ASPECTS OF SERIOUS GAMES CURRICULUM INTEGRATION
- A TWO-FOLDED APPROACH -

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Abstract: Over the years, there have been numerous definitions of curriculum integration,where the curriculum is interwoven, connected, thematic, interdisciplinary multidisciplinary, correlated, linked and holistic.[1] Curriculum integration is based on both philosophy and practicality, drawing together knowledge, skills, attitudes and values from within or across subject areas to develop a more powerful understanding of key information. Curriculum integration is best done when components of the curriculum are connected and related in meaningful ways by both students and teachers.With the large uptake of SGs in education nowadays, one must consider SGs curriculum integration an issue at large since effectiveness of SGs use in training and education is getting more and more proponents. This paper looks at SGs curriculum integration issues from two perspectives- of the teacher connecting the content of the game and the learning outcomes into the whole educational context on the one hand, and of the researcher who sees the connection between the pedagogical state-of-art in SG and what realia can offer, on the other. By drawing on the experience of three teams of researchers and educators from Romania, Italy and Spain, based on common activities conducted by same partners and others in the Games and Learning Alliance (GaLA), an EC-funded Network of Excellence on SGs, joint perspectives over curriculum integration will be presented, with a view to sharing the experience in order to give guidelines for future extension of SGs into education and training, into well built curricula. The situations presented of SGs curriculum integration in the three different educational contexts are to showcase the framework for building a SGs curriculum design , the way SGs are effective for instruction, to present forms of integrating a SG into curriculum- how,where, how long, and showcase trans- and inter-disciplinarity within SG curriculum integration. A set of guidelines will be just a quick overview on what both practitioners, researchers and policy makers should consider for the near future in terms of SG currriculum integration, to enhance a lage-scale uptake of SGs into all levels of education and training, to better respond the 21st Century student and current social needs. All the statements and observations will be outspoken based on genuine results of the experiments and long-term practice of the authors in the realm of SGs integration into the training programs.

Keywords: serious games, curriculum integration, pedagogy, psychology

I. CURRICULUM INTEGRATION AS A NEW PEDAGOGICAL APPROACH

An educational system is never an island; on the contrary, it is a continuum throughout society, culture, politics, economics and everything a country builds its foundation on. An educational

system takes after the society is built within and for which it matters as present. Attracting individuals into coming to school especially if adult education is involved is a permanent challenge in nowadays environment mostly, where consumerism and popular culture are at their best. More than children, Higher Education and Further Education students have clearly-cut and timely-framed objectives. They are attracted to learning if they receive what they look for. Student books and teaching aids are less relevant unless highlighted and integrated into a carefully designed curriculum, with a valuable content, highly applicable in the contingent reality.

If some not very long time ago we only spoke of Net generation or the New Millennials, these young people whose fingers restlessly lay on the computer devices as naturally as possible, have grown up with computer games [2] and already turned to Higher Education while the older generations have done their best to adapt to high-standard requirements. Technological advances and serious games growing uptake as complementary teaching tools, their proven educational effectiveness in the training process have given rise to a re-think of the curriculum, of the learning and teaching paradigms.

1.1. SG integrated inside curricula

Using serious games in education in a perpetual need to meet the ever growing requirements of a multi-skilled individual in a multi-cultural, multi-faceted society and labour market, asks for new pedagogical approaches in game-enhanced- learning: the one we chose to tackle here, curriculum integration, is a teaching approach that enables students and teachers to identify and research problems and issues regardless of subject-area boundaries. "The very notion of 'integration' incorporates the idea of unity between forms of knowledge and the respective disciplines" [3]

Curriculum Integration basically covers real-life themes enabling students to be inquisitive and pragmatic for real-life issues, to collaborate with their peers and teachers as well, it unifies learning related to subject areas and has students use an inordinate number of skills to inquire on present-day, living concerns, on combined disciplines of study. Moreover, students benefit from wide knowledge-access by means of a relevant learning process, irrespective of their backgrounds and abilities.

Speaking about an interdisciplinary curriculum, Loepp [4] considered that this can be closely related to an integrated curriculum while educational researchers have found that an integrated curriculum can result in greater intellectual curiosity, improved attitude towards schooling, enhanced problem-solving skills, and higher achievement in college.[4]

Serious Games or game-based –learning in general is to curriculum integration what hand is to glove.

