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Engaging Public Servants for Digital Disruption: a case report of a gamification tool for capacity building on digital strategies experienced in the context of Higher Education

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Resumo

O défice de competências para a inovação tem sido apontado como uma das barreiras ao desenvolvimento de governo digital. A capacitação de servidores públicos, especialmente dos dirigentes da Administração Pública, é por isso um vetor essencial para o desenvolvimento de iniciativas neste domínio. Por outro lado, a utilização de metodologias de gamificação na educação tem o potencial para reforçar a motivação dos alunos. Este artigo descreve e avalia o desenvolvimento e a utilização de uma ferramenta de gamificação para o desenvolvimento de competências de ideação de políticas e estratégias de governo digital, com especial enfoque na utilização de tecnologias emergentes. Os resultados concluem um conjunto de benefícios e apontam para o interesse de alargar este tipo de metodologias à generalidade dos servidores públicos.

Palavras-chave: transformação digital da administração pública; tecnologias emergentes; estratégia para a transformação digital; inovação no sector público; gamificação na educação.

Abstract

The innovation skills gap has been singled out as one of the barriers to the development of digital government. Training of public servants, especially leaders, is therefore an essential vector for the development of initiatives in this field. On the other hand, the use of gamification methodologies in education has the potential to reinforce student motivation. This paper describes and evaluates the development and use of a gamification tool for the development of competences of ideation of policies and strategies of digital government, with special focus on the use of emerging technologies. The results show a range of benefits and point out the interest of extending this type of methodologies to public servants in general.

Keywords: digital government; emerging technologies; digital transformation strategy; public sector innovation; gamification in education.

1. INTRODUCTION

Digital Government refers to the use of digital technologies, as an integral part of governments' modernization strategies destined to create Public Value, including goods or services that satisfy the desires of citizens (OECD, 2014).

Among digital technologies, emerging technologies, also referred as 4th Industrial Revolution technologies, promise to produce innovative solutions and global changes. Some examples of these

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1

technologies are the blockchain, internet of things (IoT) (Ben Dhaou & Lopes, 2018), sensor systems, big data analytics, and artificial intelligence (AI) as referred by Schedler, Guenduez, & Frischknecht (2019) as having become increasingly important.

Schwab (2018) introduced autonomous vehicles, 3D printing, advanced robotics, new materials, energy storage, wearables and wearable Internet and nanotechnology as examples of physical emerging technologies. Gil-Garcia, Helbig & Ojo (2014) say that new technologies offer a myriad of possibilities every day, for public managers, such as cloud computing, smartphone applications, mobile government, blogs, social media, social networking, blogs, Really Simple Syndication (RSS) feeds, big data, open government data, and web design programs and applications, mobile government, smartphone applications, cloud computing, sensors, and more.

Emerging technologies are not an end in themselves, but a mean to fulfill the promises made to citizens. As a matter of fact, they offer public managers countless possibilities to innovate services, products, processes or governance models to achieve different types of goals as openness, innovation, citizen-centricity, citizen engagement, improving efficiency and effectiveness, inter-organizational and intra-organizational collaboration in the public sector. Smart government, an umbrella term for the use of emerging technologies in the public sector, promises to change how governments work (Schedler et al., 2019; Bekkers & Tummers,2018; Gil-Garcia et al.,2014; Soe & Drechsler,2017).

Schedler, Guenduez & Frischknecht (2019) explore barriers to the adoption of smart government and identify six clusters as (a) legal foundations, (b) technical infrastructure, (c) cost-benefit relationships, (d) innovativeness, (e) legitimacy and (f) policy coherence. With regard to innovativeness, this study highlights the lack of skills, know-how and willingness to innovate as major concerns.

Based in these findings, other authors have stressed the need to adapt public servants' competencies to a new set of skills namely knowledge, empowerment, creativity and innovation acceptance Vries, Bekkers e Tummers (2016) and OECD/Observatory of Public Sector Innovations (2017) introduced six "core" skills areas to support the increased levels of innovation in the public sector as iteration, data literacy, user centricity, curiosity, storytelling and insurgency (OECD,2017).

