

SoilQuest: an IBSE Approach with Computer Class Role Playing Game

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Abstract – SoilQuest is a class Role Playing Game to teach Earth Science in First Cycle of Education Schools.

The educational technology is based on the idea of using language which is closer to pupils to improve the teaching/learning process. The game seems to be a perfect vehicle for education, even more when cooperative, 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. The several roles allow everyone to enhance their own skills and are perfect for a full inclusion of Special Education Needs (SEN) students.

One of the authors has already realized two role playing computer games called GeoQuest [1] and GeoQuest Vesuvius [2] creating at the same time a Role Playing Engine [3] which involves all students to the game through their personal mobiles or tablets giving a total interaction of the whole class to the game. The outcome of the class experimentation were excellent, both for didactic and educational results obtained [3].

This article is focused on our new computer class role-playing game based on soil, and specific for children 9-14 aged.

Students are guided through a virtual journey from the city across agricultural fields to the woodland. In the role game progression pupils, guided by questions and simple experiments[4], learn the different crossed soils characteristics: urban soil, wood soil, agricultural intensive and organic farming soils. The features to be investigated are related to: the soil color, the pedogenetic structure and soil fauna [5].

Different channels of perception will be stimulated with those activities and will be used multiple communication codes. In order to educate young people on environmental issues it is necessary to encourage diverse styles of learning: cognitive, emotional and pragmatic one through the 3H-Head, Heart and Hands.

Keywords – Education Game, Role Play Game, Virtual Journey, 3H, Soil.

I. INTRODUCTION

The Computer Class Role Playing Game is a new technology designed for deeper learning of Earth Sciences, Physics, Chemistry, Environmental Sciences, improving the innovation and creative capacities of learners and supporting the new role of teacher as a coach of the learner, and it is based on new interfaces (the students use their own tablet or smartphone to interact with the game) and it is naturally a mixed reality learning environment, giving to the students the feel “to be IN the adventure environment” [1].

Teaching Earth Science in Italian schools is more challenging than teaching other science subjects because it

meets with little interest and is perceived as marginal compared with other school subjects: processes remain substantially abstract and perceived as unconnected with reality [6][7].

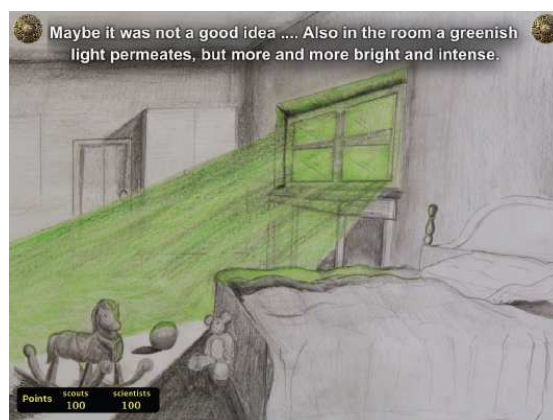


Fig. 1. Game images are made to keep the student in-situation

Priority given to initiatives that include a large diversity of practices in science teaching to respond to the diverse needs of children: problem based inquiry process; hands-on/minds-on activities; team-work; independent work on open-ended questions; trans-disciplinary activities; showing relevance of science content [8].

II. METHODOLOGY

Inquiry Based Science Education (IBSE) has proved its efficacy at both primary and secondary levels in increasing children’s and students’ interest and attainments levels while at the same time stimulating teacher motivation. IBSE is effective with all kinds of students from the weakest to the most able and is fully compatible with the ambition of excellence. Moreover IBSE is beneficial to promoting girls’ interest and participation in science activities. Finally, IBSE and traditional deductive approaches are not mutually exclusive and they should be combined in any science classroom to accommodate different mindsets and age-group preferences [8].

In obligatory school levels, like in the longlife learning, the game is an essential element and activity for the development of everybody’s personality, especially in the perspective of learning to learn (Key Skills).

Learning to learn is recognized as a meta-skill which evolves with the student and becomes the thread that guides him to a successful assumption of responsibility for its own learning process. The most effective mode of realization of metacognitive teaching, it seems to be the

self-regulating approach, in which students are helped in the process of recognition of the skills necessary for learning tasks and they are encouraged for the choice and for the most productive application of appropriate learning strategies [2].

