

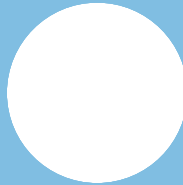
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Educational Computer Games and Gamification in Informatics and Information Technology Education – Teachers’ Points of View	766
D.I. Tuparova, G.T. Tuparov, V. Veleva, E. Nikolova	
Approaches for Integration of Educational Computer Games in e-Learning Environments	772
G.T. Tuparov, D.I. Tuparova	
Approaches to Learning in a Blended Learning Environment: Preliminary Results	777
A. Bralic	
Influence of Gamification on Student Motivation in the Educational Process in Courses of Different Fields	783
K. Aleksic-Maslac, M. Rasic, P. Vranesic	
Analysis of Correlations between Indicators Influencing Successful Deployment Sof ePortfolios	788
I. Balaban, K. Stancin, A. Sobodic	
Calibration of Source-Code Similarity Detection Tools for Objective Comparisons	794
M. Novak, D. Kermek, M. Joy	
Designing an Educational Music Game for Digital Game Based Learning: a Lithuanian Case Study	800
P. Raziūnaitė, A. Miliūnaitė, R. Maskeliūnas, R. Damasevicius, T. Sidekerskienė, B. Narkevicienė	
Measurement of the Effects of e-Learning Courses Gamification on Motivation and Satisfaction of Students	806
A. Bernik, G. Bubas, D. Radosevic	
Searching for the Reasons Why ICT is Not Adequately Used in Schools	812
M. Krasna, D. Korze, B. Kaucic	
Using Physics Simulation Environment for Better Students’ Performance	819
R. Repnik	
Outlines for Science Digital Competence of Elementary School Students	825
A. Spornjak, A. Sorgo	
Perceived User Experience and Performance of Intelligent Personal Assistants Employed in Higher Education Settings	830
S. Babic, T. Orehovacki, D. Etinger	
The Importance of Multiple Intelligences and Growth Mindset – Research Among students of University College Algebra	835
T. Babic, S. Papic, M. Babic	

The importance of multiple intelligences and growth mindset – research among students of University College Algebra

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Dramatic changes in the global society and economic structures due to information technology revolution and mass production and dissemination of the new knowledge demands a rapid response from individuals for them to have successful lives. People have very different kinds of mental and intellectual strengths, and they must be taken into account when we think about learning process which plays the critical role in this new knowledge economy with the focus on ‘human capital.’ This paper presents the research conducted over the student population of University College Algebra with the aim of identifying the most critical factors that students consider having a significant impact on their capacity to learn, ability to relate new information to prior knowledge, pose and solve problems and accordingly achieve a successful career. The survey was conducted through the prism of different kinds of intelligence and mindsets that are considered paramount for human success in the economy of the future.

Keywords - multiple intelligence, growth mindset, knowledge economy, human capital.

I. INTRODUCTION

We are experiencing dramatic changes in the global society and economic structures due to information technology revolution. The collection, validation, and dissemination of information and knowledge are crucial; they provide and guarantee power as well as wealth. Mass production and dissemination of new ideas demand from us a rapid response and open minds to see how we could integrate challenging information and expanding knowledge. Education plays the critical role in the knowledge economy and changes from traditional economic models to ‘human capital’ models. Human capital refers to the ability to solve problems, to be productive, to think creatively, to recall information and reinterpret them in a new light. Therefore, high expectations are set before education: we want ‘new skills, new jobs, new capacity to cope with rapid change, new perspectives for leading fulfilled lives - from the cradle to the grave’[1]. Students think and learn in many different ways, and education must follow. However, there is now a large volume of evidence from all realms of science that unless individuals take a very active role in their studying, unless they ask questions, to recreate and transform facts in

their mind if and as is needed, the ideas disappear. People have very different kinds of minds, and intellectual strengths and they are critical in how we learn.

Many educators now recognize that and support Multiple Intelligence theory and research on growth mindset because both can ultimately empower students to take ownership of their learning![2].

II. MULTIPLE INTELLIGENCES AND MINDSET'S PARADIGM

A. Multiple intelligences according to Gardner

Intelligence has been the subject of scientific community research for years and remains the subject of debate until today. For example, one of the definitions describes intelligence as a complex practical property of mind, integrating numerous mental abilities, such as the capacities to reason, solve problems, think abstractly, comprehend ideas and language, and learn. The study of intelligence within psychology regards this trait as distinct from creativity or personality[3]. However, the definition of intelligence has been, and continues to be, subject of reflection, consideration and accordingly the subject of discussions and debates.

