Gamification in Education: Where Are We in 2015?

Darina Dicheva, Christo Dichev
Computer Science Department, Winston Salem State University
United States
{dichevad, dichevc}@wssu.edu

Abstract: This paper presents a follow-up of a systematic mapping study of the empirical research on applying gamification to education, covering the period July 2014-June 2015. Its goal is twofold: to complement the previous survey by reviewing the papers published within the last year and to identify the shifts and emerging trends in this research field by comparing the new results to the previous data. The study also confirms that the penetration of gamification in education is still fast growing and the practice has outpaced researchers' understanding of its mechanisms. But it indicates that it has passed the "peak of inflated expectations" in Gartner's hype cycle and is sliding down into the "trough of disillusionment". The rise of the number of studies with inconclusive or negative results suggests that the gamification has passed its early phase and is considered in a more critical and analytical way instead of 'riding the hype'.

Introduction

Gamification has been a rising technology trend since 2010. Its growing popularity is stemming from the belief in its potential to foster motivation, behavioral changes, friendly competition and collaboration in different contexts, such as customer engagement, employee performance and social loyalty. As a result, it has been applied in various domains including marketing, health care, human resources, training, environmental protection and wellbeing. One key sector where gamification techniques are being explored is education. Gamification in education refers to the *introduction of game elements and gameful experiences in the design of learning processes.* It has been adopted to support learning in a variety of contexts and subject areas, but also to address related attitudes, activities and behaviors such as participatory approaches, collaboration, self-guided study, completion of assignments, making assessments easier and more effective, integration of exploratory approaches to learning, and strengthening student creativity and retention (Caponetto et al., 2014). The assumption here is that it is possible to incorporate game mechanics in the design of a learning process so as to engage learners in a productive learning experience, and more generally, to change their behavior in a desirable way.

In 2014 we conducted a systematic mapping study of the empirical research on the application of gamification to education published between 2010 and June 2014 (Dicheva et al., 2015). It was aimed at recognizing the emerging trends within the applications of gamification to education and identifying patterns, educational contexts and configuration of game elements used. For classifying the research results, the study used a categorical structure (based on the topics discussed in the reviewed papers) including game elements, context of applying gamification (type of targeted application, educational level, and academic subject), implementation, and evaluation. Although most of the reviewed 34 papers have been reporting promising results, the review concluded that more substantial empirical research is needed to determine whether both extrinsic and intrinsic motivation of the learners can be actually influenced by gamification. Giving the exponential growth of publications on gamification, a year later we conducted a follow-up study covering the period July 2014-June 2015 (see Fig. 1). Our goal was twofold: from one side to complement the previous one by reviewing the papers published within the last year, and from another, to identify the shifts and emerging trends in this research field. In the following sections, if there is no danger of confusion, we will refer to the previous and current study as Study'14 and Study'15, respectively.

Study Design

Inclusion, Search, and Screening

As in Study'14, the inclusion criterion for the reviewed papers is to discuss explicitly gamification in educational contexts. Thus we excluded papers reporting the use of full-fledged games, research on topics

conceptually or theoretically close to gamification (e.g., intrinsic motivation) or with similar measured outcomes, as well as papers discussing similar topics, but with different terms. Empirical research papers where no findings were reported were also excluded. Finally, we kept only one publication from the same authors presenting the same study.

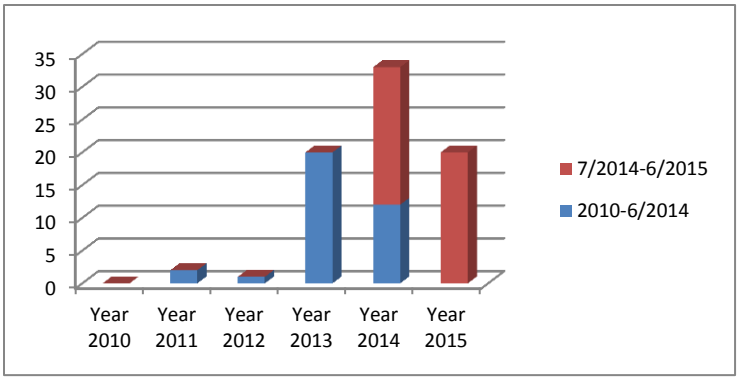

Figure 1. Work distribution by year of publication.