Our goal is to create an innovative methodology [9] based on the game, that enhances the interdisciplinarity, the informations retrieving and their decoding, for all levels of school.

In the obligatory school levels, like in the longlife learning, the game is an essential element and activity for the development of everybody's personality, especially in the perspective of learning to learn (Key Skills) [2].

A. The Game

The participants live a graphic adventure in which they face several choices of different paths with different opportunities. Furthermore, often the students must solve questions or quests to go on.

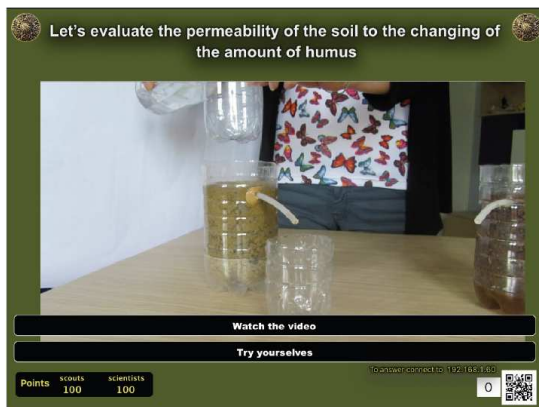


Fig. 2. It's possible to watch the videos or to do hands on activities

In role-playing games, players do not know where they are and 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 change the experience.

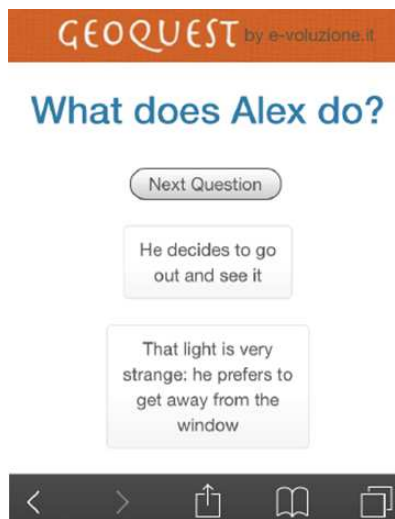


Fig. 3. Students can answer with their own devices

The students interact with the system using their own smart phones and tablets with a new technology [3] which collects the individual answers. (Fig.3)

At the same time the system calculates the overall response according to the criterion of the majority: the ultimate responsibility for the next game step is therefore collective and class dependent.

Given the age range of pupils, whose capacity for abstraction is not yet fully developed, the practical proposals in video activities facilitate learning through sensorial experience.

The added value of this game is in fact represented by such activities that are easily replicable in class with poor materials .

Experiences have as their ultimate goal to achieve predetermined educational goals: to understand that soil is a limited resource and as such it must be preserved.

Experiments relate to permeability, layering and plasticity of the soil and the presence of air in its interior .

Through questions of the game differences between urban soil, wood soil, agricultural intensive and organic farming soils are emphasized.

III. RESULTS

A first very interesting result is highlighted by pie graphic representation of global average (Fig.4) about didactic methodologies.

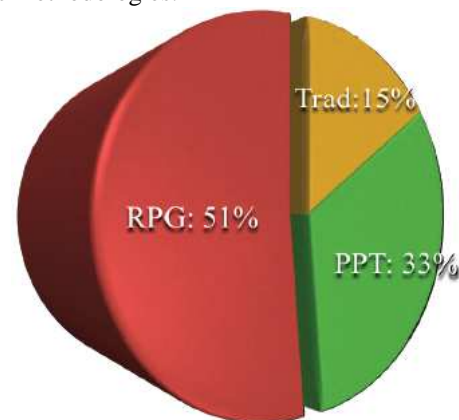


Fig. 4. RPG exceed 50% of the satisfaction.

We considered in the evaluation participation, comprehension, ability to convey complex topics, ability foreign language learning.

In yellow we have traditional lessons evaluation, in green PowerPoint (PPT) lessons evaluation and in red Role Playing Game (RPG) evaluation. It is clear that lessons PPT supported are easier to follow by students, but remain anyway frontal lessons.