The definition that comes from Mainstream Science on Intelligence, which was signed in 1994 by 52 scientists, defines intelligence as - a very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience. It is not merely book learning, a narrow academic skill, or test-taking smarts. Instead, it reflects a broader and more in-depth capability for comprehending our surroundings— ‘catching on,’ ‘making sense’ of things, or ‘figuring out’ what to do[4].

The traditional belief in the field of educational and cognitive sciences that intelligence is something that a man is born with was challenged by Dr. Howard Gardner, psychologist, and professor of neuroscience at Harvard University. According to his definition[5], intelligence is:

- The ability to create a useful product or offer a service that is valued in a culture.

- A set of skills that make it possible for a person to solve problems in life.
- The potential for finding or creating solutions for problems, which involves gathering new knowledge[6].

Gardner developed the theory of multiple intelligences that initially introduced seven different types of intelligence. He identifies them as follows[7]:

Linguistic intelligence includes 'sensitivity to spoken and written language, the ability to learn languages, and the capacity to use language to accomplish certain goals.' It also 'includes the ability to use language to express oneself rhetorically or poetically effectively, and language as a means to remember information.' Writers, poets, lawyers, and speakers are among those that have high linguistic intelligence.

Logical-mathematical intelligence involves 'the capacity to analyze problems logically, carry out mathematical operations and investigate issues scientifically,' so 'it entails the ability to detect patterns, reason deductively and think logically,' and this intelligence is most often associated with scientific and mathematical thinking.

Musical intelligence entails 'skill in the performance, composition, and appreciation of musical patterns, and encompasses the capacity to recognize and compose musical pitches, tones, and rhythms.' Also, it runs in an almost structural parallel to linguistic intelligence.

Bodily-kinesthetic intelligence refers to 'the potential of using one's whole body or parts of the body to solve problems, the ability to use mental abilities to coordinate bodily movements.' Also, it is important to see the mental and physical activity as related.

Spatial intelligence entails 'the potential to recognize and use the patterns of wide space and more confined areas'.

Interpersonal intelligence is 'the capacity to understand the intentions, motivations, and desires of other people' and it allows people to work efficiently with others. So it is crucial for educators, salespeople, religious and political leaders and counselors to have a well-developed interpersonal intelligence.

Intrapersonal intelligence includes 'the capacity to understand oneself, to appreciate one's feelings, fears and motivations' as well as having a useful working model of ourselves and ability to use such information to regulate our lives.

It is important to pay attention that, as far as classical education is concerned, linguistic and logical-mathematical types of intelligence are most valued in schools, so especially in that spirit, according to Gardner and his followers[7].

Gardner leaves the idea of expanding his theories open for discussions and development. However as Gardner warned when approaching this subject, it is important to have in mind that multiple intelligence is often mistaken for learning styles, which are ways how an individual chooses to learn or how an individual approaches a range

of tasks while multiple intelligences show different intellectual abilities[7].

B. Mindsets paradigm

Much of the individual's success depends on an individual's attitude towards life. When one wants to determine whether one has a positive or negative attitude towards life one usually asks the classic question whether the glass is half full or half empty. This is perhaps a trivial question because we have heard it so many times that we made it sound trivial. Research[8] shows that depending on the attitude we assume in the learning process, one can develop characteristics that are necessary to be successful in personal life and the economy of the future.

Research done by a psychology professor at Stanford University Carol Dweck shows that there is a significant difference between children with fixed mindset and children with a growth mindset. Children who have fixed mindset are more focused on the form and presentation of themselves and their results. Because of this narrow focus, they do not care about the content or investing effort, focusing mainly on the innate abilities that they consider to be unchangeable. Because of this superficial approach, children with fixed mindset often do not fulfill their potential. On the other hand, children who have a growth mindset are focused on investing effort into thorough content processing and are focused on the learning process. The form and self-presentation are irrelevant to them and, most importantly, they are not afraid to make mistakes. Children with growth mindset also think that their innate traits are not unchangeable and can be developed if enough effort is invested. From these research results show that the approach that teachers use to work with children has a significant impact on the development of one or another type of mindset which as a result has a significant difference in the development of children and results of their learning experience[8].