We searched the same databases as before: ACM Digital Library, IEEE Explore, ScienceDirect, SCOPUS, ERIC and Google Scholar. The search of these databases with keywords "gamification", "gamify" and "gameful" for the specified period, returned 5,100 results: ACM Digital Library (275 papers), IEEE Xplore (564 papers), ScienceDirect (148 papers), SCOPUS (93 papers), ERIC (9 papers) and Google Scholar (4,011 papers). After filtering out the papers which did not satisfy the inclusion criterion, removing duplicates and excluding the papers considered already in Study'14, the resulting list contained 41 empirical research papers. Fig. 1 shows the distribution by year of publication of the works included in both studies for comparison. Note that the number of papers (41) in Study'15, which covers only one year period, is bigger than the number of papers for the entire period 01/2010-06/2014 (34).

Categorization Criteria

Since this is a continuation of the systematic mapping study we conducted in 2014, we kept the same study design. For a meaningful comparative evaluation, we preserved the categorical structure used in Study'14 for classifying the published research reports and results. The only new criterion, "Type of supported activity", was added to reflect a recent trend of gamifying a single course activity. We kept our proposed division of gamification elements into *educational gamification design principles* and *game mechanics* (Dicheva et al., 2015).

Mapping Study Results

This section describes the distribution of published work on each classification criterion. For comparison with the publications in the period 2010 – June, 2014, each graph displays the results in both periods. As proposed above, the criterion "Game elements" is divided into two: "Gamification design principles" and "Game mechanics".

Gamification design principles. Fig. 2 shows the number of reviewed in this study papers discussing each of the educational gamification design principles compared to the results of Study'14. As it can be seen, the most utilized gamification design principles in educational context are again "Visible status" and "Social engagement" however there is a noticeable drop in the work related to "Freedom of choice" and "Freedom to fail". From another side, there is an increase of research related to "Unlocking content" (e.g. (Anderson et al., 2015), (Faghihi et al., 2014)) and "Time restriction" (e.g. (Krause et al., 2015), (Hasegawa et al., 2015)). With regard to the "Storyline" category, we notice the appearance of work on gamifying simulations (Bonde et al., 2014) and augmented and virtual reality ((Perry, 2015), (Herbert et al., 2014)). An emerging category in this study is "Surprises, Prizes". For example, Pettit et al. (2015) who used and audience response system report using random insertion of fastest responder slides and tie-breaker slides as well as trivial prizes (e.g., candy in the shape of the microbe(s) covered in that interactive lecture). The system they use also allows students to wage all or part of their points on the next, unseen question.

