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“Learning on Gaming” Improves Science Learning in a STEAM Interdisciplinary Approach

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Abstract: The “Gaming to Learn” consists in playing a game and consequently getting a learning goal: play a game, even not specifically didactic to derive a learning outcome. The “Game-Based Learning” consists of tips, techniques and tools that apply the principles of game design to the learning process-a dynamic way to engage learners and help educators assess learning. The authors’ approach “Learning on Gaming” is different: you learn “while” you play. To apply this concept, the authors realize GeoQuest, a Computer Class Role Playing Game to teach Earth Science in an STEAM (Science, Technology, Engineering, Art and Math) educational approach. The authors have realised a role playing computer game called GeoQuest creating at the same time a Role Playing Engine which involves all students to the game through their personal mobiles or tablets, giving a total interaction of the whole class to the game. Players can also discover where they are from the story of some historical and mythological figures they meet on their path. They can interact to solve several quests appearing during the game related to mineralogy, volcanology, geodynamics, history, myths.

Key words: Learning on Gaming, science education, educational game, education technology, teaching methodologies.

1. Introduction

In most European countries, theory and practice are still worlds apart. Furthermore, this lack of application of pedagogical theory impedes interdisciplinarity. To solve this problem, substantial methodology changes have been proposed [1] based on ICT (Information and Communications Technology), Cooperative Learning and Peer Tutoring.

Teachers need to learn how to integrate these innovative approaches into their classrooms. These approaches include abandoning traditional lessons in favour of teaching labs, development of interdisciplinary modules and multidisciplinary approaches, use of CLIL (Content and Language Integrated Learning) and the organisation of personalised lessons to suit different cognitive styles, including students with SEN (Special Educational Needs).

Paradoxically, in our society, there is still a considerable inadequacy of young and less young people compared to job world and civil society [1]. This is directly bound with school failure. It is related to the inability in decoding written text and to the difficulty in properly retrieving information.

It is therefore necessary encouraging teachers and researchers to develop instructional strategies to foster these literacy skills.

Learning to learn is a meta-skill which evolves with the student and guides him to a successfully learning process.

The educational technology uses the closer to pupils language to improve the teaching/learning process. The game is a good vehicle for education since the acquisition of knowledge and enhancing skills now requires more actual approaches. The use of tablets, smartphones, social networks, etc. is more comprehensible and funny for young people compared to traditional media.

Until now, serious games are a significant step forward compared to many ways of using information technologies in education, which, as it happens with

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the traditional e-learning, have often repeated the transmissive model, providing content with rich combinations of texts, pictures and possibly video and audio, but with limited possibilities for effective interaction with the teacher and with other students [2].

The aim of this work is to use the latest ICT techniques to create innovative educational products and to create new educational materials for teachers, to effectively respond to the latest methodological guidelines and regulations.

Roleplaying could help students to reach their goals easily through cooperation to acquire disciplinary and transversal skills.

1.1 Interest for Science and Educational Technology

Europe suffers from a cultural heritage that prefers theory to practice. "Cultured Knowledge" is based on transmissive, sequential, deductive and standardized teaching, opposed to workshop activities, mainly focused on production and revenue.

The misperception that intelligence was only the "rational logic" one has channeled the awareness that culture was based on the mastery of complex theories, while the scientific and technological disciplines should only serve to support the craft activities.

The discovery that there are different forms of intelligence [3], all of equal importance and effectiveness, has shifted the focus from deductive logic-rational learning to diversified forms of learning, using different knowledge channels.

At the same time, knowledge has developed from analytic to synthetic, mainly due to new multimedia communication systems.

Therefore, a modern teaching approach shapes on new forms of learning: synthetic and multitasking.

The European Community has conveyed its recommendations to the national education systems, which adopted the European guidelines in the local regulations, but not always schools are conformed to.

