Training Teachers for the Knowledge Society: Social Media in Science Education

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Abstract

Internet and social media (SM) have revolutionized the way scientific information is disseminated within our society. Nowadays professional and/or social networks are increasingly used for learning and informal science education successfully supplements the formal one at all educational levels. Students become addicted to technology from an early age and consistently use SM for communication purposes and personal image. In this context, it is reasonable to assume that the use of Web 2.0 and SM can be successfully integrated in formal science education. This integration, however, depends mainly on how teachers design the learning activities using Web 2.0 and SM, on their digital skills and expertise, on their attitude towards using SM to communicate for personal and professional purposes and to obtain educational benefits. In this study we start from the premise that a positive attitude of future science teachers towards ICT integration and their willingness to use SM in their educational communication can be formed in the initial teacher training program, being a crucial factor for the effective use of such tools in education in the future. We detail two activities and analyze them from the SM and Web 2.0 integration perspectives. The first activity is an extracurricular one in which students had to create a digital story and present it to secondary school children in class. The second activity is a curricular one aimed to promote a project-based learning and based on making a comic about an optical phenomenon taught in secondary school. We present and discuss these activities to emphasize how the skills that target science teaching using ICT and SM can be developed.

1. ICT, open educational resources and SM in the Initial Science Teacher Education (ISTE)

The various types of ICT resources (information, learning and collaboration resources) (Cacheiro González, 2011) are present now more than ever in the scientific community and in education, a reality observed for research communities, schools, universities as well as for the pre and in service teacher training programs (Enochsson, & Rizza, 2009), (Eurydice, 2011).

. The necessity to develop and integrate new, robust technologies dedicated to enhance the learning and teaching quality is also mentioned in the Digital Agenda for Europe, H2020. This agenda includes current and future projects that are to be developed for this purpose (EU Digital Agenda, 2014). Strategies have been advanced at the European level to train teachers from all member countries to use ICT in class (EU Digital Agenda, 2013). The top priorities in terms of initial teacher education (ITE) include teamwork, ICT integration, formative assessment and the teaching of key competences (EU-report, 2013).

The studies that target the integration of ICT in ISTE can be divided in two categories: those that target the need and the benefits of integrating social media (SM) (Weller, 2013), (Zaidieh, 2012), (Kidd, 2013) and open educational resources (OER) (Atkins, Brown, & Hammond, 2007) in ITE and education, and those that substantiate the link between technological, pedagogical and content knowledge (e.g. TPACK) in pre/in service teacher training programs (Koehler, Mishra, 2009), (Chai, Koh, & Tsai, 2010). These studies emphasize the digital skills ought to be acquired by future teachers as well as their attitude towards using ICT in their everyday life for personal and

professional usage, the experience future teachers ought to gain in using SM in education through the ITE program, the attitude of teachers educators towards the use of ICT in their teaching, etc.

Furthermore, the scientific world is confronted with the new concept of open science, which implies a transformation of science through ICT tools, social networks and media to make research more open, collaborative, creative and closer to society (Digital science in Horizon 2020, EU report 2013 https://ec.europa.eu/digital-agenda/en/news/digital-science-horizon-2020). As such, science communication will have a deep impact on science education and future science teachers need in turn to be prepared to teach their students to communicate and collaborate using the newly available media.

In this paper, we start from the premise that a positive attitude towards integrating SM in education can be formed through an engaging training environment that supports the use of SM, web 2.0 applications and OER in teaching and learning. Furthermore, the acquisition of the necessary knowledge and skills during the initial teacher training program which derive from the pedagogical foundation suited to this style of teaching is of outmost importance. Finally, a deep understanding of SM and their role in learning and teaching with their possible impact on the quality of education is required. We discuss two activities that involved ICT and SM which were performed by physics students during the initial teacher training program. These activities aimed to develop the communication and collaboration skills of students in a virtual environment, as well as to enhance their ability to access, assess and organize information, structure or restructure knowledge and develop deep, creative and critical thinking capacity.

2. Communicating science

2.1. SM and web 2.0 in science communication

Nowadays, academics and researchers use professional networks to present their work, communicate and establish collaborations with other scientists around the world. They use SM to disseminate their research work and results to the large public.

Open science puts communication at the heart of scientific advancement. The number of scientific authors rises exponentially; the communication channels and the sources of information proliferate through web 2.0 applications such as blogs, forums and social networks, file sharing, wikis, etc. (Bultitude, 2011). Society becomes involved in creating science (Benneworth, 2009) and a collective memory/intelligence is generated by online collaborations (Burgelman, Osimo, & Bogdanowicz, 2010).

These important changes are mirrored in science education. The new communication media raise the significance of formal and non-formal education and reduce the delays in the availability of scientific knowledge between different groups and educational levels. The way science is presented and communicated as well as the associated meta-information (comments, likes on Facebook, messages on Twitter, etc.) shape the way scientific knowledge is perceived by the public (Dahlstrom, M. F., 2014). An increasing number of students express their opinions on current scientific issues and participate in online debates or scientific projects that are based on a collective intelligence (of non-specialists). Their opinions matter and they need to express their point of view in a strong and persuasive manner. Thus, adequate communication skills and the mastery of ICT resources are needed.