In this respect, by playing for example Quest Atlantis, participants in this game will develop problem-solving skills, decision making, affective skills, based on previous knowledge on biology, physics, art, social sciences (build shelters and foster creativity), environmental issues (considering scientists who analyze data about water quality to diagnose why fish are dying) , and demographics (students must choose between renovating a homeless shelter and building a park). Similarly, in Civilization III students have to integrate knowledge on history, economics, foreign policy and geography, as "a form of transgressive play" [5] .If designed correctly from the outset, a game can successfully integrate more subject-matters within one and the same context, in a trans-disciplinary way, thus touching upon both cognitive, affective, inter and intra-personal skills. The problem remains for the Commercial-off-the-shelf games which are already in use, for cost-effective reasons. Is this a matter of one size fits all? Can they be used in a game-based –learning- curriculum integration approach or are there alterations to be made in terms of pedagogical approach and tutor's role? Is this situation much different from the specially designed or modding games and how far do the implications go in relation to the educational environment and training effectiveness, the areas covered in subject-matters and variety of skills to be developed or reinforced ?

II. PRACTITIONERS' VIEWPOINT

There have been inordinate studies and practices on integrating games into curriculum, focusing on the appropriateness of such an initiative, both considering the origin of the game and the way they respond the envisaged learning objectives. Debates whether it is more effective to use COTS or build games from scratch either by students themselves or by teams of educators coordinated by game designers have filled pages of conference proceedings . While using commercial off-the-shelf games means taking up games the way they are, not necessarily developed as learning games, and using them in the classroom, one must consider that not all games are designed to teach, so the subject matter taught may hardly fiind common points to the game and the content could be far from complete in relation to the things taught[6]. Conversely, building games from scratch to answer certain curricula might again be unefficient as by the time a game is developed the curriculum might change and then once ready, we can just discover the game needs improvement again, to correspond to the newly designed requirements. Hence, a careful analysis to match the contents of the game to what has to be studied *can only be obtained in a careful analysis of the game prior to its implementation.*

2.1. Time management, pedagogies , uses and drawbacks

Time savings could be properly obtained if full guides of COTS games provided enough discrete information on the story, contents and possible learning objectives to be met in case of game use. However this is immense work and the dusk of it is just here- „serious games classification" repository and IMAGINE as well as ENGAGE provide basic descriptions of games , lacking though important descriptors like duration of game per sequence or per full learning process; if the game can be used as guided practice , as reinforcement or development of certain skills, if the game offers procedural or declarative knowledge, if it assessment or even if it can be used as transdiciplinary project-based evaluation, or mere incentive for theoretical approach on a single subject-matter. These, along with targeted audience and any pre-requisites for learning would help the decision maker- in the person of an educator, a policy maker or corporate training stakeholder- select the most appropriate games and implement them properly inside the curriculum.

Once these instruments are at hand, then the games integration process will follow the gauntlet track of any curriculum development model, course design-the course/ courses that will actually embed the game : aim, content, teaching and learning methods; there are yet cases where the game is embedded inside the syllabus only, depending on the game content and the possibilities the latter offers for exploitation. Moreover, theories of adult learning, student centred learning, active learning and self-directed learning may all influence the overall programme philosophy, similar to other elements -student needs such as the need for flexible learning programmes [7]. With respect to this situation the idea of breaking down the game –if need be-into sequences coresponding to the learning modules might be needed. Here the idea of lowering the entertainment aspect of a game may be brought into discussion.

Once the curriculum is built on the premises of an Outcomes Based Education (OBE) which states that "educators should think about the desirable outcomes of their programmes and state them in clear and precise terms"[8] they should then work backwards , to determine the appropriate learning experiences which will lead to the stated outcomes. By using an outcome approach, educators are forced to give primacy to what learners will do and to organise their curricula accordingly-is also what Prideaux considers.

Similarly, „a balance between the needs of the curriculum and the structure of the game must be achieved to avoid either compromising the learning outcomes or forcing a game to work in a way for which it is not suited" [6]

The way the game is then incorporated into the lesson itslef once projected into the syllabus is just the educator's say. The way he makes students feel responsible for going through the game as a continuum to the real life situation or sometimes as a pre-requisite for real-life –like activities within the learning process is only given by the methodologies he uses. Differences must be made here though among the K-12, HE and adult education pedagogies to maximise the use of the game to answer the vast array of students'needs, interests and style.

III. GAMES SEEN AS INTEGRATED CURRICULUM

The introduction of games in school curricula represents a key novelty for most EU countries .[9] Things differ in approaches where COTS or games designed from scratch are used. Thus, in case of games developed from scratch accurate design and careful planning are required, together with the adoption of new educational approaches[10].