"The innovative practices are driven by champion teachers, those that are willing to go one step beyond in the benefit of their students. School's strategies are, in general, very exam oriented and have to handle lots of bureaucratic work." [4]

The decreasing of interest for science is a known issue and has been debated in several important documents as: "the Rose Project" [5], "the Rocard Report" [6] and a "Critical Reflection on Science Education in Europe" [7].

1.2 The STEAM Approach and Gaming

STEAM is an educational approach to learning, which uses Science, Technology, Engineering, Arts and Mathematics to guide students on inquiry, dialogue and critical thinking. The end results are students which engage in experiential learning, apply problem-solving, embrace collaboration and work through the creative process.

This kind of multidisciplinary approach is required in the new teaching frontiers (Fig. 1).

Gaming is an essential element and activity at all school levels as in the longlife learning, for development of everybody's personality, in the perspective of "learning to learn" (Key Skills).

Learning to learn is recognised as a meta-skill which evolves with the student and becomes the thread that guides to a successful assumption of responsibility for its own learning process. The most effective metacognitive teaching is the self-regulating

Fig. 1 Some game images are taken by Sir William Hamilton's original book together with original texts, science and literature together in a multidisciplinary approach.

approach, in which students are helped in the process of recognition of skills to learn tasks. They are encouraged to choose the most productive application of appropriate learning strategies [8].

Gaming allows devolution from "teachers" to "coaches of students".

"Devolution is the act by which the teacher makes the student accept responsibility for a learning situation (a-didactic) or for a problem, and makes itself accept the consequences of this transfert. Devolution is not only introducing to students the game that the teacher wants him to play, but also making students feel responsible, in the sense of knowledge and not the guilt, for the result that he must look for." [9]

The knowledge and the discovery of own abilities (not only scholastic ones) is a fundamental step for self-acceptance and for future planning. Socialisation implies the ability to relate and the communication with other people: this is the delicate, but strategic step to feel protagonist and to face own development tasks [10].

Serious gaming is a significant step forward compared to the use of other information technologies in education. The e-learning, which often repeats the traditional transmissive model, provides content with rich combinations of texts, pictures, video and audio, but with very limited possibilities for effective interaction with teacher and other students [2].

Edutainment (Educational Entertainment) is content designed both to educate and to entertain: especially in recent years the use of computer resources in schools allowed the spread of this type of education. "Gaming to Learn" consists in playing a game and consequently getting a learning goal: play a game, even not specifically didactic to derive a learning outcome. "Game-Based Learning" consists of tips, techniques and tools that apply the principles of game design to the learning process-a dynamic way to engage learners and help educators assess learning. The authors' "Learning on Gaming" is a different approach: you learn "while" you play. The game hides the didactic inside an adventure game.

1.3 Problem-Solving Skills and Spatial Thinking in Computer Games

Computerised games are a terrifying gym to exercise the "core capacities" involved in cognitive enhancement activities. Reaching the game objectives requires simultaneous and coordinated application of a large number of mental processes such as visual attention, processing visus-space, executive function, learning ability and memory, in addition to experiment with their coordinated use in the situation [11] (Fig. 2).

The elements contributing to educational values of digital games are sensual stimuli.

Planning and/or using a computer game to promote academic success therefore ask you to respect some measures dictated by empirical research about Scholastic Achievement. Problems that require the exercise of content and skills covered at school, presented as a game may be stimulants and not frustrating due to the controlled difficulties, and it may promote cognitive functions about targeted content: a key element for the enhancement of learning [12].

In order to acquire problem solving competence by an inquiry based learning approach—science educators

Fig. 2 Game images are chosen to keep the student in-situation.

identify it as one of the key skills to face the challenges of the future—it is necessary for learners to follow different steps and to exercise several spatial abilities [13].

Spatial thinking is considered as a significant ability for STEAM disciplines: lack of spatial thinking acts as a barrier for students leading them to dropout [14].

Except from STEAM fields, spatial thinking is also associated with social sciences, humanities [15] and education [16], demonstrating in that way its interdisciplinary character.