To meet these challenges, a course on 'e-Government (e-Gov)' was introduced in the 'Master of Public Administration' and in the 'Master of Public Policies Management' of the School of Social and Political Sciences of the University of Lisbon. The course syllabus includes lectures on 'innovation' and on 'emerging technologies'. This paper describes a gamification tool developed to complement the expository sessions on these subjects aiming to improve students' awareness, knowledge and willingness to innovate in these matters. The option for this learning methodology was based on several papers describing achievement of aimed results (Kusama, Wigati, Utomo &

Suryapranata, 2018; Ortiz-Colon, Jordán & Agredal, 2018; Subhash & Cudney, 2018; Cheong, Filipou & Cheong, 2014; Dicheva, Agre, Dichev & Angelova ,2015).

The present paper follows this structure: a 'Background' Section presents a summary of theoretical frameworks and methodologies for game design and results of its use from previous studies; a 'Designing the Game of Public Administration 4.0' Section describes the methodology and major options made in the design of the game; an 'Evaluation of the Game' Section reports the experience of testing the game in real scenario; finally, a 'Conclusion' Section summarizes the major findings of the study.

2. BACKGROUND

Gamification means adding game elements into non–gaming context (Deterding, Dixon, Khaled & Nacke,2011).

There are several frameworks which can describe game design and help designers to choose the best approaches to achieve the desired outcomes. One of the most used ones is MDA - Mechanics, Dynamics and Aesthetics, which analyses game design by breaking it into the three distinct components (Hunicke, LeBlanc & Robert, 2004), summarized in Table 1.

Component	Description
Mechanics	Rules and components that define control and courses which support dynamics in gameplay.
Dynamics	Game's context, constraints, choices, chance, consequences, completion, continuation, competition, and cooperation It describes behaviours that emerge at run-time when players utilise mechanics
Aesthetics	Game's challenge, commendation, confidence, cognizance, creativity, contribution, community, and compliance It describes as players' feeling when playing the game. Eight Aesthetics categories are defined: Sensation; Challenge; Discovery; Fellowship; Expression; Fantasy; Submission; Narrative.

Table 1 – MDA analyses game design (adapted from Hunicke et al., 2004)

Effectively designing a serious game is not a simple task. Several aspects relating to the intended audience, the goals to be achieved and all the mechanics and dynamics to be put in action must be considered. Huang and Soman (2013), in their "Practitioner's Guide to Gamification of Education" proposed an interactive five steps methodology summarized in Table 2.

Previous studies show that gamification is being used in the education domain both as a learning tool and as a means to promote collaborative attitudes and behaviors; it has been shown to achieve high levels of students' motivation and immersion, achievement and engagement (Kusama et al.,2018; Ortiz-Colon et al., 2018; Subhash & Cudney, 2018; Cheong et al., 2014; Dicheva et al., 2015).

In particular, Villalustre e del Moral (2015) applied gamification in higher education to tackle a society challenge in which students had to elaborate collaboratively an intervention plan. This study found gamification increased students' motivation and level of satisfaction with the realization of the requested project, favoring collaborative learning (Villatustre & del Moral, 2015). In consonance with those results, Barata, Gama, Jorge e Gonçalves (2013) find greater participation, motivation and proactivity and engagement of students under gamified version of course (Barata et al, 2013).

Step	Description
1. Understanding the Target Audience and the Context	• Target Audience - determine factors like age group, learning abilities, current skill-set, etc • Context - details of group size, environment, sequencing of skills, and time frame
2. Defining Learning Objectives	• General Instructional Goals - having the student complete an assignment, a test/quiz/exam, a project, etc • Specific Learning Goals - the student understanding a concept, being able to perform a task after the training, or completing the learning program • Behavioural Goals - the student to concentrate in class, complete assignments faster, minimize distractions in class, etc
3. Structuring the Experience	• Structure – define stages and milestones that enable knowledge sequencing, achievement measurement and obstacles identification
4. Identifying Resources	• Tracking mechanism – define a means to measure progression • Currency – the unit of measurement of progression (points, time, money,…) • Level – specific amount of currency used to accomplish an objective • Rules – boundaries of what can ne and can not be done • Feedback – mechanism the instructor and/or student can use to learn about progression
5. Applying Gamification Elements	• Self-elements – eg. points, badges, levels, or simply time restrictions. These elements get students to focus on competing with themselves and recognizing self-achievement. • Social-elements - are interactive competition or cooperation, eg. leaderboards. These elements put the students in a community with other students, and their progress and achievements are made public

Table 2 – Gamifying interactive process (adapted from Huang & Soman (2013))

3. DESIGNING THE GAME OF PUBLIC ADMINISTRATION 4.0

The game was developed through the interactive process inspired in 'Practitioner's Guide to Gamification of Education' (Huang & Soman, 2013) and applying the MDA model.

