Virtual Worlds for Serious Applications (VS-GAMES'12)

Paving the way to Game Based Learning: a question matrix for Teacher Reflection

Muriel Ney1*, Valérie Emin2, Jeffrey Earp3

1Laboratory of Informatics of Grenoble, CNRS, Grenoble, France
2S2HEP, Institut Français de l’Éducation, ENS-Lyon, Lyon, France
3Institute for Educational Technology, CNR, Genova, Italy

Abstract

We developed a conceptual tool intended to help teachers make a good start in using digital games in the classroom. The tool is a matrix of questions based on a literature search and an empirical study with teachers. Its primary aim is to foster self-reflection and communication with other practitioners or designers. It was produced in the context of the GEL Theme Team of the STELLAR European Network of Excellence.

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1. Introduction

Although much has been argued in favor of Game-Based Learning (GBL) in recent years, teachers still find it difficult to integrate this approach in their teaching practice [1]. In an attempt to address this matter, this paper proposes a structured question matrix designed to foster teacher reflection on key issues involved in integrating games into teaching practice, not only digital (educational) games but other game-like activities such as role-plays, simulations, etc. The matrix is work-in-progress and is presented here in its current state of development. The paper describes the method adopted for developing the matrix, starting from a literature review, and a subsequent empirical study conducted to validate its soundness.

The matrix mainly addresses teachers in formal learning settings. We envision at least two use cases for the matrix: (1) as a prompt for teachers’ self-reflection before or during the process of designing GBL scenarios (or situations), and (2) as a discussion starter and framework of reference on deployment issues for teachers, teacher communities, educational institutions or game developers. Largely designed for those who are new to GBL practices, the matrix poses a structured set of key questions to consider from the outset of the process. Fostering reflection can help teachers gain awareness of the pedagogical rationale underpinning their practice [2] and the potential complexities involved.
The recognized value of such support has seen development of other practitioner-oriented tools like handbooks and guidelines, though these are rarely integrated with worked examples [3]. Examples include European project reports from ProActive [1] and Schoolnet [4, 5], as well as in FutureLab reports from the UK [6, 3]. The ProActive guide for designing GBL scenarios covers what and how the teacher wants to teach, through to detailed description of the game and proposed activities. The Schoolnet Game in School handbook [4] addresses the motives for adoption, game choice, and conducting game sessions. The FutureLab guides [6, 3] help teachers to adopt commercial off-the-shelf games and serious games.

The question matrix described here draws on literature analysis to identify a set of pertinent questions for teachers to consider in preparation for adopting GBL. Those new to GBL face strong challenges including:

- **Practicability**: finding time to design and run game activities, locating information and support, accounting for constraints (ICT availability, game interoperability, cost, etc.) and so on;
- **Adaptability**: choosing and using existing games, using specific game segments, adapting activities to the student population (age, level, etc.), to particular learning objectives and contextual constraints;
- **Pedagogical issues**: balancing play and learning effectively, adapting a game-based approach to curriculum areas, addressing negative side effects, managing classroom dynamics and learner behaviour.

By asking themselves fundamental questions at the very outset, practitioners can begin to address these matters and gain a clear understanding of their intentions and how these are to be realised [7]: why and how to teach with games, what type of games, what competencies students will develop, how to assess learning. These questions and the issues they raise are discussed in more detail later in the paper.

The work reported here was carried out as part of GEL (Game Enhanced Learning), a Theme Team financed from April 2011 to April 2012 by the STELLAR Network of Excellence (NoE)1. Theme Teams are clusters of European researchers who investigate emerging issues in Technology Enhanced Learning. In exploring the educational potential of games, GEL sought to provide fresh insights and support for game design and game deployment [8]. GEL brought together members of STELLAR and GaLA, a European NoE on Serious Games.

### 2. Method for designing and validating the matrix

The first step in producing the question matrix was a literature search to ensure suitable scope and focus. Subsequently an empirical study was conducted with teachers to gauge (a) the matrix’s usefulness for practitioners new to GBL and (b) its soundness when set against the experience of those who had already used games in class.

#### 2.1. Design process

The work devoted to development of the matrix draws on four lines of research: (i) motivation at school (ii) pedagogical scenario design (iii) game features and mechanisms, and (iv) recommendations for teachers who want to use games. The first two themes are not as games-specific as the second two.

Enhancement of learner motivation and engagement is often advocated as the prime added value of GBL and hence central to practitioners’ core motivation for adopting this approach. The literature review for the matrix examined seminal work by the likes of Viau [9], Mariais et al. [10], Caillois [11], Garris et al. [12] as well as other sources [7, 13].