1.4 Mediation with Automatic Feedback

Among the main forms of mediation involved in computer games, a key role is the automatic feedback: the error handling strategies proposed in many games. While during school activities, errors are potential sources of frustration to be avoided at any cost. In the computer games, it is a normal part of experience (Fig. 3): after any error you can continue or restart without any consequence but having learned something [17].

Immediate reward (and feedback) is a major motivational factor, whether it is translated as game entities (more life power, access to new levels, etc.) or as neurological impulses (happiness, feeling of achievement, etc.) [18].

1.5 Learning on Gaming Strengths

Marshall McLuhan, famous Canadian philosopher of communication theory, who predicted World Wide Web in sixties, when he talked about a “global village”, stated: “Anyone who makes a distinction between games and learning doesn’t know the first thing about either.”

The constructivist problem-based and active learning methods indicate the success of learning in the context of challenging, open-ended problems.

The elements contributing to educational values of digital games are sensual stimuli (visual and audio representations of learning material), fantasy (context presented in imaginary setting), challenge (demanding or stimulating situation) and curiosity (desire to know or learn). These elements must be incorporated on an integrated platform, to structure objectives and rules, a context of meaningful learning, an appealing story, immediate feedback, a high level of interactivity, challenge and competition, random elements of surprise, and rich environments for learning.

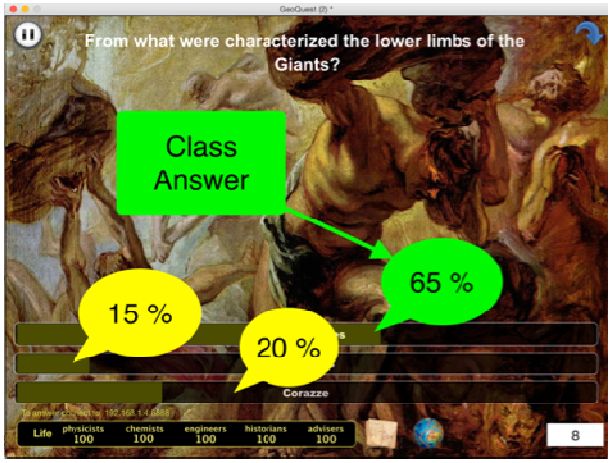

Fig. 3 The game system evaluates the answer given by the majority.

2. Methodology

Authors’ solution to realise a “Learning on Gaming” is GeoQuest Project.

GeoQuest is a Class Role-Playing Computer Game which goal is to teach Earth Science through interactive adventures lived by the class as a whole.

The plots of the adventures are designed for deeper learning of STEAM and SSH (Social Sciences & Humanities).

In role-playing games, players do not know where they are and they don’t know the map of the location where they virtually move. Everything is revealed as players proceed: different choices create a new original game experience. Through a path choice or as output of some questions, the players will change the personal experience.

The adventures are realised with EvoQuest, an innovative software which realise a Role-Play Engine (EvoRPGE) [19] to be held in the classroom. The software interface is visible to the entire group of

Fig. 4 Game interface is shown to entire group through Projector or WIB.

Fig. 5 Charon: his mythology is correlated to volcanism of Phlegrean Fields.

students (Fig. 4) through use of Projector or WIB (White Interactive Board) and the interaction between players and software is with their own smartphones, tablets or laptops [20].

In authors' game, the players-students of a class meet some mythological and historical figures along the way (Fig. 5). They tell their story introducing the player in an atmosphere of mystery and dramas [21].

"To accustom students to interactivity in which there are skills of a different kind, through an apparent simplicity of the game and autonomous reworking means that students get hard knowledge of the subjects studied." [22]

2.1 GeoQuest Features

- The adventure is driven by a speaking voice in about 30 different languages;
- Players initially choose a role and get or lose points depending on the role chosen;
- Players can change the adventure paths with different experiences any time;
- The interaction between players and the central computer is via their smartphones, tablets or laptops (Fig. 6) [20];
- Each player operates the gaming choices and answers questions that are submitted from your device: the game system calculates the answer given by the majority and proceeds according to this criterion; in case of parity, the choice is random;
- All paths are inclusive: every adventure has specific notebooks (a compensatory nature, Fig. 7) and multi-sensory stimuli (a dispensatory character);

Fig. 6 Interaction between players and the game is with their own smartphones, tablets, or laptops via a simple browser.