3.1 Target Audience and Context

The game targets two post work post-graduation classes with 20 to 26 students, in the context of a 26 lecturing hours course (one session of two hours per week) on e-government inserted in a Master in Public Administrations and in a Master in Public Policies Management. The game was designed

to be played in a two hours' classroom session, following an expositive session in the previous week, about emerging technologies. The students' background education and experience is diverse and few knowledge and skills on digital government and emerging technologies are expected. Fatigue, difficulty of focus and motivation are also expected, due to the fact that vast majority of the students are occupied with their professional activities during the day.

The game is intended to be used not only in the context of higher education, but also in the context of public servants training. Similar target and context characteristics are expected.

3.2 Objectives of the Game

Table 3 summarizes the defined objectives of the game.

Type of Goals	Goal Description
General goals	a) Raise awareness and promote knowledge of digital government;
	b) Promote a culture of "reflection - action" contextualized in the reality of public servants and transportable to their day to day.
Specific learning goals	a) Consolidate knowledge about emerging technologies and their application on Public Policies and Public Administration;
	b) Develop strategic skills associated with the design of disruptive digital government public policies which comprehend the use of emergent technologies;
	c) Apply knowledge to specific real-world problems and anticipate issues through exploration and immersing virtual scenarios.
Behaviour goals	a) Raise interest on the subject;
	b) Develop creativity and storytelling skills;
	c) Raise motivation and pleasure;
	d) Improve engagement of all students in debate and interaction with colleges;
	e) Raise commitment to finish the task within time limit.

Table 3 – Objectives of "Public Administration 4.0" Game

3.3 Structure of the Game

The game was structured in order to achieve an Action Plan for implement a disruptive public policy. Five stages were defined, according to the best practices of strategic planning (Rabaiah & Vandijck, 2009; Peppard & Ward, 2016; WHO, 2012). Stages, tasks and milestones are shown in Table 4. This step of the interactive process corresponds to definition of Mechanics dimension of the MDA game design analysis framework.

STAGE	TASK	MILESTONE
i. Scope definition	Discuss and choose a scope of focus within the functions of Government	Target Government function selected
ii. As Is analysis	Discuss the context and major problems of the function as well current trends in the next 10 years	Selected at least two problems affecting the function
iii. Vision formulation	From As Is analysis formulate a 10 year ahead vision and select major objectives to achieve	Selected two objectives to achieve in a ten year time horizon

iv. Emerging Technologies enabled Digital Services	Ideate disruptive digital public services employing emerging technologies that contribute to the achievement of selected goals	Selected two disruptive public services and emerging technologies employed
v. Risks and Challenges	Discuss main barriers to develop selected disruptive public services and challenges to face when they will be available	Selected two barriers or risks to solve or mitigate
vi. Action Plan	Discuss and prioritize main actions to develop in order to implement the disruptive public services and to manage change and risks	Action plan

Table 4 – "Public Administration 4.0" Game mechanics elements

3.4 Identifying Resources

A set of rules was developed in order to ensure that all students understand the game mechanics and actually participate in each step. The game should be played in groups, in order to promote cooperation among different students, with different background and experiences. To help the achievement of each step, a deck of playing cards was developed. The cards have different colors to be used in each step and give examples that students may choose to use. Examples were chosen from main references, as detailed in the Introduction Section. The deck includes one or two joker cards of each color to enable students to choose anything else besides the given examples. Table 5 describes the deck of cards. The game dynamics is supported by the cards which are randomly distributed by all players in a group. All players having cards corresponding to a given step should present such cards and start the debate. For each step, one or two cards should be selected by consensus and choice; explanations and further details must be written in the template sheet shown in Figure 1.