To frame the actual questions in this first matrix section, we mostly drew on teachers’ surveys, e.g. [4, 5]. Game selection issues are addressed in many reports [7]; the Futurelab literature review [3] lists aspects like

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1 [www.stellarnet.eu/instruments/theme_teams/](http://www.stellarnet.eu/instruments/theme_teams/)
To address pedagogical issues, we referred to the literature on pedagogical scenario design. Here we need to distinguish between “pedagogical scenario” and “game scenario”. The former is a proposed educational intervention comprising a set of events aimed at supporting the acquisition of skills and/or knowledge. It specifies activities, actors, roles, orchestration, environment (locations, resources, tools and services) [2] and, in the case of GBL, game characteristics. In the context of GBL it is also referred to as a meta-game that surrounds the game per se [14]. Conversely, the game or narrative scenario is the story participants are immersed in while playing the game; it is therefore restricted to (interaction with) the digital game. In the matrix, we used the ISiS model (Intentions, Strategies, and interactional Situations) [15]; this is an intention-oriented conceptual model co-developed with teacher-designers that is intended to structure and support practitioners in the design of pedagogical scenarios. By eliciting intentions, strategies and interactional situations, the ISiS framework fosters sharing and reuse of practices among designers through establishment of shared understanding, which is also a goal of our matrix for teachers. To specify strategies, we used the work done within the GEL Theme Team [16] on pedagogical paradigms and how these are translated when using games. To specify the activity phases, we suggest a briefing, gaming, debriefing and integration structure [18]. A pedagogical scenario also specifies the educator’s roles, which often shift in GBL [18] and call on the teacher to act as tutor/facilitator and also as player, pursuing curricula aims and game scenario goals at the same time [7].

Finally, under “What do I need in practice?” we compiled a list of practical questions [1], [4] like cost, time, game progress, etc. The case studies in [6] revealed a number of issues like technical considerations, institutional factors and professional factors. These include the fact that teachers may work in teams, with other teachers, but also with learners and/or designers [5].

2.2. Matrix validation process

The method adopted to verify the scope, comprehensiveness and usefulness of the matrix was to conduct a two-phase validation process with target users. For this purpose sample groups of seven teachers were selected from a larger group of practitioners who had agreed to integrate games into their teaching in 2011/2012. Of the seven, one was quite expert, with long-standing games experience. Their domains were technologies, engineering sciences, biology, history and geography, and technology in English. All the teachers were technology-confident and created a pedagogical scenario incorporating use of an existing digital game. In one school the scenario lasted one four-hour session, while in another it took 7.5 hours over a period of five weeks, depending on local constraints. The age of the learners varied from 14 to 17.

In the first validation phase (December 2011), a focus group comprising four teachers from two high schools considered a first draft of the matrix and expressed their opinions; one of the aims was to verify the comprehensibility of each question. At that time, the teachers had only just started the process of integrating games into their classes. Output from this validation round (described in Section III B) resulted in a second draft of the matrix.

In the second phase (May-June 2012), verification of the matrix’s completeness was carried out using a double interview technique [19]. The interviewee was told to imagine that the interviewer was also a teacher and was intending to introduce games in class. The interviewed teacher was prompted to tell the “colleague” (played by the researcher) anything considered important for preparing to use games for the first time. When the teacher had finished, questions related to each item in the matrix were asked. A total of seven teachers were interviewed individually; the answers were recorded, analyzed and compared to the matrix for subsequent reformulation and completion.
3. Results

First we present the final matrix obtained both from the literature review and teachers’ interviews, and then some of the teachers’ feedback from the interviews.

3.1. Matrix for teachers

As a result of the literature study, six sets of questions were created and then modified following the first and second round of interviews. We present the resulting draft in the following table.