3.1. Researcher's point of view

To later introduce them within the educational process, pilot experiments in the field are often carried out by composite teams where researchers (e.g.-researchers in Educational Technology and Educational Psychology) join and assist school teachers with both the aim of sustaining the experiments from a theoretical point of view and of acquiring data from the experience to better tune future interventions, related models and methods. The type and level of the actual collaboration between the research world and the school world varies a lot. In most situations, researchers perform both the role of devising and designing the educational actions to be carried out; they then inform and appropriately train teachers; teachers, on the other hand, are often the only ones commissioned to conduct the school experiment and to gather sensible data (via questionnaires that researchers have provided); at a later (often at the last) stage of the experiment researchers study and analyze the available results, perform the final evaluation of the experiment, draw the related theoretical and practical conclusions and publish the sensible outcomes.

Conversely, a different approach to collaboration between researchers and teachers is also possible and, in our opinion, can offer significant added value to reaching the entailed educational objectives (for schools) and the effectiveness and repeatability of the conducted experiments (for research institutions).

This triggers a more direct and mutual collaboration of researchers and teachers in all the four basic stages of a field experiment (Fig 1):
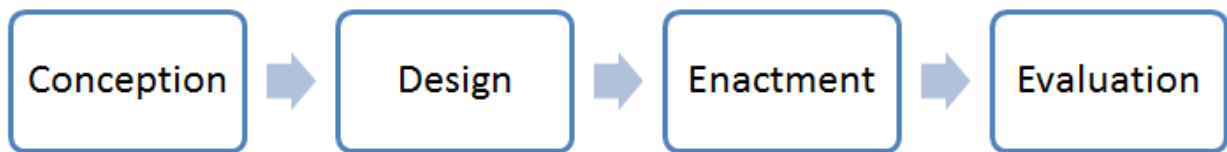
Figure 1. Phases of a game-based learning field experiment

This more "close and inclusive" collaborative approach between researchers and teachers was adopted by ITD-CNR in Italy while carrying out a pilot game-based experiment [11]; [12] in primary schools aimed at supporting and triggering young students' cognitive abilities by means of games deeply requiring the enactment of reasoning and logical skills.
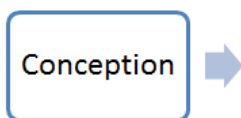

The idea itself of conducting this type of experiment actually originated from the dialogue between teachers and researchers in Educational Technology: the formers asked for some kind of ICT-enhanced tool able to sustain the children's reasoning abilities and the latter, based on previous research projects on the use of COTS games, imagined that such games could profitably be used for the intended scope. Common reflections of the two types of actors led to deciding which type of games were more appropriate: teachers, for instance, pointed out that games presenting no interference with other curricular abilities (e.g. arithmetic) would represent a better solution in order to help children concentrating on the reasoning tasks; researchers, on the other side, individuated the most appropriate tools based on their specific knowledge of software dynamics, software interface and game mechanics. Hence, following some teachers' observations, experts in the special needs education were included in the research team to better understand and address encountered needs and specific problems.

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Design

The contribution of teachers was also very important during the phase of designing the overall educational intervention, normally demanded only to researchers. As a matter of fact teachers have a more precise idea and in-depth knowledge of the peculiarities present in each class main characteristics and for each student; in particular, they also know the specific setting where the experiment will take place and the time that can be allocated to it. In the case at hand, teachers gave a sensible contribution to the planning of the activities both as to the general contextual aspects and also to those related to contents and possible personalization of the educational paths.

Enactment

The enactment phase, the one where children played the games, fully demanded both teachers and researchers to play a significant role: to follow the students during the gaming sessions (Fig.2), together with the teachers and the special needs educators: this allowed a multifaceted monitoring of the situation, revising the fine tuning, amending and improving the monitoring and evaluation sheets that had been "ad hoc" produced to allow data retrieval and analysis.
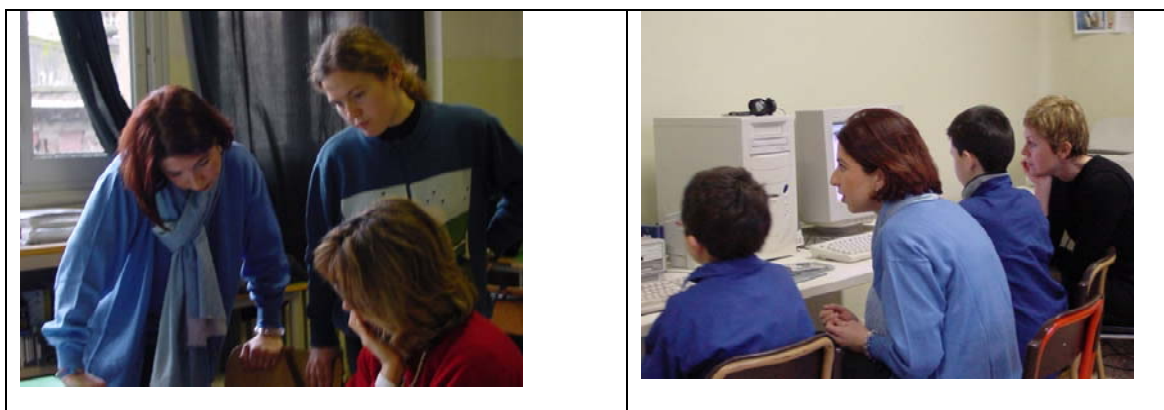
Figure 2. Aspects of the joint work teachers-researchers during experiments:sharing decisions and monitoring students