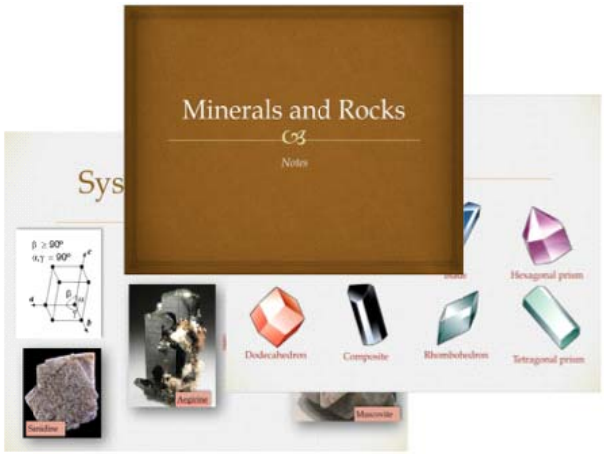

Fig. 7 Example of game notebooks.

- The adventure is enriched with recorded voices in case of literary texts;
- During the adventures, special sounds enhance the immersive effect (sound effects, original music, hiss, etc.);
- All the adventure are multidisciplinary and interdisciplinary;
- There are different adventures for different ages (childhood, primary, secondary level, upper secondary, university);
- There are trails for mixed ages, open groups, flipped classrooms, group of adults.

2.2 Adventures Already Realized

- GeoQuest: below the Phlegrean Fields, combining myth, history, earth science, volcanology, mineralogy, petrography, physics, chemistry [23];
- GeoQuest Vesuvius: at Mount Vesuvius across the millennia, combining archeology, volcanology, mineralogy, myth, history, Latin literature, Greek literature, Italian and foreign literature from the Middle Ages to contemporary art [22];
- SoilQuest: within the soil, including earth science, mineralogy, soil science, physics, chemistry, environmental protection [24].

2.3 Adventures in Preparation

- HawaiiQuest: includes volcanology, geodynamics, mineralogy, myth, history, geography, ethnography, literature, art;
- IcelandQuest: combines volcanology, geodynamics, mineralogy, Nordic mythology, history, geography, ethnography, literature, art, energy-saving, environmental protection;
- HumanQuest: inside the human body, which include biology, anatomy, genetics, physics, chemistry, health education;
- Giant’s causeway: includes myth, history, earth science, volcanology, mineralogy, petrography, physics, chemistry;
- EtnaQuest: combines myth, history, literature, earth science, volcanology, mineralogy, petrography, physics, chemistry;
- AustroQuest: Southern Hemisphere astronomy adventure, which includes myth, history, earth science, physics, chemistry, ethnography, cultural anthropology;
- CaveQuest: a travel inside the Pertosa Caves, which includes geology, medieval history, prehistoric, art and literature;
- CrimeQuest: at the crime scene, which includes biology, biotechnology, genetics, physics, chemistry, forensic chemistry;
- CodeQuest: coding adventures to test the code capacity of the students;
- SafetyQuest: adventure to learn safety and security procedures;
- HotelQuest: adventure for tourist operator and Hotel receptionist, to simulate hosts of several countries.

3. An Example of Adventure Path: GeoQuest

The adventure begins in a dark and quiet cave. There are no clues to understand where you are. The player/students are screened in a mystery story where they have to decide how to proceed. Players cross narrow tunnels and huge caverns, risk falling into the icy water, or to be involved in earthquakes. They hear the unearthly dripping water and the gentle whisperings of lost souls.

This adventure is under the Phlegrean Fields. The environment that gradually reveals itself is full of significant elements that can be traced back to a volcanic site, inserted in a complex geodynamic situation. It is located in the Mediterranean area, specifically in Campania, where there was compressive and divergent geological events, producing differentiated magmas and explosive volcanism.

