"CREATING A COMIC STRIP IS VERY CREATIVE AND THANKS TO IT WE LEARN AND REMEMBER" – STUDENT PERCEPTIONS OF A BIOLOGY CHALLENGE IN A GAMIFIED EXTRACURRICULAR CLIL PROJECT

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Abstract
Upper-secondary school students must prepare for adult life, which – among others – entails acquiring relevant skills and discovering their own potential. Efforts at European and national levels have been made to ensure that students gain the competences, the so-called key competences, which facilitate functioning in the modern world. However, in Polish upper-secondary schools their overall development may be problematic as schoolwork is heavily exam-oriented. In order to address this challenge, a study was undertaken, the aim of which was to investigate the usefulness and feasibility of applying gamification to an extracurricular CLIL project intended to develop key competences in an upper-secondary school. The paper reports on one part of this study, i.e. on how a biology challenge (two tasks) was designed, implemented and evaluated. The results show educational and emotional gains, suggesting the motivational effect of gamification in learning.
Keywords: gamification; CLIL; upper-secondary school; motivation; technology

1. Introduction

Upper-secondary students, as every other age group, constitute a group of learners with unique needs, cognitive abilities and challenges specific to this developmental stage. Among the tasks young people face is that of preparing for adult life, which entails acquiring the relevant competences, deciding upon their own future, discovering their own potential, etc. (Filipiak & Siadak, 2014). Various European and national initiatives have been undertaken to ensure that students gain the competences which facilitate functioning in the modern world. as

"key competences", they have been identified and highlighted in educational policy documents, including the Polish Core Curriculum (Szpotowicz, 2009/2010) and are as follows: communication in the mother tongue, communication in foreign languages, mathematical competence, basic competences in science and technology, digital competence, learning to learn, social and civic competences, a sense of initiative and entrepreneurship, and cultural awareness and expression (*Recommendation of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning*, 2006). Needless to say, these are of special significance for upper-secondary school students as their personal and professional success in adulthood is – to a great extent – determined by these competences.

In practice, the overall development of all these competences may constitute a challenge in Polish upper-secondary schools as schoolwork is oriented towards school-leaving exam preparation. Regrettably, important life skills, such as digital literacy, teamwork, as well as using English for communicative purposes may not be given due attention. Consequently, Polish students are well-prepared for taking exams in particular school subjects but they may not be appropriately equipped to tackle the real social, political, economic, and cultural challenges that adult life entails. Therefore, in search of a solution, it is proposed that extracurricular programmes integrating content and language learning (encompassing the competences areas listed above), which complement the obligatory schoolwork, could be taken into consideration.

The CLIL (Content and Language Integrated Learning) approach to teaching refers to "all types of provision in which a language different to the language of schooling is used to teach certain curriculum subjects other than languages themselves" (European Commission/EACEA/Eurydice, 2017, p. 55). CLIL has been viewed as beneficial to language teaching because students are provided with more language teaching "without increasing the overall instruction time, or taking away lessons from other curriculum subjects" (European Commission/EACEA/Eurydice, 2017, p. 14). Research conducted to study the impact of CLIL programmes on language competence (e.g. Lahuerta, 2017; de Diezmas, 2016; Gené-Gil, Juan-Garau & Salazar-Noguera, 2015, Navés, 2011; Várkuti, 2010) and content (e.g. Ouazizi, 2016; Gregorczyk, 2012, Stohler, 2006) points to educational gains with regard to both language and content. Therefore, it appears that there are incentives to apply the CLIL approach in upper-secondary schools with the aim of providing additional educational programmes that cater for the development of key competences, i.e. the accumulation of knowledge across the school curriculum (science, mathematics, social studies) and the development of skills (English language, digital literacy, teamwork, learning to learn).

However, the question arises as to how to achieve long-term student engagement in extracurricular activities, bearing in mind the fact that they are not compulsory.

Gamification and its principles in designing learning experiences offer a promising perspective in addressing the problem of student motivation. As Christo Dichev and Darina Dicheva (2017) put it, "[t]here are several assumptions underlying the usefulness of gamification in educational context, such as gamification is motivating, gamification is engaging, gamification can improve attendance and participation" (p. 26). Hence, it may seem that content and language integrated learning could be framed in gamification in order to boost student willingness to participate and to maintain their engagement in the activities that are outside obligatory schoolwork. The next section considers gamification and its possible application in designing motivational CLIL learning experiences in an upper-secondary school.