Type of Card	Examples provided in the cards
Brown cards - Rules	Describes the mechanics of the game
Purple cards – Government function	Chronic disease management; Public security and borders control; Protection and monitoring of the elderly; Processes of suffrage and representativeness; Prevention and control of forest fires; Urbanism and mobility; Primary and secondary education; one joker
Green cards – strategy goals	Responses to population aging; Inclusion of weakened citizens; Protection of the environment; Public service efficacy; Public service efficiency; Evidence-based policies; Open administration, participation and transparency; Circular economy; Cohesion and free movement within the European Union; New forms of organization of public administration (disintermediation, decentralization, public-private networks); two jokers
Red cards – Emerging technologies	Mobile apps; Social networks; Big data and open data; Autonomous vehicles and drones; Advanced robotics; Blockchain; 3D printing; Artificial intelligence; Wearable and implantable Internet; Internet of things to things; two jokers;
Blue cards – Risks and Challenges	Rules and Laws; Ethics; Innovation financing and new business models; Privacy, security and cyber-risk; Risk of greater gap between rich and poor; Trust and accountability for digital services; Digital skills; Loss of control; Impact on culture and social organization; Risk to employment; two jokers;

Table 5 – "Public Administration 4.0" Game cards deck
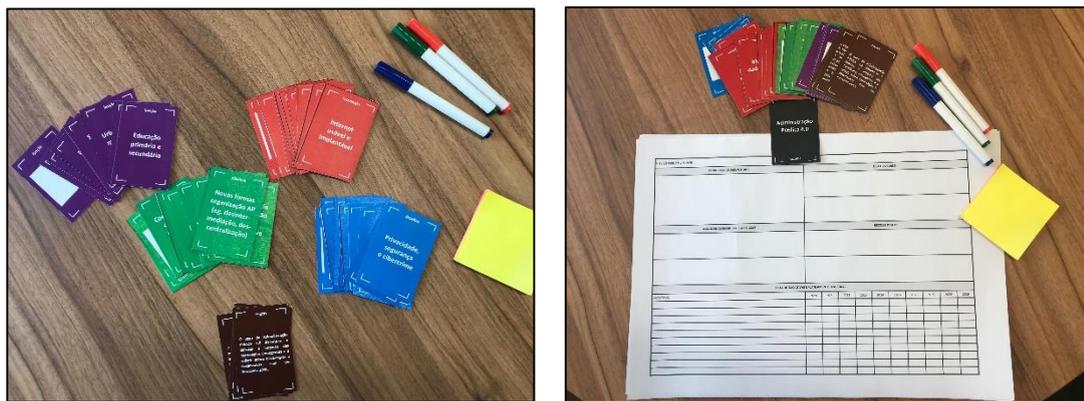
Figure 1 – "Public Administration 4.0" Game – cards deck and register template

The currency chosen was time. For each stage of the game a time limit was defined, within which students should achieve the corresponding milestone. The register sheet helps to track progression. A quick feedback should be provided by the teacher before the end of each step, in order to guarantee a second opportunity if the task is incorrect or incomplete (if there were things students needed to understand or finish before moving onto the next step) and to urge the students to move to the next stage.

3.5 Gamification elements

Time restriction is the major element included in the game. Each group should focus on finishing its tasks on time. At the end of each step, a quick feedback assures the achievement recognition by the students and allows them to proceed. Cooperation is stimulated by rules since all students have to present their ideas related with the cards having in their hand and consensus is necessary to proceed.

At the end of the exercise, all groups must present their work to the class, introducing a tenuous competition which contributes to raise students' endeavor and quality of the work.

3.6 Components of the game according to MPA model

In order to pursue the goals listed above, several mechanisms were combined to create dynamics resulting in multiple aesthetics. Table 6 maps the game on to its components according to MDA model.

Component	Description
1.Mechanics	• Progression through steps, according strategic planning methodologies: i) scope definition; ii) as is analysis; iii) vision formulation; iv) emerging technologies enabled digital services; v) risks and challenges and vi) action plan • Tracking mechanisms – time limits for complete the task and template sheet to help and register progression
2. Dynamics	• Rewards –achievement of the task • Role playing – students were invited to mimic ministers' roles, in order to develop strategic decision making competencies

