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How Multidisciplinary is Gamification Research? Results from a Scoping Review

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Abstract
Gamification has been repeatedly framed as an emerging multidisciplinary research field. However, it is unclear how multidisciplinary the field actually is. To answer this question, this paper presents initial results of a broader scoping review of gamification research published between 2010 and 2016. Close to 2,000 peer-reviewed English-language journal and conference papers were identified across 11 databases and categorized by discipline. Results indicate an explosive growth of literature peaking in 2015. Early on, Information and Computing Science dominated the field, to be overtaken by the sum of other disciplines in 2013, education, economics and tourism in specific. This indicates that gamification was initially a field within computer science and HCI and has only recently become truly multi-disciplinary.

Author Keywords
Gamification; multidisciplinarity; scientometrics; scoping review

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous; K.8.0 [Personal Computing]: Games

Introduction

Over the past years, gamification – the use of game design elements in non-game contexts [9] – has emerged as a significant topic of research that cuts across many application domains, such as education, online communities and social networks, health and wellness, crowdsourcing, sustainability, idea generation, or work productivity [25]. While some conceive of gamification primarily as a field within human-computer interaction (HCI) or computer science more broadly [25], the diversity of application domains has led others to frame gamification research as an emerging *multidisciplinary field* [20]. However, it is empirically open whether and how discipline-spanning gamification research actually is.

Early influential systematic reviews [11,25] point to application domains not disciplines concerning themselves with gamification, and operate with a small data set not representative of the growth in recent years. They have been followed by a series of more recent systematic reviews focused, again, on the use of gamification for particular application domains: education [3,18, 21, 26], health and wellbeing [10, 12, 16, 23, 28], crowdsourcing [19], software engineering and information systems [6, 22, 24, 27]. Yet precisely due to their focus on particular domains, these reviews say little about disciplines nor the relative proportions of research occurring within them. (With disciplines, we here refer to an organization of research characterized by (1) a shared object of research, (2) an accumulated body of knowledge around said object with (3) organizing theories and (4) terminologies, (5) shared methods and (6) institutionalization in the form of taught courses and degrees, departments, professional organizations, and the like [13].)

To assess to what extent gamification is a mono-disciplinary or multi-disciplinary research field, this work-in-progress reports results from a larger scoping review of gamification research on the scale and growth of gamification research across disciplines.

Method

The main review has been undertaken adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [14].

Information sources

Based on prior systematic reviews, we identified and searched eleven relevant literature databases: ACM, EBSCO Host, IEEE Xplore, Informit, Infosci, ProQuest, ScienceDirect, Scopus, SpringerLink, SpringOpen and Web of Science.

Inclusion criteria

To be included, a paper needed to be:

- Peer-reviewed
- Conference or journal paper
- Published between 2010 to 2016 (inclusive)
- Fit the operationalization of gamification by Deterding and colleagues [9]: "the use of game design elements in non-game contexts"
- English language

Search strategy

Again based on prior systematic reviews, databases were searched using the search query "gamif* OR gameif* OR gamef*" on title, abstract, and keywords where possible. Searches were conducted in 2015 and a final update completed on 29 March 2017.

Study selection

Papers were screened for eligibility by the authors based on title, abstract and keywords. Where eligibility was unclear or the abstract unavailable, the full text was obtained and reviewed. Examples of papers that were not peer reviewed and were excluded from the study included: books, book reviews, and magazine articles. Examples of papers that were excluded for not meeting the Deterding et al. definition of gamification included papers on serious games, video games, crowd-sourcing, and MOOCs. The source of each publication, year of publication and type of paper (conference proceedings or journal) were derived from the data in each paper's digital record.

Coding

Eligible papers were classified as either 'journal article' or 'conference paper' based on search result metadata and validation of that metadata by the authors. After reviewing available classification systems for scientific disciplines [29], we chose a condensed format of the 22 top-level divisions of the Australian and New Zealand Standard Research Classification (ANZSRC). [2] The top-level divisions of the ANZSRC is the only commonly used current classification system with a manageable number of categories – most other systems feature 100+ disciplinary units [29]. After initial coding, we discovered that many of the original 22 divisions yielded minimal results compared to the other others. For the purposes of presentation, we therefore condensed them further into nine categories. Because gamification could arguably count as belonging to interdisciplinary games research [8], we added a tenth category on interdisciplinary research on games and digital entertainment media to arrive at the following final set:

1. Sciences (mathematical, physical, chemical, earth, environmental, biological, agricultural) (divisions 1-7)
2. Information and Computing Science and Technology (divisions 8 and 10)
3. Medical and Health Sciences (division 11)
4. Education (division 13)
5. Economics; Commerce, Management, Tourism and Services (divisions 14 and 15)
6. Psychology and Cognitive Sciences (division 17)
7. Law and Legal Studies (division 18)
8. Engineering, Built Environment and Design (divisions 9 and 12)
9. Arts, Humanities, and Social Sciences (divisions 16, 19-22)
10. Games, Digital Entertainment Media

To build consensus around classification, two independent coders undertook initial coding of papers in small batches. After each batch of coding disagreements were discussed with a view to improving shared understanding. For the first batch of coding (n=54), inter-rater agreement (based on Cohen's kappa) was 0.56 indicating only 'moderate' agreement [1]. For the second (n=54) and third (n=54) batch of coding inter-rater agreement rose to 'good' agreement with kappas of 0.795 and 0.72. As a final check, both coders independently coded the last 686 papers, with 'good' agreement again confirmed (kappa = 0.77)

	Paper type			Categories (ANZSRC abridged classification)									
Year	**Conference**	**Journal**	**Total**	**1. Sciences**	**2. IT/CS**	**3. Medical**	**4. Education**	**5. Economics**	**6. Psychology**	**7. Law**	**8. Engineering**	**9. Hum/SoSci**	**10. Games**
2010	0	0	**0**	0	0	0	0	0	0	0	0	0	0
2011	21	4	**25**	0	12	1	5	1	0	0	0	0	6
2012	74	11	**85**	3	47	6	12	5	0	0	1	0	11
2013	177	74	**251**	5	107	13	61	13	3	0	10	4	35
2014	263	103	**366**	6	165	14	99	19	3	0	8	7	45
2015	403	295	**698**	14	221	40	258	60	10	1	34	10	50
2016	307	252	**559**	9	193	41	140	68	17	2	32	7	50
Total	**1245**	**739**	**1984**	**37**	**745**	**115**	**575**	**166**	**33**	**3**	**85**	**28**	**197**

Table 1: Gamification systematic review search results and classification

5459 papers were identified from the database searches and following the removal of duplicates and assessment against the eligibility criteria, 1984 papers were identified for inclusion in this systematic review, comprising 1245 conference papers and 739 journal articles.

Results of our initial scoping review are presented in Table 1 and figures 1-3. Overall, we see an almost exponential increase in outputs peaking in 2015. This aligns with descriptions of gamification as an emergent research trend or even 'hype' [9]. The decrease in 2016 may reflect delays in the updating of online databases, a slowing of the growth of the field, or both.

Across all years, most papers were published in sources related to Information and Computing Science and Technology (IT/CS, 37%), Education (29%), and Games and Entertainment Media (10%), followed by Economics and Management (8%). The dominance of IT/CS supports framings of gamification as a research field of HCI/CS [25]. Gamification has a long pre-history in HCI and aligns with current core industry and research interests around user experience and engagement [7]. In addition, gamification involves both HCI and computer engineering challenges (e.g. sensing, analytics, personalisation), providing ample technical IT/CS work. Along these lines, other reviews noted a prevalence of technical papers [11] in gamification.

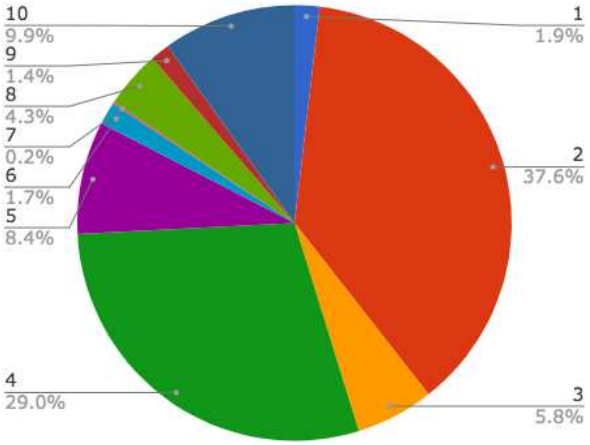

Figure 1: Disciplinary categories as a percentage of total gamification papers 2010-2016

Importantly, however, IT/CS is far from the exclusive discipline category in gamification: almost two thirds of outputs in total stem from non-IT/CS disciplines, supporting that gamification has indeed become a multi-disciplinary field [7].

