance and integrated consciousness" [18].

2.5 Critical thinking in problem solving

As to the skills involved in problem solving, several authors treat critical thinking as synonymous with problem solving [2] or at least part of it [19]. Huitt [19] emphasises that in the information age of the 21st century thinking skills are essential for life success and suggests making critical thinking skills the focus of education by which the academic achievements of students could be measured. A new definition of critical thinking is offered by Huitt [19] "Critical thinking is the disciplined mental activity of evaluating arguments or propositions and making judgments that can guide the development of beliefs and taking action". He states that this definition is essential to differentiate critical thinking from other forms of thinking such as creative thinking which is "putting facts, concepts and principles together in new and original ways" [19]. In Huitt's model both creative and critical thinking are part of and contribute to problem solving corresponding to the left brain thinking / right brain thinking dichotomy. Huitt also refers to Duemler and Mayer's study [20] that found students utilizing techniques related to both reason and logic as well as creativity and divergence to achieve more success in problem solving. As components of critical thinking Huitt offers affective, conative, and behavioural aspects in addition to the cognitive processes. Together with creative thinking, these elements that need to be developed in schooling independently and at every class, contribute to solving real problems in a wide variety of life situations, which is highly appreciated in the modern world.

Elder [21] argues that critical thinking provides the so far missing link between intelligence and emotions in the "emotionally intelligent" person. She states that critical thinking makes it possible to take active command of not only one's thoughts, but also one's feelings, emotions, and desires. Critical thinking provides practice for assessing and upgrading one's ability to judge well. As Elder puts it "It enables us to go into virtually any situation and to figure out the logic of whatever is happening in that situation. It provides a way for us to learn from new experiences through the process of continual self-assessment. [...] Intelligence in this view, then, presupposes and requires command of the affective dimension of mind. In short, the truly intelligent person is not a disembodied intellect functioning in an emotional wasteland, but a deeply committed mindful person, full of passion and high values, engaged in effective reasoning, sound judgment, and wise conduct."

Based on the literature review this research was aimed to test the following research hypothesis:
the higher the emotional knowledge capacity of the teacher and the student, the higher the possibility to become efficient and to successfully tackle circumstances in a 21st century communication-based society.

3 METHODS

3.1 Testing instrument

Success Insights International kindly granted permission to use part of their Trimetrix assessment tool for the purposes of this research. The TriMetrix assessment test determines how a person behaves, why they behave the way they do and what they are capable of doing. With this in-depth look at an individual, an accurate picture can be formed that is essential to performance growth, team effectiveness, and successful selection and retention. The test gives strengthened understanding of an individual. This is a significant component of the ability to establish superior performance by

capitalizing on strengths and understanding limitations in the workplace.As a job benchmarking tool, the TTI TriMetrix system identifies the behaviours, values and personal skills required by the job, then assesses the talent to find the best job fit. The 23 personal skills tested by the instrument give an accurate picture of the strengths of an individual that are essential for successful job performance.

3.2 Participants and procedures

The participants of the study were divided into two sub-samples. 32 young teachers of Dennis Gabor College, Budapest, Hungary participated in the research. The age range of the teachers was between 26 and 35. 68 students of Dennis Gabor College, Budapest, Hungary studying for a BSc degree in Information Technology were invited to participate in the research as well. The age range of the students was between 23 and 30. The questionnaires were filled in between 12nd March and 10th April, 2010. Participants could take 30 minutes in quiet and undisturbed circumstances to fill in the online Trimetrix questionnaire.

The size of the sample was determined by the limited range (100 access codes) of the available research tool. The members of the two focus groups were selected on the basis of the criteria set out in the research plan by non-probability, convenience sampling from the final year students i.e. young technical professionals studying in the institution where the researchers teach and from the teaching staff whose age range significantly overlapped that of the students. During data collection we managed to avoid the frequently occurring problem at written types of data collection, namely, the low willingness of the participants to reply. Quiet circumstances for filling in the online questionnaire were previously arranged for and the participants had the possibility to keep anonymous. Staying within the margin of error 99% of the respondents gave assessable answers.

The questionnaire looks at 23 personal skills, six areas of personal interests, attitudes and values and eight behavioural factors. Our research concentrated on the 23 personal skills and we selected the seven best-developed skills i.e. the skills with the highest scores for each individual. Then we looked at the skills that appeared in the highest number of individuals. This way we managed to identify the eight skills that are most typical of the teachers examined. These typical skills were subsequently ranked in order of the number of teachers who showed the given skills. Finally we compared the ranks of the teachers and students to the general average and to each other.