Players can also discover where they are from the story of the characters on their path. They meet

Charon, the conductor of souls to the kingdom of dead, the Cumaean Sibyl, recounting his love affair with the god Apollo, and Flegra, whose legend was born in Thessaly and is implanted in Campania, naming the zone to Phlegrean Fields.

Lete, god of sleep embodied in the river that flows near Lake of Avernus, relives through the verses of Ovid’s Metamorphoses. There is also Pirithous, who dared to challenge Ade attempting to kidnap Persephone.

The mineralogical data (Fig. 8), such as sanidine, biotite, pyroxene and magnetite, allow players to go back to an intrusive weakly acidic rock: the syenite. Its presence in the lithospherebowels, along with earthquakes, allows players to trace environment typical of Campania volcanism. An intrusive body such as the syenite provides a geodynamic origin by tectonic convergence.

The volcanic area of Phlegrean Fields is unique in the world and is beautifully described in the “Gigantomachy”, which tells the story of the terrible Giants who were defeated and buried under volcanoes; their attempts to free themselves would trigger the volcanic convulsions of the earth and they are the origin of earthquakes.

Going back to the surface, players can recognise the tuffs, which attest the contamination of ground water and magma, typical of monogenic eruptions of Phlegrean Fields.

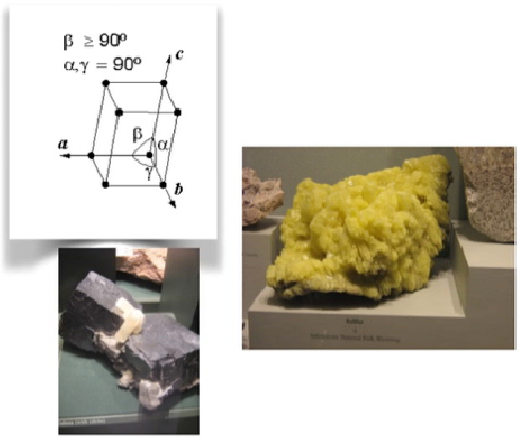

Fig. 8 Minerals and crystal lattices.

Finally, the players walk across some sulfur vapors which suggest that the group is coming under the Solfatara. They will have to connect the color of sulfur crystals to their temperature in order to find the right exit.

3.1 Scientific Questions

The questions of mineralogy (Fig. 9) are enriched with photos taken in the most important mineralogical museums in the world (Natural History Museum of New York, USA; the Smithsonian’s National Museum of Natural History of Washington, USA; Naturhistorisches Museum of Vienna, Austria; Museum of Natural History of Gèneve, Switzerland).

Next to the photo images of the crystal are shown the relative lattices, for a better classification. The questions are aimed to determine the mineralogical classification; furthermore, if the crystal is a silicate, they have also to determine mafic or felsic character, based on color and other features described in the query.

A good classification of minerals allows players to be able to recognise the mineralogical association and then go back to the rock they are going through.

The path is enriched with structural and textural features, so you can find the correspondence between rock and geodynamic environment. In this way, the resolution of questions brings the players to find the deep interconnections between mineralogy, petrology, volcanology and geology.

3.2 Humanistic Questions

The authors’ game aims to teach earth science through interdisciplinarity. The game creates strong interconnections between Earth Sciences and the humanities.

In the game, texts from Greek and Latin Classics are proposed; some of them are conveyed by the characters encountered along the way. There are also questions focused on these texts.

