

Virtual Teamwork in Gamified 3D Environment

Ferenc Erdős, Richárd Németh and Bayboboeva Firuza

Abstract—Virtual teamwork has spread strongly in various fields in recent times. COVID lockdown measures radically boosted the use of distance-independent remote collaboration methods. Although there are many modern virtual 3D spaces available for teamwork today, they lack additional motivational factors other than the visual 3d experience. Based on this, we tried to research the possible benefits of using gamification technics in 3D virtual collaboration environments to increase virtual team members' motivation. This article attempts to explore and highlight the possibilities of this area, and propose a model framework for implementation of gamified elements in 3D virtual teamwork environments.

Index Terms—3D virtual collaboration, gamification, motivational factors, virtual teamwork

I. INTRODUCTION, BASIC CONCEPTS AND OBJECTIVE

Virtual teams have become commonplace in everyday work over the past 20-30 years. According to the earliest definition, virtual teams are typically characterized as “groups of geographically and/or organizationally dispersed coworkers that are assembled using a combination of telecommunications and information technologies to accomplish a variety of critical tasks” [1].

Even if traditional phone discussions or e-mails can be the base of virtual teamwork, the info-communication foundation of modern collaborations is built on a 3D space platform and eventually with virtual reality extensions. These cutting-edge forms of teamwork need advanced info-communication solutions.

Several pieces of research [2] [3] [4] [5] [6] [7] investigated the theoretical background and effects of 3D Collaborative Virtual Environments (3D CVE) on teamwork performance.

Despite the improvements of new 3D collaborative technologies, virtual team members frequently feel the user experience demanding [8] and the lack of work motivation in virtual environments. With the use of different gamification techniques, we propose a gamified 3D CVE to increase the user experience and motivation.

The proposed objective fits the areas of Internet of Digital Reality (IoD), which is a set of several technologies that allow digital realities to be managed, transmitted and harmonized in various networked surroundings, focusing on a higher degree of user accessibility, immersiveness and experience with the help of virtual reality (VR) and artificial intelligence (AI)[10]. This

enables the creation of a 3D virtual collaboration-based, perfectly customizable, almost futuristic type of working environment, extending the known limits of virtual space and teamwork while taking benefit of the meeting of the above mentioned technologies.

II. CONCEPT OF GAMIFICATION

Most people love to play. Playing games during learning, of course, comes from pedagogy, but like so many other educational techniques initially used by children, it has proven to be extremely effective in the case of adults and works well in a corporate environment. As de Oliveira et al. stated, games were used as simulations to smooth disputes without wasting lives and resources, and also were used as an analysis tool. With the advent of video games, the role and significance of games has increased tremendously [12]. The system specially developed for this purpose is called gamification. In the past 15-20 years, thanks to the development of technology and social media sites, there was a considerable increase in attention toward this concept [13].

Gamification can be defined as the application of game elements in a non-ludic context [9], which can help team members to have better performance and supports an improved behavior. This internal type of gamification concentrates on the internal stakeholders of the company. It is not a negligible aspect that, as in real life, participants have to make efforts to be effective, whether it is about problem-solving, community interaction or achieving an objective. In this way, development, victory and improvement of position can be made even more tangible, and therefore can actually appear as a motivating factor, in addition to strengthening the spirit of competition or cooperation skills. The creative use of gamification helps employees in their learning process, in understanding tasks and in seeing the connections between different phases of work. The more we actively rehearse information, the easier it is stored in long-term memory [32] - the experience of learning in a 3D environment is quite unique, making it much more likely to transfer information from short-term to long-term memory.

III. MOTIVATIONAL FACTORS AND TOOLS

Researchers usually distinguish between three basic types of game mechanics and game design that affect motivation: immersion-, achievement-, and social interaction-related features. “Immersion-related features primarily attempt to immerse the player in self-directed and challenging games, including game mechanics such as avatars, storytelling, and role-playing mechanics. Achievement-related features are principally intended to provide positive feedback to players;

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they may incorporate game mechanics, including symbols, challenges, missions, goals, or leaderboards. Finally, social interaction-related features attempt to use game mechanics to empower users' social interactions" [14].

A study carried out by the World Government Summit in cooperation with Oxford Analytica classified the elements of gamification into three main groups: personal, mechanical and emotional factors [15], displayed in Fig. 1.

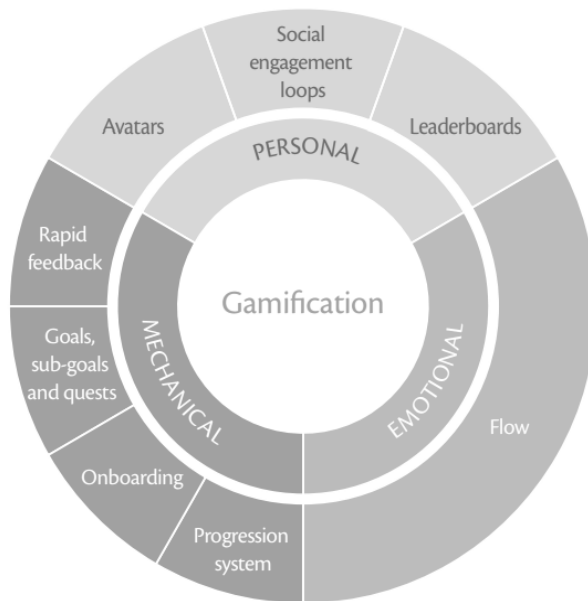


Fig. 1. Personal, mechanical and emotional elements of gamification

Personal elements of gamification are avatars, social engagement loops and leaderboards, the emotional side is characterized by the concept of flow, and mechanical elements include rapid feedback, goals and subgoals system, the onboarding process and progression. In developing environments and tasks based on gamification, competition and storytelling are also key elements – gamification users can earn points for certain actions, such as commenting on each other's ideas, so they compete [13].