Evaluation

The genuinely common work carried out in the previous phases of the project by the full crew had a particularly important impact on the evaluation phase. Although in this phase researchers(Educational Technologists and psychologists) were in charge of elaborating data and carrying out the statistical data analysis, the overall evaluation of available data highly benefitted from the contribution of all the team members. The gained insight in the students' learning process would not have been so in-depth and so effective without the single contribution of each team member. Each of them could give his own contribution from his specific stand point but having personally participated in all the intermediate steps of the learning process, he/she was able to frame it in the general context of the overall experiment, thus coming to consistent and homogeneous conclusions with the others.

IV. POINTS TO CONSIDER WITHIN CURRICULUM INTEGRATION

As it was showcased in the previous sections, serious games can complement the standard rigid curriculum of schools, providing transversal learning activities as well. Unlike the already

mentioned situation where games that had no interference with other curricular activities were used, the basic idea would be to complement the classes with special sessions in which the students play serious games and reflect upon their play, linking their different in-game activities with different areas of the curriculum.

However, in spite of the important effect achieved by initiatives such as the one described in the previous section, the adoption of serious games in general education remains slow and elusive. To begin with, there are social, cultural and technical barriers that hinder real application of videogames in schools. For each successful case study, there are dozens of failed attempts to convince schools to explore serious games-based learning approaches. In this section we summarize some of the barriers and challenges of bringing games into the educational process in general, and how a curriculum integration approach could overcome them.

4.1. Bringing a game into the classroom: barriers and challenges

One of the main battlefronts when bringing a game into a school is the much degraded social perception of videogames. Media coverage tends to focus exclusively on controversial games, and we if were to study the medium just through its coverage on TV, we would deduce that all games are extremely violent, that they all purport explicit pornography and that only lonely male kids play them[13]. In this context, it is normal that parents and teachers display a great concern when the idea of introducing games into the classroom is presented.

In addition, parents legitimately argue that using games in class as part of the curriculum, may undermine their ongoing efforts to control the time their children spend playing games at home.

Moreover, since games are an advanced form of technology, they will undergo the gauntlet any innovation goes through: Teachers tend to resist innovation, especially when such innovation may be a drawback against their more tech-savvy students. Even supposing teachers would accept that and turn themselves into guides (rather than oracles), the availability of the proper technologies in many schools is scarce, giving raise to hindrance of the process as well.

In addition, the syllabus is tight as it is, and there is little time for any kind of extraordinary activities. In this respect, educational authorities in many countries have made an effort to provide public schools with adequate IT infrastructure to introduce a more relaxed and effective curriculum, yet school staff still lacks proper training to use them.

Finally, even students have been found to reject game-based learning approaches, rapidly identifying them as requiring more time and effort and preferring minimal effort approaches .[13]

4.2. Bringing the game out of the classroom

All the barriers and resistances presented by schools end up discouraging further growth and research in this area, and it seems obvious that schools are not prepared to embrace game-based learning as part of their curricular activities. [14] discuss the notion that schools entrenched in fixed methodologies cannot take big steps forward. Drawing from experiences in other industries, they suggest that advances in education should be disruptive, targeting niche markets first and then growing from there.

Their suggestion focuses on the use of student-centered online education systems that cater to the needs of each individual student, as a means to customize the learning experiences beyond the ability of formal schooling. From their perspective, as these customized learning experiences grow, they will eventually gather enough momentum to compete with the traditional school model, or even displace it entirely.

This very same idea has been always at the core of our research with educational games. We believe that game-based learning can thrive in the more open-ended and innovative e-learning arena, and eventually use that as a vehicle to enter the schools [15], and this is already happening. Higher education institutions are massively embracing blended-learning models, in which traditional face-to-face lectures are complemented (rather than substituted) with e-learning technologies (the so called, *learning management systems*). Using these systems as the infrastructure to deploy educational games allows their employment today as a complement in higher education settings and tomorrow, hopefully, in all kinds of educational settings.