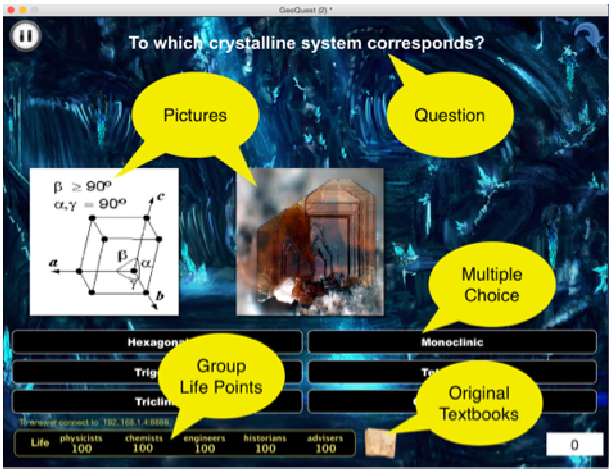

Fig. 9 Example of game interface. Students can appreciate perfectly the shape, the crystal habit, the color of the mineral.

The large variety of themes keeps the interest of the students and supports the game pace.

4. Results

The first test of prototype was performed in a high school in several classes testing different groups:

A. a homogeneous group of students, after the developing of corresponding educational module (mineralogy and volcanology): the game can be seen as a control test of understanding;

B. a homogeneous group of students, before the developing of corresponding educational module: the game is a “stimulus”;

C. a heterogeneous group of students, during an extracurricular workshop;

D. a reference group consisted of students of the same order, which attend traditional lessons on the same mineralogy and volcanology subjects without playing authors’ game.

The results of groups A and B, were excellent, in terms of learning, involvement and pleasure. Compared with group D, even students who normally were less concerned on the topic were fully involved.

The system allows students to participate all together to the games as an active group providing real-time feedbacks and evaluationspreserving entirely the educational value (Fig. 10).

Fig. 10 A classroom experience.

Science Research now is based on field expert interaction: the role-playing game categories reflect the necessary team to get their goal.

The game’s features are also ideal for a personalised teaching to be used as compensatory measures for a full inclusion of SEN students, saving the cooperative learning.

5. Discussion

Sociologists attribute to role play the triple value of:

1. storytelling games (expression, communication, creativity);
2. cooperative games (teamwork, tolerance, mutual understanding, listening);
3. flexible games (different ages, different interests).

5.1 CLIL compliance

CLIL is an immersive learning approach that aims to build language and communication skills in a foreign language along with the development and acquisition of topic knowledge.

The best environment to learning both language and non-linguistic contents is certainly the teaching laboratory through a cooperative learning, since it will involve the “construction” of knowledge and not only its transmission.

In authors’ games, it can be easily changed the game language compliance to CLIL

recommendations.

5.2 Special Education Needs

- Different student levels: the path of play can be followed by students with different levels of knowledge and skills using the note books as compensatory measures;
- Visual impairment: a talking voice guides the players all over the game;
- Audio impairment: iconographic contributions, text on the question buttons and on speaking as subtitles.

All are ideal for a personalised didactic, even in the case of Special Education Needs.

"Technology enhanced learning environments have great potential to provide equality on diffusion of knowledge, sharing resources, social involvement and participation of the disabled learners within the society. Reaching out learning facilities with the support of technology, learners with special needs can enrich their potential for their learning experience anytime and anywhere." [25]

GeoQuest design is a particular type of seriuos games.

"Characteristics of serious games include: a storyline (or some story-based elements), types of goals (short-term, medium-term or long-term), types of rewards (such as feedback on response accuracy, rewards for correct responses or cumulative point systems across trials), increasing levels of difficulty over time (or some potential difficulty increases), and individualised learning (including individualized starting points, some provisions of choice or presence of clinician/teacher facilitators)." [26]

"Serious games are designed to foster learning of targeted skills that are particularly difficult and not rewarding for participants. A central goal of serious games is that the learning in the game generalises to improve real life outcomes. Serious games accomplish these goals, in part, by employing principles of video game design to create enjoyable and immersive environments but, importantly, they are also are grounded in theories of learning and development." [27]

GeoQuest design is also a nice example of Digital Storytelling.