If we accept that it is possible to change the way we think and that it has a significant impact on the success of individuals, it is necessary to teach children in a way that will enable them to take advantage of their potential to the greatest extent possible.

In addition to categorizing people as a fixed or growth mindset, which then reflects on all other aspects of their life, some scientists like Howard Gardner go a step further and bring an expanded view of the minds we should nurture in individuals so that they can be successful in the economy of the future, but also in your everyday personal life. Dr. Gardner presented his ideas of the minds for the future[9] which is in some way a result of his long career as a developmental psychologist, but also a continuation of research about different kinds of intelligence[10]. According to Gardner, the minds that each person needs to develop to be successful in the economy of the future, which will be primarily based on human capital, are a disciplined mind, a synthesizing mind, a creative mind, respecting the mind and the ethical mind.

According to some research[11] to become an expert in any skill one needs to invest around ten thousand hours of practicing that skill. Whether it is ten thousand hours or not, it is certain that without investing considerable time and

effort in any skill in a structured way, it is not possible to become an expert at any reasonable time, so discipline is undoubtedly something that is necessary to install in human beings since the early age. A *disciplined mind* implies responsibility in work, but also the readiness to accept the consequences of one's actions and decisions, and directly relies on the growth mindset that has been mentioned above.

Today, and especially in the future, when information is available from the vast number of sources, it is crucial to have the ability to select and objectively consume this information, to make conclusions based on objective truth, and to present those conclusions to those who depend on us. This will be possible if we develop *synthesizing mind* in young people. Synthesizing mind is closely related to the disciplined mind and a growth mindset. The synthesizing mind is a mind that will enable not only individuals but also society as a whole to live by objective truth and no longer by superficial opinions, feelings or superstitions when making important decisions for society.

It is clear to all, or it should be, that the civilization whose benefits we enjoy are created by hardworking individuals rather than masses of people. These individuals are the ones who are creative, who think differently than most, they see into the future, imagine a better world and then build it. Imagine how the world today would look like without internal combustion engine, book printing, the internet or, God forbid, electricity? Creativity is one of the few critical elements without which civilization cannot develop. Gardner under the term *creative mind* thinks about the mind that challenges the status quo and deals with possibilities, offers new solutions to existing problems, in short, a mind that creates a new reality for the rest of us. The research[12] shows that creativity is one of the most desirable traits that humans can possess, and according to some experts[13] there is evidence that shows that creativity can be discovered despite limiting and an uncreative environment in our schools.

People who grow up in different environments under the influence of different cultures will inevitably have different value systems that will guide them in their daily decision making and affect relationships with other people. Because the world is increasingly integrated, it is necessary to be respectful in everyday interactions with people from different cultures to work together for the common good. This, of course, must never be at the expense of reasonable behavior by the objective truth, for in this case we are all doomed to fail. A *respectful mind* is something we need to develop in people for practical reasons, precisely because we have different value systems, to be able to function efficiently in the more complex economic conditions of today, and especially the future.

Since every individual is part of a larger entity in which he lives and helps to build, it is paramount for all members to be aware of this fact, so that one can make the most out of his role in the society. The *ethical mind* Gardner's advocate describes individuals place in a broader context of society and emphasizes the fact that we need to teach people how to accomplish their goals in the context of the environment in which they live. Individuals goals need to be in accord with societies so that the individual and the

society have the greatest benefit of such relationship. This is not an easy task, but it is a necessary one.

All of these minds, respectful mind, disciplined mind, synthesizing mind, ethical mind and creative mind should be developed in a balanced way so that children can grow to become valuable people who are building a better world for everyone. Although this kind of mindset will enable every individual to be more successful in their personal and business life, a 20000-foot view is required to appreciate benefits of developing such a mindset in people fully. Society, in general, is something that affects all stakeholders, and from that point of view, the development of individual members of that society should be of utmost importance.

III. RESEARCH METHODOLOGY OF DOMINANT MINDSET AMONG STUDENTS OF UNIVERSITY COLLEGE ALGEBRA

A. Research Subject, Purpose and Hypothesis

The subject of this paper is the dominant mindset of students and its role in learning motivation.