Instead RPG, the only interactive activity, exceed 50% of the satisfaction.

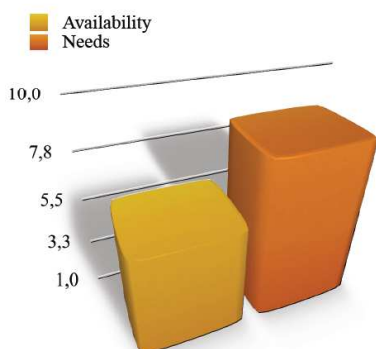


Fig. 5. The availability of suitable teaching material, in yellow, is inadequate compared to teachers needs, in orange

Teachers are also conscious that the actual availability of structured teaching materials is poor and unsatisfactory (Fig.5).

Our work experience gets everywhere excellent feedbacks by teachers, in terms of efficacy of this new teaching methodology and of results achieving (Fig.6) [10].



Fig. 6. The efficacy of this new teaching methodology and the results achieving are been excellent

The effectiveness of the traditional frontal lesson is very low. Students are digital natives and they are comfortable with visual and synthetic transmission codes. However pure transmission of information through the images of a PowerPoint lesson remains a top-down approach. Today teachers need to have available a bottom-up materials, which give a more than satisfactory outcomes.

IV. DISCUSSION

The game meant as a teaching tool is a situation-learning mode that requires the student to mobilise its resources to find solutions that require skills rather than simple knowledge [10].

The use of an educational game can achieve several significant results:

- students are asked to recover their previous knowledge;
- encouragement of the use of complex cognitive processes (reasoning, transfer, critical thinking, creative thinking) [11];
- learning into meaningful and real contexts;
- stimulation of students' interest;
- enhancement of students' abilities;
- facilitation of learning;

- increase in the teaching of the last generation ICT;
- teaching support [1], through the use of materials that meet all of the latest instances of standards and methodologies (as delineated in Europe 2020: A European strategy for smart, sustainable and inclusive growth);
- teaching support with Content and Language Integrated Learning (CLIL) [1], with the ability to have all the materials in any language;
- spreading a truly interdisciplinary training culture, exceeding the dichotomy science / humanities;
- personalised teaching support, also in case of Special Educational Needs.

V. CONCLUSION

Experimental results were outstanding and prove the achievement of these goals [10]:

- New games development and new teaching methods
- Earth Sciences strengthening into science education.
- Teaching of the last generation ICT increase.

Support to the teacher, through the use of teaching materials updated to the latest standards and methodologies.

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REFERENCES

- [1] Maraffi S., "GeoQuest Project: Computer Class Role Playing Games, an innovative teaching methodology based on interdisciplinarity and ICT to foster STEAM education". *In printing*, 2016
- [2] Maraffi S., Sacerdoti F.M. & Scamardella A. "GeoQuest VESUVIUS a Class Role Playing Game". *Hawaii University International Conferences on Science, Technology & Engineering, Arts, Mathematics and Education (STEAM)*, Honolulu, Hawaii, USA, 2016.
- [3] Maraffi S. & Sacerdoti F.M., "EVO-RPGE an Interactive Role Playing engine". *ICEILT International Congress on Education, Innovation and Learning Technologies, Granada (Spain)*. ISBN: 978-84-944311-3-5, Edited by: Science KNOW Conferences C.B., 148, 2015.
- [4] www.earthlearningidea.com
- [5] Pennesi D. Acqua A., Stacchiotti L. & Paris E. 2016. "Why Are Soils Different?: An IBSE Approach". *International Conference New Perspectives in Science Education Conference Proceedings*, 305-310, 2016.
- [6] Venturini, C. "Earth science in high school: arousing enthusiasm students is really a 'hopeless undertaking?'" *New Trends in Science and Technology Education*. Selected paper; CLUEB. 2009
- [7] Scapellato B. "A pilot training course to take IBSE approach in Earth Science teaching in Italian secondary schools: analysis of teachers' perceptions". - *PhD Thesis, University of Camerino*, 2014.
- [8] Rocard M. et al. Rocard Commission report "Science Education Now: A Renewed Pedagogy for the future of Europe", 2007
- [9] Maraffi S. et al. "GeoQuest, an Interactive Role Playing game", *EGU European Geosciences Union General Assembly Wien (Austria)*, Poster Session EOS3. 2015