2. Theoretical framework of gamification in language education

Gamification is defined as "the use of game design elements in non-game contexts" (Deterding, Dixon, Khaled, & Nacke, 2011, p. 10) and in education gamification has been defined as "the use of game elements in a learning environment" (Simões, Redondo, & Vilas, 2013, p. 3). Additionally, according to Su and Cheng (2015), gamification is "[t]he use of game design elements and game mechanics in nongame contexts in order to engage people and solve problems" (p. 269). Gamification was originally applied in business to foster e.g. customer loyalty and employee performance, followed by its use in other domains such as health, the environment and education (Dichev & Dicheva, 2017; Simões et al., 2012). Gamification has to be distinguished from other related concepts, such as "a play" and "a game". Matallaoui, Hanner and Zarnekow (2017) explain that playing involves doing something freely in order to experience joy and excitement, without having to follow strict rules, while gaming "represents a rule-based and goal-oriented form of playing" (p. 6).

It is important to note several principles that guide the design of a gamified system. Most importantly, gamification requires (1) defining goals (i.e. providing a purpose for the game) and (2) rules of the game, (3) providing feedback on how the players are performing and (4) encouraging participation in the game (Matallaoui et al, 2017). Additionally, engaging players in achieving the goals involves considering mechanics, dynamics and aesthetics in the design. Game mechanics are "the particular components of the game, at the level of data representation and algorithms" (Hunicke et al., 2004), such as points, leaderboards, levels, an achievement system (Matallaoui et al, 2017, pp. 8-9). Game dynamics describe "the run-time

behavior of the mechanics acting on player inputs and each others' outputs over time" (Hunicke et al. 2004) and include: rewards, status, achievement, self-expression, competitions, altruism (Matallaoui et al., 2010, p. 10). Aesthetics refer to "the desirable emotional responses evoked in the player, when she interacts with the game system" (Hunicke et al. 2004).

Gamification is underpinned by a number of theories that explain player motivation and engagement. Accordingly, behaviourism and self-determination theory will be featured next as the most relevant to the current article.

Conditioning theories related to behaviourism dominated psychology in the second half of the twentieth century (Dörnyei, 2001). The focus was on explaining behaviour in terms of responses to stimuli, where positive and negative reinforcement, reward and punishment were important in human behaviour, including learning. It was believed that people were motivated extrinsically, which was epitomised in grades and praise in education or salary and promotion in work contexts (cf. Werbach & Hunter, 2012; Dörnyei, 2001). The current - cognitive - approach views motivation as a function of an individual's attitudes, thoughts and beliefs (Dörnyei, 2001). A prominent example within this strand is the self-determination theory (SDT), developed by Edward L. Deci and Richard M. Ryan. It is a theory of human motivation that puts emphasis on three basic psychological needs that promote intrinsic motivation, i.e. competence, relatedness and autonomy (Ryan & Deci, 2000). As Deci, Vallerand, Pelletier and Ryan (1991, p. 327) write:

> Competence involves understanding how to attain various external and internal outcomes and being efficacious in performing the requisite actions; relatedness involves developing secure and satisfying connections with others in one's social milieu; and autonomy refers to being self-initiating and self-regulating of one's own actions.

In contrast to extrinsic motivation that was accentuated in behaviourism, intrinsic motivation is highlighted in STD and is claimed to appear when humans feel the urge to fulfil these basic human needs (Ryan & Deci, 2000). Applied to education, SDT focuses on facilitating student interest in learning and self-confidence as learners (Deci et al., 1991).

The assumptions of both theoretical perspectives need to be considered in the process of gamification design in an upper-secondary school, to accommodate both extrinsic and intrinsic motives. The use of game elements, such as points, badges, levels and leaderboards are viewed from a behaviourist perspective as forms of reinforcement, which can foster the extrinsic motivation of students. However, in order to create a satisfying internally-driven learning experience and to achieve appropriate learning outcomes, the activities and tasks

undertaken in the game must address the students' needs for competence, autonomy and relatedness – only then will they be perceived as relevant, meaningful and enjoyable, guaranteeing longer-lasting engagement.

Gamification has been a popular trend, yet mixed results have been reported on its application in educational settings, which is reflected in a recent study conducted by Dichev and Dicheva (2017) – a metaanalysis of 63 theoretical and empirical articles published between 2014 and 2015 dealing with gamification in education. The results show that most studies (N=44) were conducted at university level, fewer studies (N=7) in K-12 education. Among the gamified subjects are: computer science and information technology, maths, multimedia/communication, medicine, biology, psychology, and languages. The following types of learning activities were gamified: whole courses, exercises, collaboration/discussion forums, projects/labs, tests, etc. The studies under scrutiny investigated the influence of gamification on student learning, perception, engagement and motivation, as well as social outcomes. It appears that the results concerning the effects of gamification are inconsistent – there were studies that reported positive effects, as well as those in which the results were inconclusive or supported by insufficient evidence. The authors of the metaanalysis conclude as follows:

> (i) The practice of gamifying learning has outpaced researchers' understanding of its mechanisms and methods, (ii) Insufficient high-quality evidence exists to support the long-term benefits of gamification in educational context, and (iii) The understanding of how to gamify an activity depending on the specifics of the educational context is still limited (Dichev & Dicheva, 2017, p. 25).