"The story-driven goals (especially when designed to be meaningful to the individual playing the game) can increase affective engagement and are thus critical for providing a rationale for driving game play." [28]

"A narrative storyline that elucidates the motivations of why characters in the game might be angry (and what behaviours should follow the correct identifying the expression) is essential for linking knowledge of an emotional expression to actionable social and communicative behaviour. As noted, players can be motivated by their own curiosity when the game's storyline provides mysteries that allow for exploration." [29]

5.3 Skills Assessment

The educational game mobilises demanding learning situations for the student, which contain a challenging dimension in relation to his knowledge and experience, and which solicit the activation of his resources and lend themselves to different ways of solution.

This form of learning is based on the definition of a complex thought, not purely reproductive or mechanical, where the path of action is not fully specified a priori, since it involves self-regulating processes of thinking [30].

The system that controls GeoQuest can recognise answers of each student, therefore can be used for the skills assessment: the score validation is guaranteed by learning "in situation", typical of gaming.

6. Conclusion

Role-playing helps students to reach their goals easily through cooperation; unlike other games or virtual paths, which are carried out individually by each student/player. With the authors' game, class

group must cooperate since each one is assigned a “role” regarding the various different branches of science: in this way, students may also understand the importance of working together to reach a complex goal.

Students are engaged by initial mystery in a role-playing game, they have to explore the virtual environment to go on, stimulating independent research on the context studied.

The authors’ game is naturally IBSE (Inquiry Based Science Education), the pedagogical approach promoted by the European Commission [6] based on the investigation, which stimulates the formulation of questions and actions to solve problems and understand phenomena.

GeoQuest project is a perfect kind of “Learning on Gaming”: students can learn while gaming and get ‘traditional’ skills such as communication in one’s mother tongue, foreign languages, digital skills, literacy and basic skills in sciences, as well as horizontal skills such as learning to learn, social and civic responsibility, initiative and entrepreneurship, cultural awareness and creativity.

References

[1] Avvisati, F., Hennessy, S., Kozma, R. B., and Vincent-Lancrin, S. 2013. “Review of the Italian Strategy for Digital Schools.” *OECD Education Working Papers 90*: 102, OECD Publishing.

[2] Mori, L. 2012. “Simulation and Serious Games as Education Tools.” *Meta: Research in Hermeneutics, Phenomenology and Practical Philosophy* 4 (1): 56-72.

[3] Gardner, H. 1983. *Frames of Mind: The Theory of Multiple Intelligences*. New York: Basic Books.

[4] Doran, R., Almeida, M., Costa, A., Cabral. L., and Furtado, P. 2016. “Inspiring Teachers for Inspired Children.” *Inspiring Science Education Conference Proceedings*. Pallini, Greece.

[5] Sjøberg, S., and Schreiner, C. 2010. “The ROSE Project: An Overview and Key Findings.” *Oslo: University of Oslo:* 1-31.

[6] Rocard,, M., Csermely, P., Jorde, D., Lenzen, D., Walberg-Henriksson, E., and Hemmo, V. 2006. *Science Education NOW: A New Pedagogy for the Future of Europe.* Tech. Rep. European Commission.

[7] Osborne, J., and Dillon, J. 2008. *Science Education in Europe: Critical Reflections.* Vol. 13. London: The Nuffield Foundation.

[8] Valentini, C. 2009. “Gaming to Learn to Learn.” Accessed October 4, 2016. http://www.pavonerisorse.it/meta/gioco/gioco2.htm.

[9] Spagnolo, F. 2002. “History of Mathematics, Research in Teaching and Mathematics Teaching.” *Mathematics and Its Didactics* 1: 78-95.

[10] Montanari, F. 1998. “High School and Group.” *Reform and Teaching* 2 (2).

[11] Bisanti, M., Ligabue, A., and PlayRes, A. 2015. “The Role Play as a Learning Tool.” *Association PlayRes www.playres.it, Modena.*

[12] Greenfield, P. M., and Carbone, M. C. 1985. *Mind and Media. The Effects of Television, Computers and Video Games on Children.* Armando.