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[13] This contrasts with the data gathered by the Entertainment Software Association, which claims that the average age of videogame players is 34 and that 43% of them are female.

4.3. **Blended curriculum integration**

In this view, it would be possible to explore new educational models that attempt to complement the traditional curriculum with integrating activities, rather than overhauling the existing curriculum to make it integrating. The key idea would be that students can play at home, on their own computers or gaming devices, in direct connection with the school's online learning management system.

This connection would allow the integration of game outcomes with the other curricular activities' outcomes and assignments, while the learning management system (LMS) would connect the game sessions at home to the reflection sessions in school.

Hence, the games can act as transversal curriculum integration activities, while the teachers act as facilitators of the process by connecting those activities with the regular curriculum: students would play at home and then participate in debriefing sessions at school, facilitated by the teachers. These debriefing sessions not only relate the game to the content, but also enhance the reflection about the play, as important as play itself [16]

Yet, in order to facilitate this debriefing process, the facilitators need insight into the students played the game, along with the certainty of having done that. This requires having games that can track the gameplay session and create feedback reports used to guide those debriefing sessions.

From this perspective we created eAdventure[14,] as a tool to facilitate the creation of games as a complement to education in blended learning environments. eAdventure is an authoring platform for the creation of educational games that tries to overcome some of the challenges of educational gaming highlighted above. The games created with this editor can be run either as a stand-alone tool (allowing instructors or learners to execute educational games on their computer) or embedded in a web-based e-learning system.

The games include features to track the movements of the player, and it is possible to create assessment reports that summarize the most meaningful events from a learning perspective (as indicated by the instructor). These reports can take the form of a human-readable log or send data to be stored in the system. This is achieved using the communication APIs described in the SCORM framework or through one of the ad-hoc communication mechanisms supported by the platform [17]

V. CONCLUSIONS AND WAYS FORWARD

The joint work of teachers and researchers requires, as previously highlighted above, the capacity of selecting appropriate tools and resources in accordance with specific learning objectives and of devising appropriate and suitable educational methods. The educational effectiveness of games (as well as that of any other technological means) mainly depends on the choices made by those in charge of designing and setting up the activity : in order to take a significant step forward, the use of e-tools needs to be carefully planned and structured, and conceptually well integrated in mainstream activities , bearing in mind that e-tools (including digital games) do not make the difference per se, simply by being used; it is the concepts and ideas underpinning the learning activities that produce effective and significant changes on educational processes and the related pedagogical planning.

Thus, regarding the use of the integrating game activities outside the classroom as a complement to traditional education, the key challenge is the meaningful integration of it so that it is possible to connect the game activities with the different aspects of the traditional curriculum.

In this sense, we have suggested using an online learning management system to deploy the games so that students can play from home, at their own pace, on their own computers. In order to avoid this "playing at home" from becoming a barrier for the posterior reflection and debriefing sessions, it is necessary to produce games that provide insight into how the game was played by each student. Traditional learning management systems track when each student accesses each piece of content, but simply knowing that the student did open the game at home is not enough for preparing a

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[14] http://e-adventure.e-ucm.es

meaningful debriefing session. Games should include mechanisms to track the activity of each student *inside the game*, providing insight into where the students stumbled, found problems or tried different things. The eAdventure platform, as described in section 4.3, represents a first step towards meaningful integration, proposing a model in which the games report back to a central server using standard-compliant communication methods.

It is yet worth mentioning that while games will certainly not replace the teacher, as some fear, they can open the way to more creative approaches that could have a significant impact on teaching practices[18], by simply engaging transversal learning where more skills are challenged into project based-type of activities, fostering not only cogntive, but also motor and affective skills similarly, provided they are well chosen in accordance with the subject-matters they can refer to as a conntinuum, within the syllabus or –on a larger basis- within the curriculum.

Moreover, from the stakeholder's viewpoint, numerous education institutions, particularly universities and colleges, have identified the advanced distributed learning as the first priority of their development strategy. The importance and expansion of this kind of education has grown in the last years at a pace that shows the feasibility of the modern education system created in recent years [19] setting thus the proper environment for alternate means of instruction and teaching devices among which Serious Games are a distinctive category based on the inordinate challenges they bring and the novelty towards making learning and real-life application a continuum from which both students and instructors benefit, as well as labour market stakeholders to a final end.

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