4 RESULTS AND DISCUSSION

The practical completion of quantifiability and measuring is sometimes problematic in social sciences research. In the present research, the qualitative information arising in the field of competences can be converted into quantitative criteria with the help of the competency scale used in the TTI Trimetrix® validated questionnaire based on the Success Insights Pairwise data collection procedure.

The final, complete research will aim at a scholarly processing of the results measured in all the three dimensions of the research tool. The primary investigation at the present phase of the research is directed at the extent of integration of problem solving thinking and at the investigation of how much the strengths reflected in the seven-item priority hierarchy emerging from the answers contribute to developing problem solving thinking.

Mapping the mental construction was performed on an ordinal scale assessing 23 affective competences, which differentiated each personality feature on the basis of their intensity. However, the ranking in itself does not ensure a constant distance between the ranks, therefore, the ranking is less suitable for counting for instance average values.

The data processing was aided by the large-scale benchmark average included in the TTI Trimetrix® evaluation. The linear relationship between the competency preferences of the two subsamples emerging from the data series is apparently close showing a close correlation. The correlation between the rank variables was measured using Pearson correlation coefficient. The result (0.84) has a high explanatory value. The scale of competences emerging in both groups with the same content allowing for variation at one or two items but occurring in a different order is the following:

- Empathetic outlook
- Leading others
- Interpersonal skills
- Conflict management
- Objective listening

- Teamwork
- Influencing others
- Customer focus
- Flexibility

A significance test was carried out to determine the strength and probability of the correlation using a single sample t-test. The level of significance (p=0.04) is under the criterion level, as a result of which a significant difference can be rendered probable. In the next phase of the research it will be necessary to examine the difference between the two test results of the t value apart from the significance level by repeating the test.

The relative deviation measured on the attitude scale in the preferred competency range is around DX=0.50 at student respondents typically in the under average range. The difference in the data of the teacher group is lower (DX=0.05), however, it is typically changing in the opposite direction over the average.

When comparing the competencies of the general public and the teachers investigated, it was found that 75% of the major competencies were identical in both groups, these were: empathetic outlook, interpersonal skills, leading others, objective listening, planning and organisation, and conflict management. This means that teachers mostly have the same strengths as the people in general. However, two competencies emerged as strong competencies of teachers, namely customer focus and flexibility, which were missing from the strongest competencies of the general public. In other words, teachers have stronger skills in customer focus and flexibility than other people, which aid their problem solving processes in new and unusual teaching situations. At the same time, the skills of teamwork and influencing others that were among the strongest skills of the general public as well as the students were missing from the strengths of teachers i.e. teachers were found not to be talented in these fields. The lack of a strong teamwork skill is understandable considering that teachers work individually in their classes. Finally, it can be stated that in the case of the two examined samples i.e. graduate students and young teachers the competency scales showing their strength were almost identical. In the case of teachers, competencies supporting effective problem solving were more developed, more stressed in their personalities.

The competency of problem solving did not appear among the seven prioritised competencies with any of the participants. This result is remarkable considering that problem solving is thinking leading to reach a goal and it can be found on the top of the process pyramid leading to action. At the same time, the participants in both subsamples have shown the key competencies supporting creative problem solving. At the same time, the average results for problem solving competency were the following: students – 5.8, teachers - 7.3. However the average result of the general public in problem solving competence is 7.5, which means that even teachers performed under the general average. Thus, based on the present results of a small sample, education needs to provide more training in problem solving thinking so that future graduates can react adequately to current market expectations of supplying immediate solutions and results.

5 CONCLUSION

A well functioning education system prepares students to be effective in realistic, complex problem situations. Affective factors necessary for problem solving strengthen the efficiency of the problem solving process. Several basic competencies contributing to successful problem solving have been found to be present in the sample investigated in this research for example interpersonal competency mentioned by Tubutiene [1] and identified as high cooperativeness by Chavez-Eakle [17]; objective listening, which corresponds to Somfai's [2] information categorising and exploratory excitability at Chavez-Eakle [17]; confict management suggested by Tay et al. [13]; flexibility included by Kontra [11]; customer focus described by Ömeroglu et al. [15] as pleasing others; and most important of all empathy provided by Chavez-Eakle [17], which surprisingly appeared at the top of both students' and teachers' priority list. Empathy is in fact an element of emotional intelligence, therefore it might be stated that emotional intelligence significantly contributes to problem solving. Further research is necessary to justify the present results in a larger sample, to further specify the competencies involved in problem solving and to work out a problem solving competence developing program. Also, apart from cognitive abilities higher education should pay more attention to developing affective skills.

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