[13] Tiemann, R., Annagar, A., and Langheinrich, J. 2016. “Illustrating Problem Solving Skills in ISE.” *Inspiring Science Education Conference Proceedings.* Pallini, Greece.

[14] Uttal, D. H., and Cohen, C. A. 2012. “4 Spatial Thinking and STEM Education: When, Why and How?” *Psycology of Learning and Motivation-Advances in Research and Theory* 57: 147.

[15] Goodchild, M. F., and Janelle, D. G. 2010. “Toward Critical Spatial Thinking in the Social Sciences and Humanities.” *GeoJournal* 75 (1): 3-13.

[16] Baglatzi, A., Darra, A., Kavouras, M., Kokla, M., and Tomai, E. 2015. “The Role of Spatial Thinking in Supporting Crosscutting Concepts in Education.” In *Proceedings of the GEOTHNK International Closing Conference; Nov 7; Greece*, 17-28.

[17] Trinchero R. 2014. “Computerized Game for Cognitive Enhancement and the Promotion of School Success. An Approach Evidence Based.” *Form@ re* 14 (3): 7.

[18] Rugelj, J. 2016. “Serious Computer Games Design for Active Learning in Teacher Education.” *Serious Games, Interaction and Simulation*. Springer International Publishing, 94-102.

[19] Maraffi, S., and Sacerdoti, F. M. 2015. “EVO-RPGE an Interactive Role Playing Engine.” *Granada (Spain) ICEILT International Congress on Education, Innovation and Learning Technologies*, 148.

[20] Sacerdoti, F. M. 2013. “Autonomous System to Use Web Educational Contents in a Classroom.” *Patent Pending NA2013A000048*.

[21] Maraffi, S., and Scamardella, A. 2016. “GeoQuest VESUVIUS an Interdisciplinary Role Playing Game.” *In Conference Preceeding. New Perspectives in Science Education, 342.* Florence, Italy.

[22] Maraffi, S., Sacerdoti, F. M., and Scamardella, A. 2016. “GeoQuest VESUVIUS a Class Role Playing Game.” In

Hawaii University International Conferences on Science, Technology & Engineering, Arts, Mathematics and Education (STEAM). Honolulu, Hawaii, USA, 10-2.

[23] Maraffi, S., Sacerdoti, F. M., and Scamardella, A. 2015. “GeoQuest an Interactive Role Playing Game.” In *EGU General Assembly Conference Abstracts* 17: 14720.

[24] Maraffi, S., Pennesi, D., Acqua, A., Stacchiotti, L., and Paris, E. 2016. “SoilQuest: An IBSE Approach with Computer Class Role Playing Game.” *International Journal of Research and Innovations in Earth Science* 3 (5): 88-91.

[25] Altınay, F., Cagiltay, K., Jemni, M., and Altınay, Z. 2016. “Guest Editorial: Technology Support for Fostering Life-Long Learning of Learners with Disabilities.” *Educational Technology & Society* 19 (1): 1-3.

[26] Whyte, E. M., Smyth, J. M., and Scherf, K. S. 2015. “Designing Serious Game Interventions for Individuals with Autism.” *Journal of Autism and Development Disorders* 45 (12): 3820-31.

[27] De Freitas, S. I. 2006. “Using Games and Simulations for Supporting Learning.” *Learning, Media and Technology* 31 (4): 343-58.

[28] Baranowski, T., Buday, R., Baranowski, J., and Thompson, D. T. 2008. “Playing for Real: Video Games and Stories for Health-related Behavior Change.” *American Journal of Preventative Medicine* 34 (1): 74-82.

[29] Garris, R., Ahlers, R., and Driskell, J. E. 2002. “Games, Motivation and Learning: A Research and Practice Model.” *Simulation & Gaming* 33 (4): 441-67.

[30] Maraffi, S., and Marinelli, A. 2016. “ValuQuest, a Role Playing Game for Skills Assessment.” *Hawaii University International Conferences on Science, Technology & Engineering, Arts, Mathematics and Education (STEAM). Honolulu, Hawaii, USA.*