These findings are rather worrying, indicating that the full potential of gamification has yet to be realised in education. It becomes apparent that applying leaderboards and points within the course or activity will not be sufficient in creating a successful learning experience. It is essential that educators-designers have appropriate skills and knowledge of gamification design and the methodology of designing for learning, as well as knowledge of the curricular goals and the socio-psychological context of the target group. This increases the chances to design gamified activities that will appropriately target educational goals in a specific context.

Innovative learning activities need to be evaluated in order to make valid claims about their effectiveness or pedagogical value (Półturzycki, 1998). This is especially relevant in light of the discussion above – gamified educational activities need to undergo a process of evaluation in order to provide evidence informing theory and practice. The ARCS motivation model developed by John M. Keller constitutes a useful frame of reference for evaluating

designed learning activities. It is posited that the ARCS model comprises the factors that have an effect on the motivation to learn. The factors are as follows: (1) Attention – relates to stimulating and maintaining the learners' interest, (2) Relevance – concerns meeting the learners' goals and needs, (3) Confidence – refers to the learners' sense that they will succeed in completing the task, and (4) Satisfaction – indicates internal or external gains. The ARCS model emphasizes that by catering for attention, relevance, and confidence in an activity, achieving learner motivation is possible. It is also claimed that in order to obtain a long-lasting motivation to learn, learners need to experience satisfaction with the learning outcomes. It is important to note that satisfaction can be affected by factors that are both external (rewards, grades, etc.) and internal (better self-esteem, positive interactions with people, completing challenging tasks that increase the sense of competence) (Keller, 2009, pp. 45-46).

3. The current study

3.1. Background and focus

The data reported in this article come from a larger research project conducted in the 2016/2017 academic year by two educational organisations i.e. the Student Society SNEC at the Institute of Modern Languages of the Pedagogical University of Cracow and the 21st Kołłątaj Secondary School in Warsaw, Poland [Polish: XXI Liceum Ogólnokształcące im. Hugona Kołłątaja w Warszawie]. The cooperation brought the "Hatters" project into existence and involved the design, development, implementation and evaluation of a learning experience, the aim of which was to investigate the usefulness and feasibility of applying gamification to an extracurricular CLIL project developing key competences in upper-secondary school. English language and technology play a major role in the project – English is the language of communication and technology makes learning and project execution possible.

As mentioned earlier, the "Hatters" project emerged as a gamified project-based extracurricular activity. While designing this learning experience, efforts had been made to ensure that students would be provided with the opportunities to develop the competences that would enable them to live successfully in a knowledge society. Game elements and principles (goal, mechanics, dynamics, aesthetics) were employed in the project design to achieve long-term student engagement, which primarily involved creating the storyline, rules and adopting the appropriate technology (cf. Schell, 2015), as discussed below.

Storyline in the "Hatters" project. The Smart Hatter, the main protagonist, lives in the Smart Castle and owns the Magic Hats. The Hats have most extraordinary powers – they serve their Masters, called the Hatters. Once a Master casts a spell on a Magic Hat, it serves them by performing its Master's wishes. Unfortunately, the Hats are temporarily unavailable because they have been captured by Grifftonn, a strong, malicious and very smart monster with five heads, each of which is a specialist in one area: history, biology, mathematics, languages, or social studies. Luckily, due to a deficit in one chromosome, his power is weakened when humans perform smart acts (such as learning English vocabulary, using digital tools), acts of kindness, creativity, etc. in his vicinity. Therefore, to get the Magic Hats, contestants need to complete five challenges (to fight each head) and perform acts of smartness, such as cooperation, innovation, inspiration, etc. Once all five challenges are completed, all Grifftonn's heads are disabled and the Hats can be taken for use. The Smart Castle, which consists of five Chambers and the Hall of Hats, has extraordinary powers too. Walking from Chamber to Chamber, the humans' level of smartness increases, but only those who are smart enough can pass through all the Chambers, complete the challenges, and reach the treasure – the Magic Hats. As the Smart Hatter does not speak the contestants' mother tongue, English must be used as a medium of communication. More details on the project website can be found at http://smarthatter.weebly.com.