- [10] Maraffi S. & Sacerdoti F.M. "GeoQuest a Computer Classroom Role Playing Engine to teach Earth Science in an Interdisciplinary way" - *9th annual International Conference of Education, Research and Innovation, Seville (Spain)*, 2016.
- [11] Maraffi S., Marinelli A. "VALUQuest a Role Playing game for Skills Assessment", *Hawaii University International Conferences on Science, Technology & Engineering, Arts, Mathematics and Education (STEAM)*, Honolulu, Hawaii, USA, 2016

AUTHORS' PROFILES



Maraffi S. Master Degree in Geological Sciences with honors, confirmed teacher of Sciences by 1993, iPhD student on Science Education at the School of Science and Technology, Geology Division of the University of Camerino, Italy.

She worked on research on teaching and learning processes in the Earth Sciences education. In particular she is experiencing interdisciplinary and multilingual teaching of Earth Sciences with Computer Class Role Playing Games. She deals with STEAM Education in research and has published several articles in international journals.

Prof. Maraffi gained experience in the field of European Projects (as tutor and expert), in multimedia teaching, author of multimedia didactic works for the preparation of future teachers, project manager of scientific conferences, participated as a collaborator in the European Programme Erasmus plus.



Pennesi D. Born in Camerino - Italy on 29th April 1978. Degree in Natural Sciences with honors, confirmed Math and Science teacher since 2012, she is a PhD candidate at the School of Science and , Geology Division, University of Camerino, Italy.

She works on research in Teaching Earth Sciences Education. In particular in IBSE approach and she published some International Conference proceedings.

Prof. Pennesi experienced in summer camp for children, worked as University tutor and as educator in an environmental education center.

She organized the first geo-science Summer School for teachers at Camerino University, 2015, and she held a seminar at the second geo-science Summer School for teachers at Camerino University, 2016.

She held workshop for teachers about the Soil with IBSE approach, October 2015.

PhD candidate Pennesi participated in ESERA Conference in September 2015. She exhibited posters in International Educational Congress:

"EGU-GIFT" Wienn, April 2015 - "New Prospectives in Science Education" Florence, March 2016 - and "27 Encuentro de Didactica de las Ciencias Experimentales", Badajoz September 2016 .

1. Pennesi D., Acqua A., Stacchiotti L. & Paris E. 2016. Why Are Soils Different?: A lab with the IBSE approach



Acqua A. Born in Loreto on 10th April 1971. Degree in Natural Sciences, confirmed Math Sciences teacher since 2012, he is a PhD at the School of Science and Technology, Geology Division of University of Camerino, Italy.

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Prof. Acqua participated and organized Summer School for teachers Geo-Sciences I Edition in July 2015 at University of Camerino; he held a seminar for teachers Geosciences II Edition in July 2016 at University of Camerino.

He participated in ESERA conference in August 2015. He exhibited posters in international educational congress: "New perspective in Science Education" in Florence, March 2016, "27 Encuentro de didactica de las Ciencias Experimentales" Badajoz, September 2016 and he published related conference proceedings - "Studying the soil: from the school organic garden to the ibse activity in the classroom". Alessandro Acqua, Daniela Pennesi, Lucia Stacchiotti, Eleonora Paris.



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In 2002-2004 she worked with the role of tutor at University of Camerino. Her tasks were: organization of activities for the newly-registered, support the student for the facilitation of learning and study, finding teaching materials and support, teaching's monitoring and data collection.

She works on research on teaching and learning processes in the Earth Sciences education. Now she is planning lessons and activity using IBSE approach. She participated in Summer School for teachers "Geoscience at School- I Edition" in July 2015 at Camerino University, she organized Summer School "Geoscience at School- II Edition" during which she held a seminar. She participated in several International Congress about Education: "New perspective in Science Education", Florence 2016 and "27 Encuentros de didáctica de la Ciencia Experimentales", Badajoz 2016.

Prof. Stacchiotti gained experience in the field of teaching Environmental and Natural Science, Biology and Math especially with pupils with cognitive issues.