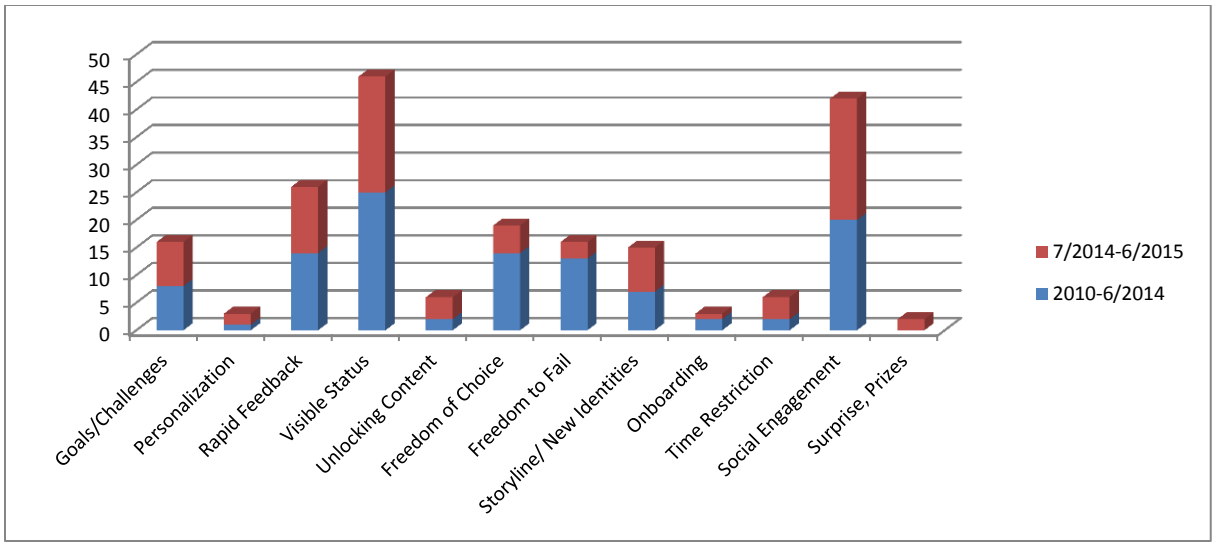

Figure 2. Work distribution by Gamification Design Principles.

Game mechanics. As Fig. 3 shows, the most utilized game mechanisms are again points, badges and leaderboards. However, we observe a noticeable increase of the works employing badges compared to those employing points and leaderboards. Another distinction is the substantial increase of the works employing avatars. For various examples of use of the different game mechanisms as well as gamification design principles we refer readers to the previous study (Dicheva et al., 2015).

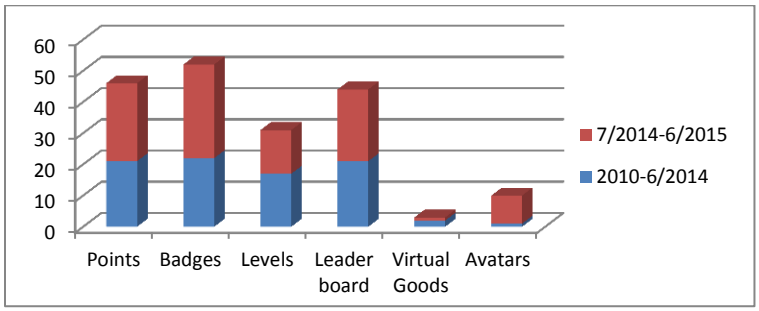

Figure 3. Work distribution by game mechanisms.

Type of application. This criterion is about the context of the gamification application, i.e. where gamification is applied. The papers were grouped in the following categories: gamifying courses without online gamification support; gamifying MOOCS or online courses; gamifying blended learning courses; gamifying e-learning sites, learning environment or experimental settings; and developing gamification support platforms. As Fig. 4 shows, the majority of the reviewed case studies report again gamification of blended learning courses, while there is a decrease of the works reporting gamification of courses without online support and of MOOCs and online courses.

A noticeable increase of work on gamifying e-learning sites and learning environments can be seen, too. We witness a novel trend related to gamifying specialized tutoring systems, e.g. (Long & Aleven, 2014) and (Faghihi et al., 2014), or simulations, e.g. (Bonde et al., 2014). In addition, a new type of applications has emerged in this category, namely studies addressing learner categories, gender issues, etc., in applying gamification in educational settings (see the following section).

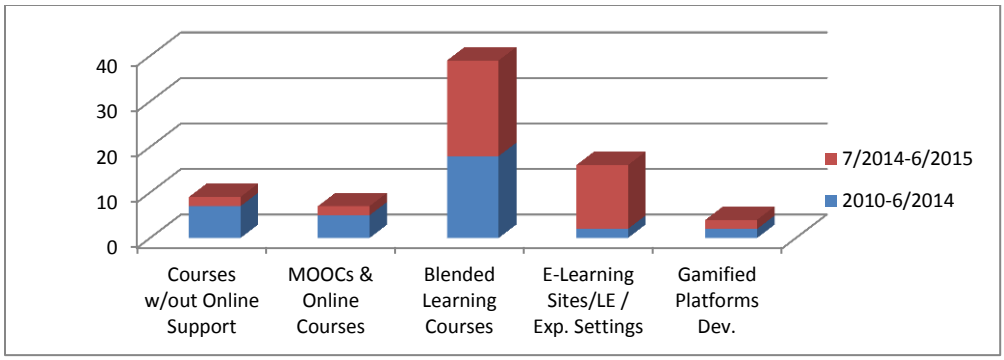

Figure 4. Work distribution by type of application.

Targeted learning activities. This criterion was not included in the previous study; it is included here to reflect the recent trend of gamifying a *single course activity*. Therefore, Fig. 5 summarizes only data for the period July 2014 – June 2015.