Mechanics and dynamics in the "Hatters" project. Students battle Grifftonn in teams, each team consisting of 5 students from different classes, each student specialising in one school subject: history, biology, maths, Polish (language and culture), or social studies. They engage in completing five challenges[1], one challenge assigned per month, each one involving the preparation of an online "product", such as a multimedia presentation, a comic, a report, etc. Completing each challenge requires creativity, cooperation, problem-solving and innovativeness in how the students approach the problem. The results (presentations, comic strips, reports, etc.) are prepared in English, using open-source online tools and posted on teams blogs. The results (presentations, reports, etc) are assessed taking three criteria into

[1] Challenge 1 History. "Kraków – a magical place". Teams participate in a location-based game and prepare multimedia presentations about Kraków.
Challenge 2 Biology. "Facts and myths in bioscience". Teams conduct a study on vaccinations or birdfeeding, conclusions are presented as comic strips.
Challenge 3 Maths. "Stinginess or thriftiness". Teams analyse fuel combustion or car loans, conclusions are presented on Google Slides.
Challenge 4 Polish. "Truth about us saved on walls and in literature". Teams write online columns about Warsaw murals or online books based on a story by L. Kołakowski.
Challenge 5 Social studies. "According to the law of [date]… – Know your rights". Teams prepare online reports on the rights of Polish school-leaving exam-takers or on the rights of Polish citizens concerning the work of Members of Parliament.

consideration: substantive (factuality, originality and creativity in approaching the task, etc.), English language and teamwork. The award to be gained is the title of "the Hatter" – the finalists receive hats, which when worn allow magic forces to influence their school teachers during the 2017/2018 school year.

Technology in the "Hatters" project. Technology plays a crucial role in the project (cf. Cope & Kalantzis, 2017). Among others, it enables communication during the project and facilitates the development of digital competence, learning to learn, teamwork, the English language, and subject knowledge. With regard to communication, website and blog builders are employed to provide information about the project, successive challenges and team results. What is more, teams are urged to communicate online via *Google Docs*, *Skype*, *Google Hangouts*, etc. while working on the project. Various open source digital tools (apps, online platforms, authoring tools, etc.) are suggested for creating their projects: *Adobe Spark* (https://spark.adobe.com/), *Storyboard That* (http://www.storyboardthat.com/), *Google Docs*, *Google Forms*, *Google Slides* and others. The teams learn how to use each tool on their own by viewing *YouTube* tutorials. Their "products" are displayed on the teams' blogs. Each member's engagement in the execution of the task is also described on teams' blogs.

Organisation of the project. The project was targeted at first-graders and student participation was voluntary as the project was an extracurricular activity in the 2016/2017 school year. In November 2016, 25 students-contestants were recruited to the project, who were then assigned to one of five teams, each of which had five members. Each team collectively devised a name for the team, elected a team leader and a chronicler (blogger). The implementation of the project began on December 1st 2016 and lasted throughout the remainder of the school year. Each month the teams dealt with a challenge related to a different school subject. The biology challenge came second in the project (the order of the challenges was motivated by the subject teachers-designers' availability) and was performed by the teams in January 2017. It needs to be noted that January marks the end of the first school semester in Poland, which entails a lot of tests and homework. Unsurprisingly, this is usually considered a very difficult month within the school year – students tend to be exhausted and unwilling or unable to engage in additional work at school.

The present article focuses on how the biology challenge (two tasks) was designed, implemented and evaluated. This process was undertaken by two Polish educators, an academic teacher at the Pedagogical University of Cracow (Project leader and Researcher 1) and a biology teacher at 21st Kołłątaj Secondary School in Warsaw (Researcher 2), the authors

of this article. Specifically, the study examines the students' perceptions of the biology challenge (i.e. one of the tasks) and the following questions guided the investigation:

1. How do the students rate the biology task regarding its usefulness, difficulty, satisfaction and interest?
2. Which features of the task make it useful or difficult and which create satisfaction?
3. What, in the students' opinion, are the learning outcomes?
4. How do the students rate the biology task as a whole?

It is hoped that the reported results will provide evidence for the educational value of the gamified activities, thus enriching didactic theory and offering valuable insights to school teachers, educational researchers and policymakers.

3.2. Procedure - biology challenge design and implementation

The problems that were selected to be addressed in the biology challenge relate to contemporary biological and social issues and concern the majority of the population, not just a small group of scientists and nature lovers. It was assumed that the students would benefit from exploring and verifying certain views that may go against rational and scientific knowledge. The first problem that was considered was the attitude to vaccination that is gaining in popularity among the public. There is a growing trend not to vaccinate, despite the fact that scientific sources clearly indicate that refusing immunization puts people's health and even lives at risk (Bonanni, 1999, pp. 120-125; Marchewska, Majewska & Młynarczyk, 2015; http://www.who.int/mediacentre/factsheets/fs286/en/). The other issue revolved around feeding wild birds, especially in winter. Unfortunately, by using unsuitable food (e.g. bread), people can do more harm than good (Bocheński, Ciebiera, Dolata, Jerzak & Zbyryt, 2013; Czujkowska & Kruszewicz, 2014). As a result, the challenge entitled "Facts and Myths in Bioscience" was created. The aim of the first task, "Vaccinations – facts and myths," was to confront popular beliefs concerning vaccinations with medical knowledge. The second task, "Feeding wild birds – facts and myths," necessitated confronting popular beliefs on feeding wild birds with bioscientific knowledge. The teams were to choose only one task.