2.2. Creative communication methods in science education

Creativity is the foundation stone of progress and innovation in science. Creativity can be developed even throughout middle school through interdisciplinary activities that aim to enhance written and verbal communication in science. Fostering creativity is achieved through learning activities that develop in children divergent thinking, imagination, communication and collaboration skills. Examples of such activities include creative writing, creative analogies to understand phenomena and ideas, mystery solving or approaching the teaching and learning of science through art (Hadzigeorgiou, Fokialis, & Kabouropoulou, 2012).

The use of narrative explanation complementary to the descriptive one in science and science education leads to a deeper understanding of the phenomena and scientific concepts discussed (Avraamidou & Osborne, 2009). Combining narration with ICT and new communication media makes the scientific content even more attractive. In this paper, we focus on two such methods that combine creative expression with visual art: digital storytelling and digital comics.

Digital storytelling is a form of multimedia that combines narrative and digital content to create a story (Robin, 2008). These stories can be used both in the teaching-learning process in science (Martinelli & Zinicola, 2009) as well as in the ISTE programs (Sancar-Tokmak, Surmeli, & Ozgelen, 2014). The various types of stories that can be used in science education (such as storylines, historical presentations, evocative descriptions, small illustrations, confrontations, thematic narratives, dialogues or dramatizations generally created to raise questions or make a point (Robin, 2006) aim to enhance the teaching-learning process in science (Klassen, 2009). These stories represent a first step towards the development of the necessary skills needed to hold a scientific discourse and thus, have an important role for science communication in school.

Digital comics are another form of narration which is mainly based on the visual art that the authors use to transmit a certain message by arranging images and text in a suitable manner (Tatalovic, 2009). Comic strips and concept cartoons are two types of comics that can be employed in various teaching-learning-assessment activities during science classes to introduce/communicate scientific issues, identify preconceptions and assess what the pupils have learned throughout the academic year (Olson, 2008). Digital comics can be created and visualized using dedicated online applications (Dittmar, 2012). This type of narration can also be used in ISTE programs.

Digital stories and comics provide a viable alternative for science teachers to incorporate creativity and emotional content in their class and to develop in their students the skills needed in the 21st century. These methods can aid in humanizing science, making it more accessible to students regardless of their propensity towards science (especially in middle school).

3. Comics and digital storytelling in ISTE at the West University of Timișoara

3.1 Activities description

In the academic year 2014-2015, students from the Faculty of Physics within the West University of Timişoara, who were also enrolled in the initial teacher training program, participated in two projects that aimed to enhance their ability to communicate science in a creative way using freely available online resources and SM. Moreover, the goal of the projects was to induce in students a positive attitude towards using SM in science education. One project additionally aimed to raise the pupils' interest for science (for the middle school children that benefited from this project).

The first project developed in collaboration with the Timişoara branch of the Romanian Physics Society consisted of an extra-curricular activity which combined SM with web 2.0 applications for creating digital stories and focused on raising the pupils' awareness to the values promoted by science. Six volunteering third year physics students participated in this project. The volunteers prepared a set of digital stories that were inspired from the life of scientists, scientific discoveries, inventions or the history of science. The stories were presented in four middle schools from Timişoara and the surrounding area. These stories served as an incentive to initiate discussions between the students and the pupils on current scientific issues and the necessity for all graduates to achieve a scientific literacy in order to be competitive in today's society. Finally, pupils were invited to create their own stories and to participate in a digital story contest on "Light – phenomena, researchers, inventions, applications".

The second project involved all thirteen second year students from the Faculty of Physics within the West University of Timişoara, who were also enrolled in the initial teacher training program. The main activity within this project was to create a digital comic to present a concept from optics which is studied in middle school. The aim of this project was to enhance the creativity of students in presenting scientific information and to integrate web 2.0 applications in science

communication. The main interest revolved around the effect of using comics in teaching-learning-assessment activities. Students created comics which they then presented within a workshop dedicated to the use of new media in science education.

3.2 Results

The first project included six volunteering students, over one hundred middle school pupils from Timişoara and the surrounding area and fifteen teachers. The students developed eight digital stories on topics that comprised but were not limited to Archimedes principle, The story of Physics, The story of the Battery, Curiosities in the world of Physics, and others.

The second project included thirteen students and two teachers. The students developed eleven comics on topics such as optical phenomena (reflection and refraction, mirage, etc) and instruments (telescope).

We applied a self-evaluation questionnaire to all nineteen students involved in both projects in order to analyze the impact of these activities upon the students from the perspective of integrating SM, web 2.0 applications and ICT resources in ISTE. We were interested in identifying their attitude towards the use of SM and web 2.0 applications in science education and communication. The results obtained are presented in Table 1.

Table 1. Overview of the answers obtained after applying the self-evaluation questionnaire.