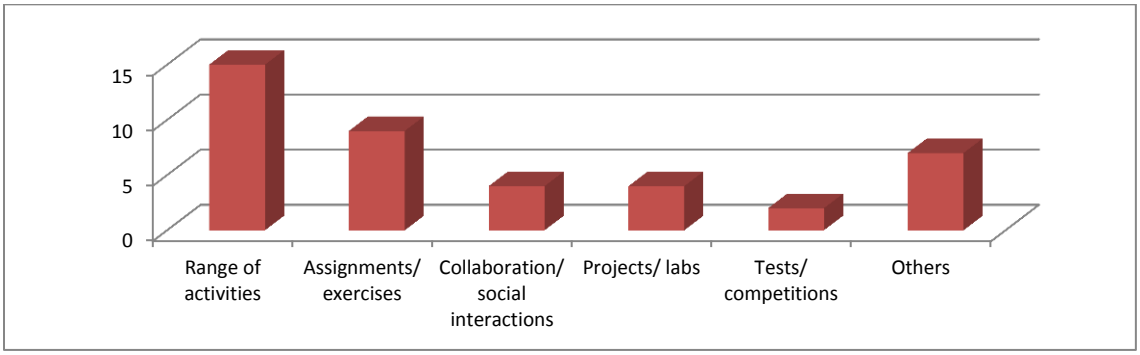

Figure 5. Work distribution by type of targeted learning activity.

The papers were grouped in the following categories: assignments/exercises, collaboration/discussions/social interactions (including voting), projects/labs, tests/competitions, and such that include gamifications of a range of activities. As it can be expected, within the group of the individually targeted activities, gamification related to assignments and exercises is the most popular. The other noticeable group – "Others" – includes research related to some recently targeted aspects, such as stereotype threat (Christy et al., 2014), gender (Pedro et al., 2015a), gamification type of learners (Herbert et al., 2014), student perception of badges (Davis et al., 2015), supporting student autonomy (Holman et al., 2015), etc. Projects or labs are targeted in (Landers & Landers, 2015), (Sillaots, 2015), (Su & Cheng, 2015) and (Bonde et al., 2014), while tests or competitions in (Attali & Attali, 2015) and (Nevin et al., 2014). Examples of collaboration/discussions/social interactions include team discussions in class when taking clicker quizzes (Latulipe et al., 2015), online discussions (Knutas et al., 2014a), and collaborative work in a Software Engineering course (Knutas et al., 2014b).

Subject. This criterion is related to the subject domain of the application of gamification. The following categories were identified here: Computer Science (CS) /Information Technology (IT), game programming, math/science/ engineering, and subject neutral (see Fig. 5). While most of the papers still report gamifying of Computer Science or IT courses, there is an apparent increase of the number of papers reporting STEM courses and a significant decrease in the papers reporting gamifying of Game Programming courses. In addition, a new category has been added: "Others". It includes papers related to the topic Technology and Society, e.g. human uses of technology (Leach et al., 2014), use of Photoshop (Jang et al., 2015), and multimedia content production (Barata et al., 2014), as well as to new educational fields, such as medical education ((Nevin et al., 2014)), language learning ((Hasegawa et al., 2014), (Perry, 2015), (Abrams & Walsh, 2014)), psychology (Landers et al., 2015), research methods (Sillaots, 2014) and business (Poole et al., 2014).

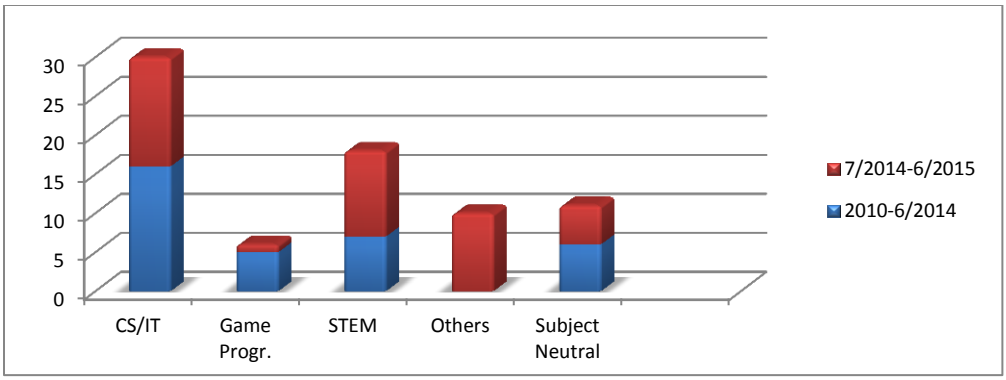

Figure 5. Work distribution by subjects.