In each of the tasks the students were to design and conduct a survey (at least 20 people) on the selected topic and then compare the results with the scientific facts. Expert knowledge on the subjects was gained by interviewing scientists and/or doctors and by researching and obtaining professional information from relevant literature. The conclusions gained from confronting the views and beliefs with modern scientific knowledge were to be presented in the form of an online comic strip. To prepare and conduct the survey, as well as

the comic strip, the students were encouraged to use online tools such as *Google Forms*, *Storyboard That* or *Stripgenerator* (http://stripgenerator.com/). Links to tutorials in English were added so that the students could learn how to use them (English was the language used in the tutorials). Assessment criteria for the tasks were as follows: compliance with the topic, accuracy of the survey questions, appropriate terminology, language accuracy (English), appropriate conclusions, the aesthetics and logic of the comic strip organisation, volume – 6-10 frames/cells, creativity and originality in the approach to the topic. A deadline for submission was assigned, with team leaders and chroniclers reminded of their duties. The full text of the biology challenge is available on: https://goo.gl/fXUZp6.

Information about the challenge was published on the project website at the beginning of January 2017. In order to introduce an element of surprise, access to the challenge was through a QR code. The teams worked towards the completion of their projects for three weeks and submitted links to their blogs (where the links to their comic strips were published) via email to the Smart Hatter (Researcher 1) prior to the deadline. While pursuing their biology challenge, the contestants worked in the teams formed at the start of the project.

All five teams completed the biology challenge by submitting their online comic strips, with an example presented below (Figure 1). What is more, based on blog entries, we know that all the team members were involved in the task execution.

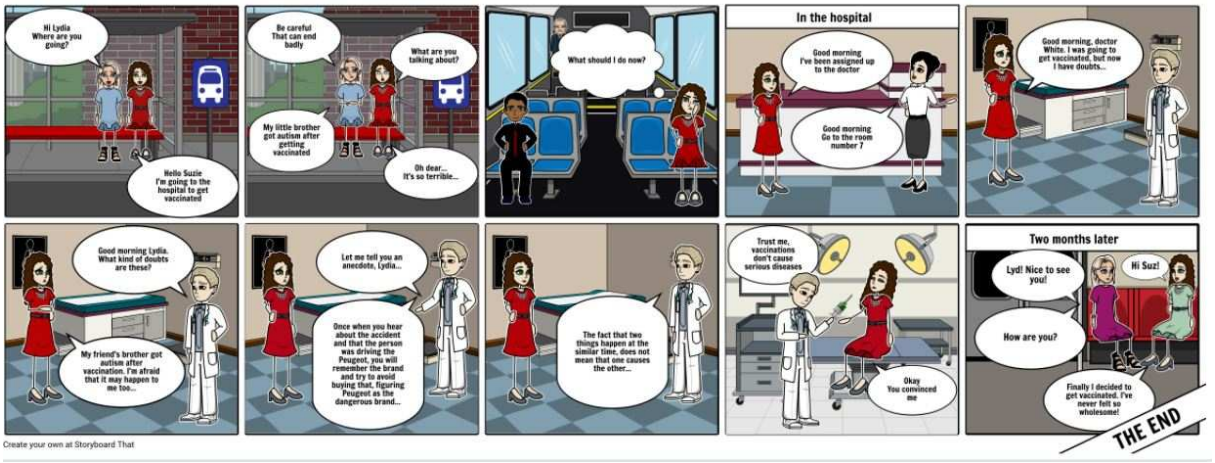

Figure 1. "Lydia's dilemma" by Highfliers. Taken from:
https://www.storyboardthat.com/portal/storyboards/highfliers/corp-public/lydia-s-dilemma

It became evident that only one team completed the task by contacting an expert. To gain an objective scientific view, they went to a lecture on vaccinations and antibiotics in the Copernicus Science Center (Warsaw, Poland). After the lecture they talked to the professor

conducting the lecture. The result of their work was a comic strip that illustrates correctly drawn conclusions. Other teams decided to find the necessary scientific knowledge on their own (from literature)[2]. The results of these teams were weaker. Their comic strips contained substantive errors (e.g. erroneously included information about the presence of bacteria and viruses in the vaccines) or a complete misunderstanding of the problem (a focus on the issue of not feeding birds instead of on the issue of feeding birds with wrong kind of food, like bread). However, interestingly, the surveys of these groups were prepared correctly. Therefore, incorrectly drawn conclusions are related to an insufficient understanding of the topic. Direct contact with a specialist, as well as the ability to inquire and explain certain issues are likely to prevent such errors.