This study examines whether students of the University College Algebra believe that intelligence and talent are fixed abilities. There are two extremes; one belief is that life choices cannot change or improve one's intelligence and another belief is that one's life choices can change the level of intelligence and have a positive impact on one's life. The research was done by evaluating twenty statements concerning ability, mindset and personality/character mindset. Emily Diehl (2008) has designed a Mind-set quiz[14] based on the Dweck's book *Mindset: The New Psychology of Success* and she has made the scale of 'growth and fixed mindsets' which we used for research purposes [15].

More specifically, The research was aimed at how students evaluate their impact on their abilities, personality and character traits and characteristics.

B. Methodological framework and instruments

In this paper, we used the quantitative method. The data were collected by a questionnaire that contained twenty multiple choice questions.

The Mindset Quiz was adapted from Classroom 2.0 network[14]. The questions were predefined and offered to students who were asked to identify the extent to which they agree or disagree with the statement. Potential answers on each of the twenty statements were: Strongly Agree, Agree, Disagree and Strongly Disagree.

The survey was conducted on the obligatory lectures of the students at the University College Algebra in January 2018. After explaining the purpose of the examination, all students that received the questionnaires were asked to answer the questions honestly.

The data processing of the survey results was made through the Microsoft Excel tool.

C. Participants

A random pattern sample was used in the research and consists of the students of the undergraduate study

programs: Applied Computing, Multimedia Computing, and Digital marketing at the University College Algeba. The population sample included 104 students, with 11 polls being declared invalid. The total sample was 93 respondents of undergraduate students (100%). 11 female (12%) and 82 male (88%), and of which 61 students (66%) studies on study program Applied Computing, 11 students (12%) on study program Multimedia Computing and 21 students (23%) on study program Digital Marketing (Table I.). The total number of students in the first academic year is 60 (65%), in the second academic year is 33 (35%), and there were no participants who were in the third academic year (0%). No respondent is older than 27 years.

TABLE I. STRUCTURE OF PARTICIPATION BY STUDY, GENDER AND ACADEMIC YEAR

Undgraduate Study Program	Applied Computing	Multimedia Computing	Digital marketing
Total number of Students per Study Program (N)	61	11	21
Number of Studnets by gender			
Male	58	10	14
Female	3	1	7
Number of Students per academic year			
First year	28	11	21
Second year	33	0	0

D. Results

The underlying hypothesis of this research is that dominant mindset affects student's desire to improve and will for advancement in a way that students who have a growth mindset are more motivated to learn, work and overcome difficulties.

One of the fundamental questions of this research was the question of ability mindset sphere; if students consider that intelligence is something fundamental that they can or can't change very much? The research has shown that the highest number of students disagree (45%) or strongly disagree (14%) that their intelligence is something fundamental about them that they cannot change very much, but 34% of students think agree and 6% strongly agree with it. However, 47% of the participants disagree, and 10% strongly disagree with the statement "One can always substantially change how intelligent one is.", moreover, only 4% strongly agree along with 39% of students who agree with this statement.

Regarding personality/character mindset statements, results show that 61% students disagree with the statement "One can always change fundamental things about the kind of person one is.". On the other hand, 18% strongly disagree, while only 20% of students agree (17%) or strongly agree (3%) with that statement. 51% of participants agree, and 3% strongly agree with the statement "Some people are good and kind, and some are

not - it is not often that people change.", while 46% of the participants disagree and, 3% strongly disagree with this statement.

Only 4% of students agree (and 0% strongly agree) that they appreciate when parents, coaches, teachers give them feedback about their performance and a high number of students disagree (59%) or strongly disagree (37%). The 94% of students disagree (66%) or strongly disagree (28%) about often getting angry when they get feedback about their performance, but only 4% agree and 2% strongly agree with the statement.

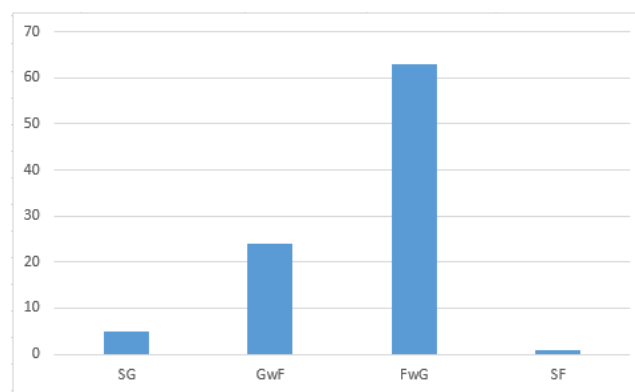
83% of students disagree (61%) or strongly disagree (22%) with the statement "Important reason why one does one's school work is that one like to learn new things.", Moreover, only 17% agree (from what 5% strongly agree) with that. As far as the statement "Truly smart people do not need to try hard" is concerned results showed that most of the students disagree (57%) or strongly disagree (29%), and only 4% strongly agree or agree (10%) with this statement.