Implementation. The papers reviewed in this study were grouped in the same categories as in Study'14 (see Fig. 7):

- No e-learning platform or other software used, manual collection of data on student performance ((Hanus et al., 2015), (Codish et al., 2014), (Laskowski et al., 2014), (Poole et al., 2014)).
- Third party software *used* to support some aspect of gamification, e.g. using Moodle (Barata et al., 2014), Moodle and clickers (Latulipe et al., 2015), clickers and TurningPoint ARS (Pettit et al., 2015), and MediaWiki (Landers et al., 2015).
- Software for supporting gamification *implemented* as an extension or plugin of an existing Learning Management Systems (LMS) or other online learning environment (LE). Examples include extending TRAKLA2 (Hakulinen et al., 2015), LearnToMine (Anderson et al., 2015), a linear equation intelligent tutor (Long et al., 2014), Moodle (Utomo et al., 2014), GradeCraft (Holman et al., 2015), the collaborative learning platform SAPO (Pedro et al., 2015), the online LE of a Data Structures and Algorithms course (Auvinen et al., 2015), the adaptive web-based educational system ALEF (Filipcik & Bielikova , 2014), etc.

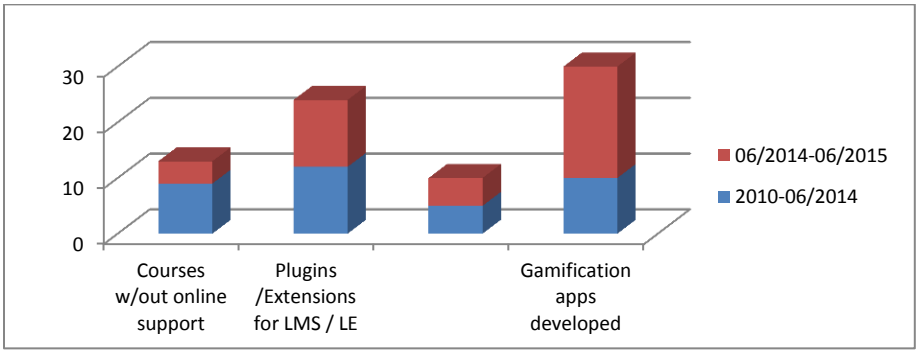

Figure 7. Work distribution by implementation.

- Software for supporting gamification *implemented* as a standalone application. The authors of the corresponding papers report the development of applications to support some aspects of gamification in educational contexts. These include applications for gamified collaboration support (Knutas et al., 2014), gamified laboratory simulation (Bonde et al., 2014), science education reward system (Davis et al., 2015), m-learning app with badges (Boticki et al., 2015), a math LE (Pedro et al., 2015a), the gamified LE Reflex (Herbert et al., 2014), mobile apps for learning English vocabulary and French ((Hasegawa et al., 2014), (Perry, 2015)), the app MathDungeon (Faghihi et al., 2014), etc.

Reported Results. In Study'14, the criterion "Reported Results" included the following categories: "Positive", "Positive first impression" (not properly evaluated), "Mixed/Recommending", "Negative" and "Not evaluated yet" (including results not accessible). In this study we decided to categorize the reported results from the empirical studies so as to reflect the level of "conclusiveness" from the authors' or from our point of view. The later, naturally, assumes some degree of subjectivism. The new grouping yielded the categories "Positive", "Negative", and "Inconclusive". A paper was marked as "positive" if a *clear evidence* of positive outcomes *resulting from*

gamification was found. It was marked as "negative" if *clear negative* outcomes *caused by gamification* were found. A paper was marked as "inconclusive" if the presented evidence was judged as insufficient, based on shortcomings such as: small sample sizes, lack of control groups, use of purely descriptive statistics, short experiment timeframes, and unreliable statistical evidence. In this category we also included papers studying gamification along with some other technologies, which makes uncertain whether the effects found can be attributed to gamification or other factors, as well as papers where no positive effect was found but negative effect was not discernible either. Accordingly, to incorporate the results from the papers included in the previous study, in Fig. 8 we merged the previous categories "Mixed/Recommending" and "Positive first impression" and included the result under the new category "Inconclusive".