3.3. Study participants

The sample consisted of 21 first-grade students (out of the total project participants N=25; boys N=10, girls N=15) from the 21st Kołłątaj Secondary School in Warsaw. Four students did not participate in the evaluation of the challenge because they were absent from school on that day. Online questionnaires could solve this problem but due to the students' workload at that specific time, the researchers accepted that not all the students were able to complete their evaluations.

3.4. Data collection

The data were collected in January 2017, two days after the deadline for the task submission. Project participants who were present at school on that day were gathered in a classroom and given pen-and-paper questionnaires[3]. This procedure was not new to them – one month earlier they had participated in the evaluation of the history challenge.

Six variables were considered in the study: (1) task usefulness, (2) task difficulty, (3) task satisfaction, (4) interest in the task, (5) perceived learning outcomes, and (6) overall task evaluation. A self-report pen-and-paper questionnaire was designed to collect data. Polish was used in the questionnaire to avoid language problems and to allow respondents to freely express their opinions.

Four variables, i.e. *task usefulness*, *task difficulty*, *task satisfaction*, and *interest in the*

[2] The design of the study does not allow us to find out whether they had difficulty reaching the specialists.

[3] This mode of data collection was preferred as the school computer laboratory, which would allow online administration of the questionnaires, was not available. Use of the students' mobile phones had been considered but as it was not certain whether all the students would have their mobile phones on that day, pen-and-paper questionnaires were used to ensure an appropriate response rate.

task were measured using the questions specifically designed for the study. While designing the items we drew on the Motivational Design Matrix which includes four dimensions: Attention, Relevance, Confidence, Satisfaction (Keller, 2010, pp. 261-270). The questions in the questionnaire were formulated as follows: "How useful / difficult / satisfying / interesting was the biology task?" The participants were asked to respond using the five-point Likert-type response scale: 1 – "not at all" to 5 – "very". To obtain more information about each variable, the respondents were asked to explain their reasons.

The *perceived learning outcomes* variable was investigated by one open-ended question "What did you learn while doing the biology task?". The *overall task evaluation* variable was measured by "How do you evaluate the biology task overall?". The responses were collected by means of a five-point scale, ranging from 1 – "poor" to 5 – "very good". An additional open-ended question "Why do you think so" was added to gain more understanding of the respondents' ratings.

3.5. Results and findings

Mean results for the participants' evaluations (N=21) of task usefulness, task difficulty, task satisfaction and interest in the task are shown in Figure 2. On average, the respondents rate all the aspects as moderate to good – the mean value of task usefulness in the sample is M=3.43, task satisfaction M=3.52 and interest in the task M=3.48. Task difficulty is rated as rather low to moderate M=2.90. The standard deviation values ranging from SD=1.18 to SD=1.50 show that participants differed markedly in their ratings.

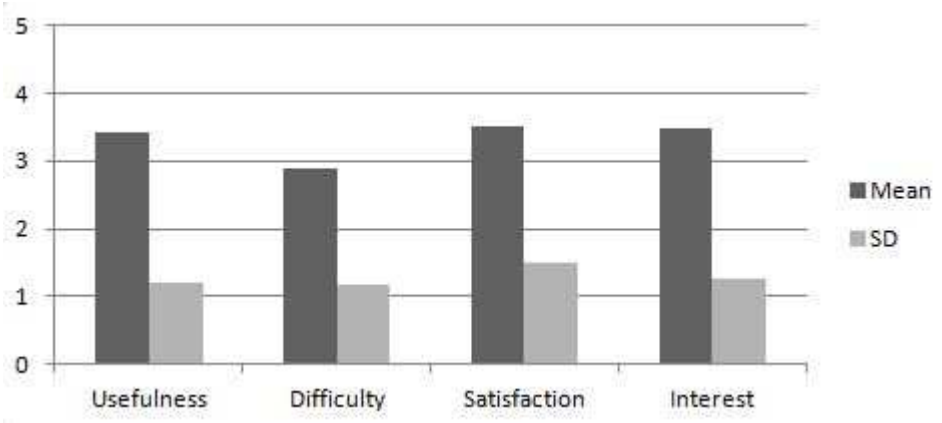

Figure 2. Means and standard deviations in the sample (N=21); 1-5 scale: 1 – not at all, 5 – very

Task usefulness. Many respondents indicated that they had learnt some or a lot of new

facts related to biology (7 respondents) and how to use an application for making comic strips (1 respondent). One participant felt that the task would facilitate schoolwork in the future. In five respondents' opinions not much or nothing was learned because the information was not new to them. The topic was not considered useful by one respondent.

Task difficulty. Those participants who rated the task as easy explained that the information was readily accessible, the task was not complicated, it was enough to get involved and spend some time doing it. What was a bit difficult for some participants was finding and/or approaching people in the street in order to recruit survey participants. Finding information from a reliable source and checking if it is still up-to-date also required some effort, in the respondents' opinions. Finally, it was also pointed out that the task was (very) time-consuming.