Emily Diehl suggested the processing of the results in a way that each of the statements makes between 0 and 3 points (more in a MindsetQuiz table scores adapted from Classroom 2.0 network[14]), and the total sum of points is divided into four categories:

1. *Strong Growth Mindset*
2. *Growth Mindset with some Fixed ideas*
3. *Fixed Mindset with some Growth ideas*
4. *Strong Fixed Mindset.*

Through the proposed distribution of scores results shows (Figure I.) that only 5 students (5%) have Strongly Growth Mindset (SG), 24 students (27%) have Growth Mindset with some Fixed ideas (GwF), 63 students (69%) have Fixed Mindset with some Growth ideas (FwG) and only 1 student (1%) has Strong Fixed Mindset (SF).

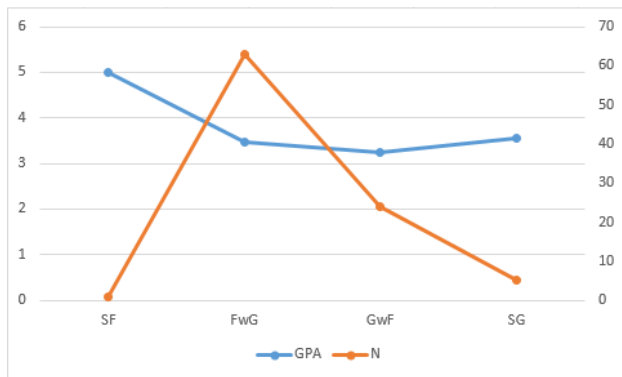
FIGURE I. NUMBER OF STUDENTS PER EACH OF 4 CATEGORIES OF MINDSETS



An additional research question was whether there is a correlation between the dominant mindset and the better grade score. As a relevant student's grade point average (GPA) for the first year students was obtained the average grade achieved on state examination at the end of secondary school and for the 2nd year students was

obtained the grade point average achieved in the previous academic year (Figure II).

FIGURE II. NUMBER OF STUDENTS (N) AND THEIR GRADE POINT AVERAGE (GPA) PER EACH OF 4 CATEGORIES OF THE MINDSETS



Although it can be assumed that students who have developed a growth mindset or growth mindset with some fixed ideas also have greater achievements which can be seen in average grade rating, it has not been possible to derive direct correlation between grade score and dominant mindset.

E. Limiting elements of the research and recommendations for further researching

Before any conclusions can be made it is important to emphasize the difficulties encountered during the research and ultimately its limiting elements.

The sample used in the survey was very small - students of the undergraduate study programs present at the time the survey took place. Out of 104 students who completed the survey, there were 11 invalid questionnaires, which gives a total sample of 93 students. The method of distributing the survey was limited to sampling. This should be changed in future research so that more relevant data can be acquired.

Also, for future research, it is important to define what success means so that it can be easier to measure the impact of growth mindset on increased motivation necessary for achieving success. The distinction should also be made between male and female students.

Maybe one of the most important things is considering longitudinal research on the same subjects so that it can be determined whether there is an influence of the learning experience at the university concerning the change in the mindset.

IV. CONCLUSION

The results of research among students of University College Algebra show that more than half of them (precisely 57%) do not think about the intelligence as something that you cannot work on and what can't be changed. However, it is also apparent that total 70% of participants have a dominant fixed mindset with some or none growth ideas, which 83% of students do not consider

a schoolwork as an important way to learn new things and 96% of students do not appreciate given feedback about their performance.

Although the population sample was not significant, it is possible and even highly likely, that the results reflect more fundamental fact about our educational system which is that our education system is not aimed at encouraging students to live up to their potential. Moreover, it would be interesting, if not necessary, to conduct research that could define causal link and correlation between student's academic success and their dominant mindset. This is something that would be worth a while to investigate in the future to stimulate learning 'how to think' and student's development as individuals in every aspect. Finally, that is the central postulate of the concept of human capital; quality of labor is proportionate to the quality of employees, and quality of employees is proportionate to investment in them.

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