We also introduced here a category "Others" for research that studies why students respond differently to gamification. This category includes works related to learner perception of gamification elements (e.g. (Knutas et al., 2014), (Sillaots, 2015), (Davis et al., 2015), (Herbert et al., 2014), (Holman et al., 2015)) and to categorizing learners ((Codish et al., 2014), (Barata et al., 2014)). Such studies are an emerging trend in the field.

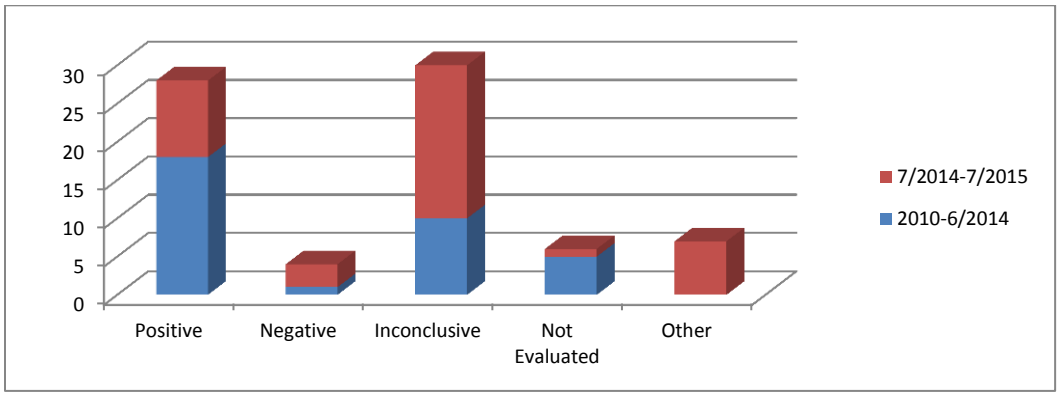

Figure 8. Work distribution by reported results.

Fig. 8 shows very different pictures for the two periods of time. While in the period January 2010 – June 2014, 53% of the published papers were positive, only 3% were negative, and 29% were inconclusive, in the period July 2014 – June 2015 the papers that report positive results are only 24%, while those reporting negative results – 7% and the inconclusive – 49%. Thus from 41 papers only 10 can be considered as evidence of positive effects for gamification in education ((Hakulinen et al., 2015), (Krause et al., 2015), (Hasegawa et al., 2014), (Landers et al., 2015), (Nevin et al., 2014), (Bonde et al., 2014), (Jang et al., 2015), (Pettit et al., 2015), (Abrams et al., 2014), (Su et al., 2015), (Attali et al., 2014)), while 3 studies demonstrate negative effects ((Hanus et al., 2015), (Christy et al., 2014), and (Long et al., 2014)). The biggest jump (18 studies) is in the reported inconclusive outcomes, which means that there is no solid basis for confidence in the reported results.

Considering the positive reports further, one can see that the studies are highly diverse in terms of game elements and learning domains. An additional problem related to the "conclusiveness" of the reports of the studies is the use of combinations of game elements, since it is unclear whether the combination as a whole or a single particular element in it led to the reported positive or negative outcome. These facts make questionable attempts for a generalization of the conclusion for a specific game mechanism or a specific learning context. For example, there are studies that use similar combinations of game elements (points, badges, leaderboards, avatars), one of which reported positive results (Krause et al., 2015) and the other negative results (Hanus & Fox, 2015). This requires the empirical research studying the use of game elements in educational settings to take into account the different variables representing the learning context and the learners. A good example of this is (Su & Cheng, 2015), which describes a study on learning motivation and achievement of primary school children using a gamified mobile system to outdoor science learning activities. In the study the authors have taken into account learners' characteristics including demographic variables, personal interest in the studied topic, prior smartphone experience, etc. We are planning to further analyze the works in both studies with regard to their evaluation and findings aiming at a more detailed and systematic presentation of the reported results in the light of the supporting evidence.