Task satisfaction. Enjoyment, i.e. having fun while collecting survey data and preparing the comic strip, was indicated by four respondents. For two respondents, working with people or with the team constituted a source of satisfaction. Two study participants liked the outcome – their comic strip. The task brought satisfaction to the participants who were interested in biology. No satisfaction was reported when the subject (biology) was not considered to be interesting or because the survey prepared by the teams was not treated seriously by their respondents. No satisfaction was associated with the reported fact that the task itself was not challenging (1) or uninteresting (1).

Learning outcomes. When asked what they had learned while doing the biology task, five respondents reported that they had learned about vaccines, as well as about people's opinions about them. Four students learned more about feeding birds and actual practices. Four students declared that they had discovered interesting applications for creating online surveys and comic strips. Two students indicated that they had learned that teamwork could be difficult when team members do not contribute to the work. One student reported learning that people do not use reliable sources of information. Finally, one student declared they had learned nothing new.

Overall task evaluation. Two respondents did not provide their answers unequivocally (e.g. "4/5") so their answers could not be entered into the data set. For this reason there were N=19 with regard to this variable. Quite surprisingly, the mean for the overall task evaluation is higher (M=4.16) compared with the other variables and the respondents provided less varied responses (SD=0.83) (Figure 3). As illustrated in Figure 4, the respondents most often rated the tasks as "very good", i.e. 5 on a 1-5 scale, followed by those who gave it a rating of 4. These who rated it 3 were the least frequent in the sample.

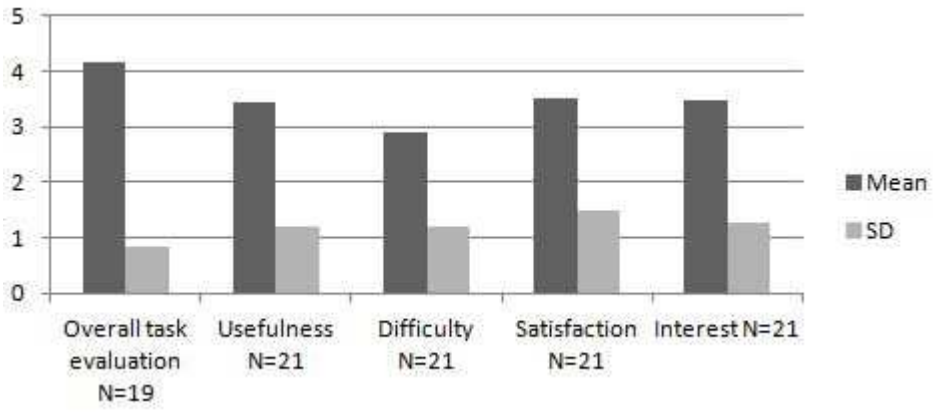

Figure 3. Means and standard deviations in the sample; 1-5 scale: 1 – not at all, 5 – very

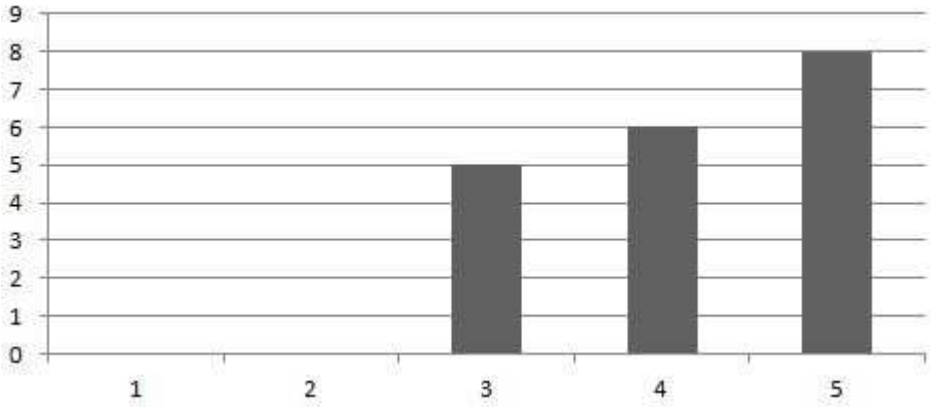

Figure 4. Overall task evaluation. Frequencies of responses (N=19); question: *How do you rate the biology task on the whole*? 1-5 scale: 1 – poor, 5 – very good

When asked to explain the rating, five participants highlighted interaction with other people: a doctor, strangers (in the street), and/or the team. Three students indicated that they had learned how to use new applications (*Google Forms* and/or *Storyboard That*). Also three students stated that the task was interesting. Two students liked the idea of making a comic strip "because creating a comic strip is very creative and thanks to it we learn and remember" (authors' translation). Two students declared they had broadened their content knowledge (biology). One student stated that they had fun. On the negative side, six students declared that the topic was not interesting or they were not interested in biology. Individual students felt that the task was awkward, required preparation or covered a lot of material. Finally, one student felt they could not show their full potential.