A diachronic look nicely explains and qualifies this observation (figure 2). From 2010 to 2014, IT/CS publish the majority of papers. This flips in 2015 and 2016, when other fields begin to make up the majority (67% in 2015, 66% in 2016). In other words, in the early years covered by the first reviews [11, 25], gamification *was* predominantly an IT/CS field as per [25]. Since then, however, it has broadened to become multi-disciplinary, as per [20].

This is reflected in the steady increase of the proportion of journal publications (figure 3). Where conference

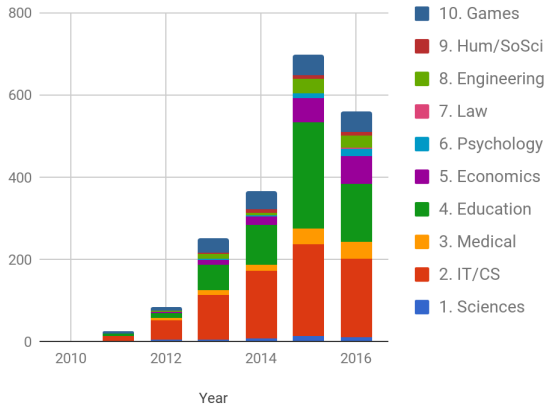

Figure 2: Gamification papers 2010-16 by category

papers made up 71% and more of all outputs in 2010-14, in 2016, journals see their share increase to 45%. Since IT/CS are singularly conference-dominated fields [15], a declining proportion of IT/CS in the overall research fields should coincide with a decline in conference paper proportion. It is worth noting though that journal publications have longer lead times that conference outputs, a 'lag' that may also contribute to explain the relative late growth of journal outputs.

Looking at other disciplines, the data holds several further interesting observations. Far from dominating the field, as might be expected, games and digital entertainment research (category 10) makes up a mere 10%. This aligns with observations that games and play research in HCI and interdisciplinary game studies haven't meshed due to different epistemologies and politics [5, 7]. Instead, education has been pushing forward in 2014-16 to become the second-largest gamification discipline in terms of outputs (29% in

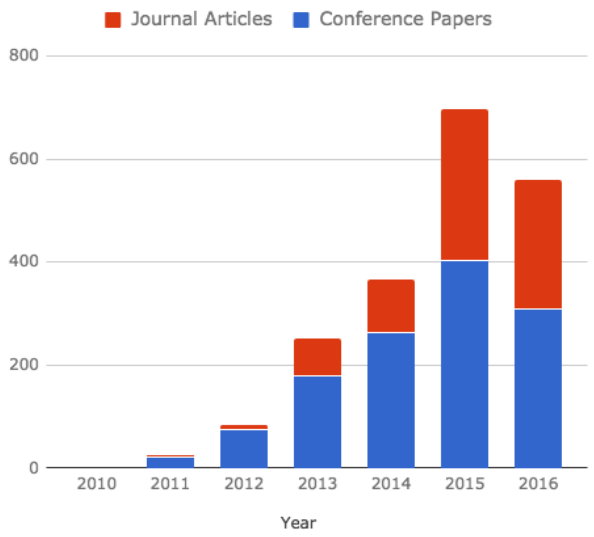

Figure 3: Gamification papers 2010-16 by publication type

total). This mirrors the dominance of education in games research more broadly [17] and may be linked to education being the dominant application context of applied gaming including serious games [4]. Economics and management, medical research, and engineering are other domains that have seen a steady growth particularly in the later years of 2014-16. Informal surveying of the reviewed papers suggests that this is linked to customer and employee engagement, tourism, health and wellbeing, and engineering education as application domains. In contrast, there is a noteworthy dearth of gamification research in the humanities and social sciences (category 9, 1.4%). We assume that this is a least partially a methodological artefact of our review excluding books and book chapters, publication outputs more common in those domains.

Future Research

While useful, our disciplinary categorization remains quite coarse. In future work, we intend to analyze the type of research conducted within and across fields (technical, empirical, theoretical, etc.), determine the application domain, the game design elements used, and empirical study quality. Given the significant amount of work required for these next steps we week input from the CHI PLAY community regarding the most interesting and relevant areas upon which to focus.

Conclusions

Our review of peer-reviewed gamification research from 2010-16 suggests that gamification was a CS/HCI field at its outset (2010-14) that has become a multidisciplinary field in the past two years, particularly due to an increase in gamification research in education, economics and management. Far from being the home of gamification as a research field, interdisciplinary games research makes a distant third in terms of research outputs. This multidisciplinary shift goes hand in hand with a growth of the overall field peaking in 2015, and a growth of the proportion of journal to conference outputs.

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