	• Hints – access a set of alternatives (playing cards) to help students who have scarce context on emerging technologies; quick feedback from the teacher • Simulation – students build their own vision for the future in an iterative matter • Turn-based – every student should express itself in each round
3. Aesthetics – the game was developed to achieve	• Sensation – to be pleasant to play • Fantasy – make believe it is possible to build a better government through the use of Emergent Technologies and build possible future scenarios • Narrative – to mimic a policy decision maker and build story telling competencies • Challenge – to develop the best draft strategy on disruptive digital government in less than 90 mn; • Fellowship – to guarantee every student participates and interacts with the others • Discovery – arise new disruptive ideas for digital government and related issues

Table 6 – "Public Administration 4.0" Game goals and design according MDA model

4. EVALUATION OF THE GAME

4.1. Experience

The game was tested in two classes of a post-graduation course on "e-Government" one of them integrated in a Master in Public Administration (MPA) and the other on a Master in Public Policies Management (MPPM). Before the game was played, an expository session about emerging technologies took place. At the end of this previous session students were asked about proposals of applications with no satisfactory answers.

Thirty-nine students played the game (23 from the MPA and 16 from the MPPM). The majority (70%) of those students were public servants from different areas, namely healthcare, justice, education and local administration; none of them had any information technology or engineering background. The students had the following age distribution: 41% between the ages of 20 and 29; 28% between the ages of 30 and 39, 17% between the ages of 40 and 49 and 14% over 50.

The game was rolled out according to the rules and within a predefined time limit of 120 minutes (including final presentation). Students grouped themselves in teams of five to eight elements each. Within each team, the cards were randomly distributed by the players. For each step of the game (corresponding to card's color) players presented their points of view related with the cards in their hands and, at the end of the round table the team chosen by consensual the card(s) to build the final proposition. The game proceeded in an incremental way following the dynamic predefined by the rules (corresponding to the six steps of strategic planning) and the choices and explanations were recorded in the appropriate template, as presented on Figure 2. At the end, teams presented their proposal to the class and the best proposal was chosen through voting by all students.
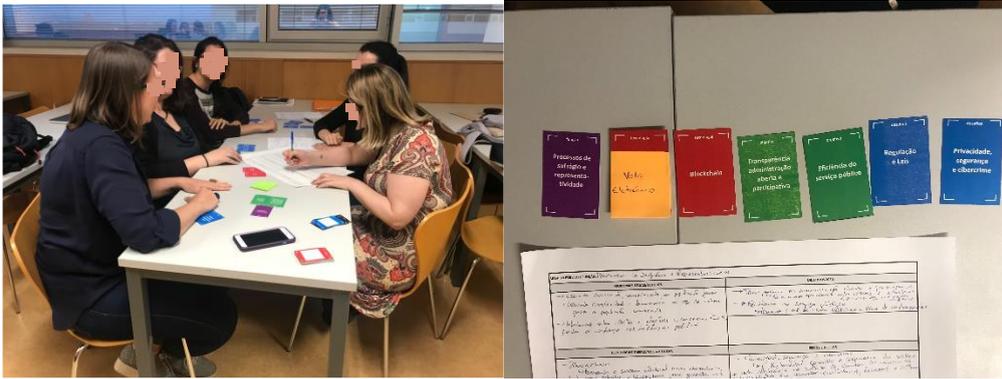
Figure 2 – Public Administration 4.0 game – experimenting the game

All teams completed the game within the time limit and all the proposals responded quite well to the major learning objectives. Table 7 summarizes the resulting proposals.

Group	Government function	Strategy Goals	Emerging Technologies	Risks and Challenges
MPA1	Forest fires prevention and combat	• Promote efficacy of prevention and combat • Data driven policies	• Drones and Advanced Robots for surveillance and combat • Artificial Intelligence for risk forecast	• Unsuitable laws and regulations • New innovation financing models needed
MPA2	Protection and monitoring of the elderly	• Promote inclusion of fragile people • Promote efficiency of healthcare emergency services	• Internet of Things to Things applied to Demotics • Implantable health monitors	• Data protection and cybersecurity risks • New regulations and program financing schemes
MPA3	Public security and border control	• Promote efficacy and efficiency • Promote s	• Artificial Intelligence supporting intelligence services • Electronic identification through wearable or implantable Internet	• Data protection and cybersecurity risks • Society and Public Administration digital skills gap
MGPP1	Urbanism and Mobility	• Promote planet sustainability • Develop new forms of Society organization and participation	• Internet of Things to Things applied to smart city clean transports • Social networks for policy stakeholders' integration	• Innovation resistance • Conflicts of interest between stakeholders
MGPP2	Primary and Secondary Education	• Promote efficacy and efficiency of teaching • Promote efficiency and safety of children life-events	• Artificial Intelligence to adapt learning pathway to child needs • Electronic identification and Internet of Things to	• Laws and regulations concerning privacy and data exchange • Ethical concerns about children control