<table>
<thead>
<tr>
<th>TABLE I. QUESTION MATRIX FOR TEACHER REFLECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A WHAT ARE MY MOTIVATIONS?</strong></td>
</tr>
<tr>
<td>1. What are my motivations and my needs?</td>
</tr>
<tr>
<td>1.1- to solve a specific teaching problem (complex or abstract topic, inaccessibility of the real context, lack of attention/concentration in my class, ...)</td>
</tr>
<tr>
<td>1.2- to attain specific learning goals (knowledge, skills, attitudes, ...)</td>
</tr>
<tr>
<td>1.3- to innovate, diversify or improve my teaching practices, to change</td>
</tr>
<tr>
<td>1.4- to promote specific values</td>
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<tr>
<td>1.5- to foster learner creativity and imagination</td>
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<tr>
<td>1.6- to foster learner curiosity and questioning</td>
</tr>
<tr>
<td>1.7- to engage learning in resource searching and mobilizing</td>
</tr>
<tr>
<td>1.8- to motivate learners (in particular disaffected learners)</td>
</tr>
<tr>
<td>1.9- to get learners to collaborate</td>
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<tr>
<td>1.10- to make learners more active and make the problems their own</td>
</tr>
<tr>
<td>1.11- to prepare learners for a digital world and knowledge society</td>
</tr>
<tr>
<td><strong>B WHOM AM I ADDRESSING?</strong></td>
</tr>
<tr>
<td>1- What specificities do learners present as a group? In academic or vocational settings? In a given age range?</td>
</tr>
<tr>
<td>2- What are the individual characteristics of learners?</td>
</tr>
<tr>
<td>- prerequisite abilities/experience (ICT skills, gaming, domain, language etc.)</td>
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<tr>
<td>- background (socio-economic, immigrant, ...)</td>
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<tr>
<td>- disability</td>
</tr>
<tr>
<td>3- Will learners accept to play in class? (take responsibilities, have fun, change pedagogy…).</td>
</tr>
</tbody>
</table>
C-WHAT CONTENTS AND GAME FEATURES?

1-What is the general / specific curriculum coverage? What is the embedded model of knowledge? Scientific validity?
2- In what way will the digital game environment address my needs?
2.1- it gives feedback to learners adapted to their actions
2.2- it allows errors, and shows that failure can be useful
2.3- it proposes emotionally rich experiences for learners
2.4- it is realistic with respect to a reference context outside school
2.5- it is close to learner’s life and engaging
2.6- the interface is appropriate (attractive, easy, dynamic, not overloaded…)
2.7- it is open and allows a multiplicity of solutions that vary in difficulty
2.8- it is entertaining, learners plunge into activities without fear and without the feeling they’re studying
2.9- learners need to mobilize knowledge at stake to be successful, they experience the problems
- ...
3-What game features and motivational factors does the game employ?
3.1- goals and competition (type of victory, type of competition…)
3.2- immersion and fantasy (narrative scenario, role identification, sensorial stimuli…)
3.3- chance and mystery (probabilistic events, level of complexity and unknown)
3.4- risk management and control (gain/lose control…)
3.5- cooperation / collaboration
3.6- recognition (share results, receive positive feedback…)
3.7- challenge (to outdo oneself, to reach a level in the game…)

D-WHAT DO I NEED IN PRACTICE?

1- What limits do I need to consider?
1.1- time (for planning/organisation, for accommodating game activities in timetable)
1.2- cost (extra human / financial resources)
1.3- access to infrastructure and resources (teachers and learners)
1.4- acceptance (from staff, institution, families…)
- ...
2-What incentives and support are needed/available from my institution/s? (ICT, games, active pedagogies, …)
3 - What game environment/s do I intend to adopt?
3.1- an existing digital game (open source, free, proprietary software)
3.2- an existing game environment to be personalised (open source, free, proprietary software)
3.3- a new game environment created using a model (game authoring tool)
3.4- a new game environment created from scratch by drawing on existing tools (forum, chat, wiki…)
4 - How will I be working?
4.1- alone
4.2- in a community of teachers (single or multiple disciplines)
4.3- in a mixed team of teachers and other professionals (researchers, game designers /developers) and/or students

5-Are there (good) practices I can refer to? Game portals in my discipline? Research on GBL?
### E-How do I design the ped. scenario?

1- **What are my intentions** (in terms of knowledge, skills, attitudes, and curriculum)?

2- **What is the pedagogical strategy** I want to adopt (project-based, exploratory, discovery, problem-based, collaborative learning...)?

3- **What phases** are planned (briefing, gaming, debriefing, and integration)? **How many sessions**?

4- **What are the activities** I want to include? **What roles, resources, tools, location** (in class, online, blended), group/individual activities? **How do I imagine a situation starting from an existing game and/or from a curriculum**?

5- **What are the tutor’s issues** (be closer to students, work with whole class, give clear goals...) and the tutor’s role (character in the game, game master, facilitator...)?

### F- How to assess and capitalize?

1- **What will I evaluate** (results, method, implication)? When (during or after the game)? **How?** **What type of assessment** (self-assessment, peer assessment, teacher’s assessment, assessment by characters...)?