4. Discussion

The aim of this paper was to investigate the scope of gamified extracurricular CLIL activities

for developing key competences in upper-secondary school. In particular, we wanted to find out whether the theory-inspired biology tasks would be motivating and meaningful to students, ensuring their engagement in a non-compulsory educational activity.

Based on the results, it becomes evident that the students were willing to undertake work outside the classroom. It is clear that it is possible to engage students in additional educational initiatives, even though they were burdened with obligatory schoolwork. It seems that the students were driven by a feeling of fun, curiosity, as well as a sense of community and achievement. These appear to be strong motivating forces behind student engagement.

Secondly, we notice that technology plays a significant part in the students' learning experiences. The study participants appreciated the opportunities to learn and use new digital tools. Interestingly, we observed that students, initially not familiar with the tools (*Google Forms* and/or *Storyboard That*), learned how to use them on their own by watching the suggested *YouTube* tutorials and managed to successfully use them in the execution of the tasks. Hence, it appears that, by adopting digital solutions, teachers can provide new opportunities for student work, as well as an attractive space for creative problem-solving (biological in this case).

Next, it became clear that it is worth introducing students to other sources of knowledge (apart from a teacher and a textbook) as meeting with a specialist seems to have been essential in drawing the correct conclusions. The example of the other teams, however, shows how important it is to scaffold students' work and to prepare them for the use of other sources of knowledge. In the tasks performed, we observed that they had read the literature related to the given topic, but they had problems with interpreting it correctly.

Students did not refer to the English language in their responses while evaluating the tasks. Surprisingly, it was never mentioned that using English constituted a problem, nor was it said that they had learned anything to do with English. The skills connected with using language for project purposes appears to be transparent, eluding the students' attention while executing challenging social activities, where the focus is primarily on content, and not on language. It may be speculated that the extracurricular activities and tasks, such as those presented in this paper, have the potential to afford upper-secondary school students with an environment which facilitates implicit language learning, serving a complementary function to the explicit language instruction provided in a language class.

On the negative side, six students declared that the topic was not interesting or they were not interested in biology. This lack of interest is probably a sign of certain social trends as the problems involved in the challenge have social and environmental significance. An

awareness of the need for vaccination is the foundation of the social health of the population. Additionally, an understanding of the environment within a city (e.g. by appropriate feeding birds) is essential to maintain biodiversity in metropolises. As a society, we do not attach much importance to these issues, which may have negative consequences in the future. That is why it is so important to discuss these topics with young people, who will – among others – decide in 5 or 10 years whether to vaccinate their own children.

The results show that the challenge on the whole is evaluated favourably, even though specific dimensions are given lower ratings. It is speculated that this is caused by gamification, where two kinds of motivation came into play: external (leaderboards, points, competition, etc.) and internal (the need for relatedness, autonomy and competence). As a consequence, the individual students within the teams acted together, and this included the students who were not particularly interested in biology. This might have led to the emergence of group dynamics that enhanced the perception of the task.

Finally, the major limitation of the current study needs to be acknowledged. Not all the students out of the total N=25 participated in the evaluation of the challenge, which slightly narrows our understanding of the students' perceptions. It appears that, despite organisational and time constraints, adequate ways must be sought to ensure access to the perspectives of all the participants in order to gain insight into their learning experiences. This would provide more comprehensive results.

5. Pedagogical implications and final conclusions

Certain suggestions can be put forward on the basis of the results obtained in the study:

- Teachers should not refrain from engaging in activities that integrate different areas of knowledge (e.g. computer science, English and biology). This allows for the practical use of the skills acquired by the students and influences the motivation to learn.
- It is worth giving students more freedom within active learning and skill acquisition. With appropriate motivation, students use a wide variety of sources of knowledge. It is necessary, however, to support this process – the teacher should verify the sources of knowledge and monitor the students' work.
- Clear assignment of the responsibilities within the groups probably contributed to the increase in work efficiency. By assigning each student a task such as a leader, a chronicler, etc. we ensure the contribution of all the team members.

The biology challenge in the "Hatters" project required the contestants, among others, to use the English language, technology and online resources, as well as to think creatively,

analyze data and draw conclusions. Not all the teams dealt appropriately with the task at the substantive level. Nevertheless, all the students took an active part in the challenge, successfully using technological tools and presenting their results in English. It is hoped that these results shed some light on the use of gamification in upper-secondary schools, serving as evidence that gamified systems have the potential to promote student motivation and engagement in long-term non-compulsory educational activities.

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