Answer / ***Statement*** I consider	Strongly Disagree (%)		Disagree (%)		Undecided (%)		Agree (%)		Strongly Agree (%)	
myself an experienced SM/web 2.0 user	-		-		5		37		58	
SM/web 2.0 useful in my personal life	-		-		-		26		74	
SM/web 2.0 useful in my professional activity	5		5		16		32		42	
that the use of SM/web 2.0 enhances professional and transversal skills necessary in the 21st century.	-		5		5		37		53	
I was/am confident	B*	A**	B	A	B	A	B	A	B	A
Communicating science trough SM/web 2.0	-	-	10	5	21	16	42	32	26	48
Collaborating with other students online	-	-	-	-	10	-	37	26	53	74
Using social networks and web 2.0 in science education	5	5	10	5	21	16	32	37	32	37
designing learning experiences using web 2.0 and media resources	5	5	16	10	21	21	32	32	26	32
motivating students to learn and communicate science trough SM/web 2.0	5	-	10	10	48	26	21	48	16	16

* B- before; **A - after

3.3. Discussions

The two projects aimed at developing the creativity of students in communicating scientific knowledge and integrating ICT resources and new available media for this purpose. The digital stories were created using online software such as Scratch, Prezi, MovieMaker or ProShow Gold. Additional to the stories, students also created short tutorials to help pupils create their own stories. The comics were created using dedicated online tools such as MakeBeliefsComix, Pixton or ToonDoo. 74% of the students considered that SM and web 2.0 applications are useful in their professional activity as well as in science education. 80% of the students considered that SM is important for the dissemination of scientific knowledge.

The projects helped students develop skills linked to accessing, assessing and organizing information, 95% of the students considering themselves to be experimented users of SM and web 2.0 applications. Additionally, these projects also targeted the professional and transversal skills necessary in the 21st century, mainly ICT skills but also learning skills (e.g. critical thinking in

choosing the appropriate application to develop the story/comic, creative thinking in portraying the contents of the story/comic, communication and collaboration with students and pupils) and respectively life skills (e.g. initiative and flexibility in the management of the activities, social skills as a result of the interaction between students, pupils and teachers). 90% of the students considered that SM and web 2.0 applications can enhance the professional and transversal skills necessary in the 21st century.

The stories that resulted from the first project were published on the Facebook page ***English plus Science*** and have been viewed or accessed by almost 700 people. This shows that the use of SM increased the visibility of the activity and the scientific content published impacted people that were not directly involved in the project. However, in both projects students preferred to organize and discuss their activities privately through emails and private Facebook messages. Only a few students shared their activities publicly through social media. This shows that students use SM primarily for personal purposes.

3.4 Students attitude toward using SM in science education

The data presented in Table 1 shows that the majority of students considered that SM and web 2.0 applications are useful in their professional activity and can enhance the professional and transversal skills necessary in the 21st century, thus having a positive attitude towards integrating these concepts in the training program and in science education in general. All students were confident in their ability to collaborate with other students in the online environments. The students' confidence in using SM and web 2.0 applications for science communication has increased through the projects: 80% of the students were confident after the projects compared to 68% before. A similar increase can be observed with respect to their confidence in using these tools for science education: 74% of the students were confident after the projects compared to 64% before.

A small increase in the students' confidence in designing learning experiences using web 2.0 and media resources can be observed: 64% after compared to 58% before. It is important to note that the students were reserved with respect to their ability to design compelling learning experiences in general as they did not yet have a relevant teaching experience. This can be a main reason for which the increase is so small in this case. Nevertheless, students were positive towards their ability to motivate pupils to learn and communicate science through SM and web 2.0 applications: 64% after the projects compared to 37% before. The limited teaching experience offers again a possible explanation for this result as students are not able to understand the intrinsic link between the pupils' motivation and authentic learning experiences. At the end of the projects, the students have gotten acquainted to the advantages and challenges that these new media pose and thus, the students who were undecided discovered that they are able to efficiently and effectively use these media: 26% of the students remained undecided after the projects compared to 48% before.

The results in Table 1 show that both projects reached their desired aim to increase the students' confidence in using SM and web 2.0 applications during their teaching and learning activities. The digital stories and comics created during these projects encouraged students to become more creative by trying to find the most approachable and easily comprehensible manner to present the scientific knowledge to the pupils and other students involved.

4. Conclusions

In this paper we have described two activities proposed to physics students during the pre-service science teacher training program. The activities were discussed from the perspective of integrating SM and web 2.0 applications in science education and in the ISTE. Our study shows that the two activities proposed have helped future science teachers increase their positive attitude towards these new media and gain confidence in their ability to use SM and web 2.0 applications in science education. Moreover, students became a little more confident in their capacity to design efficient learning activities using these media. Student teachers were positive that they could induce in their pupils the desire to learn and communicate science through SM and web 2.0 applications.

The activities also led to an increase in the students' creativity for scientific communication and enhanced their professional and transversal skills, which are necessary for the modern teacher who will activate in the knowledge-based society of the 21st century.

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