2- **How will I judge whether the experience as a whole has been effective**?

3- **How will I capitalize on the experience for myself and for others**?

### 3.2. Teachers’ feedback

The focus group teachers in the first round of interviews provided useful feedback. They recognized their own motivations in the list of teachers’ needs and helped reformulate some of the questions. For them it was especially important to take into account the institutional curriculum and competencies, to give clear rules to learners, to limit the duration of the game session, and to use collaborative games. One question they considered important is how to make game activities really “playful”. Fun is not always an intrinsic characteristic of games [1], and is not always seen positively, especially by adults who might not take a playful session seriously [20]. However, as previously mentioned, a balance between play and learning clearly has to be found.

The second set of interviews using the double interview approach with seven teachers provides a new set of concerns for integrating games into class, from the point of view of experienced teachers. These are integrated into the final version of the matrix presented above.

Factors that were mentioned by almost all the teachers (6 out of 7) were:

- I use games to solve a specific teaching problem / to attain specific learning goals / to motivate learners
- I look at the curriculum coverage of the game and its scientific validity
- The games I use include competition and goals
- I work with other teachers
- I use existing games
- Issues about assessment

Factors that were never mentioned by any of our seven teachers were:

- Use a game to foster creativity and imagination / to prepare for the society of tomorrow
- The game gives feedback to the learners adapted to their action / It proposes emotionally rich experiences
- Use an existing game that has been personalized or create a new game using a model (authoring tool)
4. Example of scenarios using a digital game

After the initial review and refinement work with the teachers, the empirical validation of the matrix continued by asking them to design a pedagogical scenario including the use of an existing digital serious game. Three teams of two teachers working together were formed and three digital serious games were chosen from a list they had drawn up from different sources after testing each as a player. At the end of a three-month period involving focus groups and monthly virtual or physical meetings, four scenarios were produced and formalized according to the ISiS model [15] and implemented in the ScenEdit\(^1\) authoring tool [21], of which three were implemented in real conditions in their classrooms.

One of the teachers’ scenarios features “Ecoville”\(^2\), a serious game in the field of Education for Sustainable Development dealing with greenhouse gas emissions. In the game, players need to develop a city from 1630 inhabitants to 7500 inhabitants within the constraints of providing energy with reduced greenhouse gas emissions and considering waste treatment. This scenario has been field tested with six groups of 16 students and tutored by four teachers; one of them was among the designers, while the others used the scenario produced by their peers. This scenario uses a problem based learning strategy; the phase “Defining the solution space” uses the serious game Ecoville in order to test the hypothesis from the learners’ brainstorming on the possible solutions to reduce greenhouse gas emissions. There is a collective synthesis phase where each group of students presents their findings to the whole group. At the end, each student proceeds to a self-evaluation quiz that establishes how far the initial objectives have been achieved. Then the teacher holds a discussion on the knowledge and competencies addressed by these activities and leads a critical debate on the relevance of certain aspects of the game identified by some students.

All the materials necessary for enacting this scenario in class where provided by the two teacher-designers. This collaborative work was highly appreciated by the teachers, and the students found the sequence of activities with the serious game to be very interesting. The teachers judged that the engaged students had benefited more from this experience in terms of competency and knowledge gain than from previously proposed activities. Some students managed to make a critical evaluation of the game’s authenticity; errors they discovered included improbable data on the cost and social impact of energy plants.

5. Conclusion

In our efforts to support teachers’ adoption and employment of GBL through a question matrix, we have sought to synthesize the literature on the subject, but without the intention of including all the possible aspects involved. Validation of the proposed matrix suggests that practitioners’ main concerns have indeed been addressed. However, the teachers involved in the validation process were all working directly with the research team, and this could well generate bias in the findings. The next step would be to submit the matrix to a wider, “independent” teacher population to obtain more balanced and reliable feedback. This would also allow us to investigate to what extent teachers’ responses are dependent on their teaching domain. The potential impact of this factor has already emerged in the work performed so far, where teachers’ concerns about aspects like game authenticity, transferability and social dimension appear to vary according to the subject area taught. The matrix contains a number of questions regarding teachers’ motivations and intentions, and these come first before practical issues. It is hoped that this work could help overcome some resistance to GBL among teachers, and this will be the subject of further verification.

\(^1\) http://scenedit.imag.fr/
\(^2\) http://www.ecovillelejeu.com/
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