Discussion and Conclusion

Gamification in education is a developing approach for encouraging learners' motivation, engagement and retention by incorporating game elements in learning environments. This study was designed as a continuation of the systematic mapping study of applying gamification in education, which we conducted a year earlier (Dicheva et al., 2015). That study covered the peer-reviewed research related to gamification in education and published till June 2014. The goal of the study was to review the directions and tendencies of the conducted empirical research on the application of gamification to education, and more specifically to shed light on the context of application and used game elements. With this new study we aimed, from one side, to complement the previous study by reviewing the papers published within the last year (from July 2014 till June 2015) and from another, to identify the shifts and the emerging trends as compared to the results of the previous survey.

Concerning the limitations of the review, as in the previous study we included only papers that clearly study the effects of implementation of game elements in educational contexts. As before, we excluded research on topics conceptually close to gamification or discussing similar topics with different terms as well as papers that do not report results of evaluation of particular studies. Thus, the review provides a fresh, in-depth look on the empirical research being done particularly on the topic of gamification in education.

The review of the recently published papers in the field reveals that despite the fact that gamification in education is still growing phenomenon: (i) The practice of gamifying learning has *outpaced* researchers' understanding of its mechanisms and methods; (ii) Gamification in education has passed the "peak of inflated expectations" in Gartner's hype cycle (Gartner, 2014) and is now sliding down into the "trough of disillusionment".

The first observation is backed by the inconclusive and insufficient evidence for making valid claims about the efficacy of gamification in education as revealed by this review. The second one is obvious by the drop of the empirical studies reporting positive results and the big jump of the studies with inconclusive or negative results. Indeed, in the initial period of climbing to the peak of inflated expectations of Gartner's hype cycle for emerging technologies, many authors have tried to address overly broad research questions, even such as whether gamification as a whole is effective in education. With the maturing of the field, which we believe has started after the review period of Study'14, the published studies try to narrow their research questions. Thus we see a move towards studying the effect of a single game mechanism or design, or applying gamification to a single learning activity. Such studies are vital, since they can isolate the reasons for success or failure of applying gamification in a specific context, which is what the educational community expects from the empirical research.

The other emerging trends identified by this study include the growing number of subject areas of gamification application. While Computer Science/IT educators (and in particular Game Programming instructors) were the early adopters of gamification, there is an evident shift towards a wider scope of its application, including arts, humanity and business education. Considering the implementation aspect, the study shows that the empirical studies have still been mainly conducted by the developers of the software used to support gamification or by their colleagues. There are only two studies using standard LMS ((Barata et al., 2014) and (Latulipe et al., 2015)), the second one in combination with clickers. The observed situation is understandable, since today's course management systems offer limited support for gamifying courses. More interesting, there are no new attempts except (Utomo et al., 2014) for developing gamification plugins for standard LMS. This can be explained partly with the software complexity and constraints on the development of such extensions and especially taking into account the tendency of more focused explorations and gamifying specific learning activities. A novel trend related to gamifying specific learning activities is the development of mobile educational gamification apps (e.g. (Hasegawa et al., 2015), (Perry, 2015), (Su & Cheng, 2015), (Boticki et al., 2015)). The last category of studies identified in this review is the emerging research examining how different groups of learners are affected by gamification (e.g. (Jang et al., 2015), (Barata et al., 2014)). Several papers also prompt the need of addressing learner modeling in their future work. The problem of personalization here is very interesting. It has two sides: from one, using the interaction of the learner with the gamification features of the system in building the learner model, and from another personalizing the gamification features offered to the learner depending on their "gamification type". We accept this as an indication of the beginning of a new line of research aimed at exploring these issues in greater depth.

There are several assumptions underlying the usefulness of gamification in educational context such as gamification is engaging, gamification is motivational, gamification can improve participation. However, current empirical research remains inconclusive on these assumptions. Educational contexts in which gamification may be particularly useful have not been identified yet. However, this does not mean that gamification cannot be used with success in learning contexts. It simply means that the educational benefits of gamification have not been scientifically confirmed yet. Only continued theoretical and rigorous empirical work in differing gamification

settings and across different learning contexts will enable us to establish a practical, comprehensive, and methodical understanding of gamification in education.

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