MGPP3	Processes of Suffrage and Representativeness	• Promote transparency and participation • Promote process efficiency	• Electronic vote • Blockchain	• Insufficient laws and regulations • Cybersecurity and privacy risks

Table 7 – Students' proposals arising from the game

4.2. Evaluation by the students

A questionnaire was carried to find out student's perceptions about the experience. The complete responses' rate was 90%. Students were asked to classify in a 5 points Likert scale their perceptions in the contribution of the game on the target aspects. The results of this survey are shown in Table 8.

Students' classification of the degree of contribution of the game to reach the following learning goals	Frequency distribution of responses (Relative frequency distribution of responses)				
	contributed negatively	did not contribute at all	contributed slightly positively	contributed significantly positively	contributed decisively positively
Consolidate knowledge about Emerging Technologies	0 (0%)	1 (3%)	4 (12%)	**23 (70%)**	5 (15%)
Develop competencies on strategic planning	0 (0%)	0 (0%)	6 (18%)	**21 (64%)**	6 (18%)
Bridge theoretical concepts with their applications in real world	0 (0%)	1 (3%)	4 (12%)	**17 (52%)**	11 (33%)
Explore alternatives and anticipate issues through immersion on virtual scenarios	0 (0%)	0 (0%)	9 (27%)	**15 (45%)**	9 (27%)
Develop creativity and storytelling skills	0 (0%)	0 (0%)	4 (12%)	**17 (52%)**	12 (36%)
Promote participation and interaction among all students	0 (0%)	1 (3%)	4 (12%)	13 (39%)	**15 (45%)**
Promote motivation	0 (0%)	1 (3%)	1 (3%)	14 (42%)	**17 (52%)**
Promote commitment in finishing the work	0 (0%)	1 (3%)	4 (12%)	9 (27%)	**19 (58%)**
Promote quality effort due to competition	0 (0%)	4 (12%)	4 (12%)	11 (33%)	**14 (42%)**
Raise satisfaction and pleasure	0 (0%)	0 (0%)	2 (6%)	13 (39%)	**18 (55%)**

Table 8 –Students' perceptions on benefits of using the game

Furthermore, students were asked whether or not they thought that its proposed initiatives would be implemented in the future and what kind of involvement they would have in it. Only one student replied that those initiatives will not occur and, on the other side, only two students considered the projects will occur within a 3 year' period. The vast majority was divided between considering that the projects would occur either in a five-year period (53%) or not before 10 years (39%). Considering the students' perception on their involvement in these projects, 52% considered they will be impacted by them and their way of acting will change and 33% consider they will play an active role implementing this type of projects.

5. CONCLUSIONS

The study confirms the students' perception of the importance that emerging technologies will assume in the future and the relative low knowledge they have about current developments, possibilities and challenges.

It also points to the fact that gamification approach contributes to greater knowledge, skills development and ability to design innovative projects, by bridging the academic and work context. Moreover, the approach proved to provide great results in class dynamic, namely raised sensation of pleasure, motivation, commitment, interaction and participation. These results are in accordance with previous studies (Kusama et al., 2018; Ortiz-Colon et al., 2018; Subhash & Cudney, 2018; Cheong et al.,2014; Dicheva et al., 2015, Villalustre & del Moral, 2015; Barata et al., 2013).

Besides raising awareness to the subject of digital government and emerging technologies, results suggest that the methodology have promoted a culture of "reflection - action", since half the students are already anticipating their way of acting to change, due to disruptive innovations; and another third aims at participating in this kind of projects.

It may not be possible to generalize the results of this study to national or international levels, due to the small number of participants and the specific context of its implementation. Further work should be developed to confirm the findings, including measuring this benefit of the gamification approach comparing to a control group or enlarging it to real work contexts and introducing other gamification elements.

6. ACKNOWLEDGMENTS

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