In 2019, TalentLMS carried out a survey research project in order to collect the experiences of employees in workplaces where gamification was initiated in order to make workers more satisfied and production more effective. The results are more than thought-provoking. According to the survey, employees claimed that they were more productive and happier because of the positive effects of gamification [16]. As an outcome of the research, the authors collected the top five most significant gamification-like tools, which are rewards, badges, points, leaderboards and levels, respectively. Overall, it can be said that this internal type of gamification appears as a kind of factor influencing behavior and perception at workplaces, while further strengthens the experience of belonging to a community.

Teamwork also can be a motivational factor as partners and teammates can encourage and motivate each other, and collective responsibility is a driving force of cooperation.

IV. GAMIFICATION IN 3D VIRTUAL ENVIRONMENTS

In current years, internal gamification software solutions in enterprise level have been potentially used for the formation and motivation of work teams. From this point of view, 3D CVE implementation with gamification elements can be an innovative and effective solution that helps to mitigate some negative effects of pure virtual collaboration.

Some related works have been already published in which virtual collaborative environments with gamification add-ons for teams have been researched. Wendel et al. [11] developed a virtual space in Minecraft with a serious game, that aims to enhance the soft skills in a team, such as communication, collaboration, motivation and teamwork. Bozanta et al. [19] proposed to apply serious games in a multi-user virtual environment as an efficient instrument to increase the unity, responsibility, communication, and collaboration of team members. The research results showed that the gamified user interface affects the communication, collaboration, and performance of the whole team significantly in the virtual 3D space.

Nowadays, the main goal is to smuggle immersive technologies into the workplace, not only in terms of learning and trainings, but also in terms of the work process. "Microsoft, Facebook and Samsung have already introduced a combination of software and hardware based on VR, AR, and MR. Facebook's Oculus for Business and Gear VR by Samsung are prime examples of such innovations that promise efficient, cost-effective and interactive learning through virtual simulations and a rich visual sensory experience" [17].

The importance of working in a virtual environment has been greatly increased by pandemic closures in the private sector because of the COVID-19 started from China in 2020, and the home office institution came to the fore in most workplaces. People were less and less able to keep in touch with each other physically, and the emphasis shifted from personal contact to online messengers, phone and video calls [24]. This, of course, had a destructive effect not only on social relations but also on teamwork and collaboration.

V. TEAMWORK WITH AVATARS IN THE METAVERSE

Virtual reality linked to 3D visualization and its diverse application prospects can be identified as one of the most significant topics of recent cognitive infocommunication research projects [21]. With the use of various display types, sound systems, and sensors, these systems may provide users an extremely realistic experience. The use of the currently known form of gamification, which is most typical for websites and social media, combined with the possibility of realistic representation provided by 3D space, also explores new dimensions in the fields of education, social interactions and working methods.

Obviously, nowadays social media sites and networks like Facebook belong to our everyday life, they form our thinking and interpersonal connections, influence the way we communicate, and they are also the platforms of exchanging information [25]. And the future of social media platforms will

be three-dimensional for sure. Facebook has also changed its name to “Meta”, indicating that they want to bring the metaverse to life. Metaverse is defined as an internet-based 3D virtual reality world where individuals engage with each other and with software agents as avatars [20].

Throughout history, our lives were constrained by the laws of physical world and influenced by our senses. VR rewrites these rules. It allows us to digitize our experiences and teleport our perceptions to a computer-generated world where reality is constrained by our imagination only [29]. In our view, that day is drawing near when virtual avatars will open virtual files in a three-dimensional/virtual world, will show real processes on virtual boards, while the worker is sitting at home on the couch, with a VR headset and other devices creating lifelike reality. It will give us the ability to work independently of distance, in a workplace where we don't have to go in, we don't have to rent an office, we don't have to be afraid of infections. We could work in a comfortable family environment at home, while the worker's health is measured by sensors. It does not seem impossible that this will be the job of the future.

However, the concept is not much different from home office, which has already revealed several negative effects. During this type of work, we also have to deal with the erosion of social relationships, loneliness and depression [23]. Gamification can also help to solve these problems, as employees can really feel themselves at the workplace without sacrificing the benefits outlined above. We can take advantage of teamwork without anybody being around.

Nowadays more and more business communication platforms announce the development or go-live of their own metaverse. For instance, Microsoft Teams enables immersive collaboration with 3D virtual meeting spaces and avatars (see Fig. 2.) from 2022.

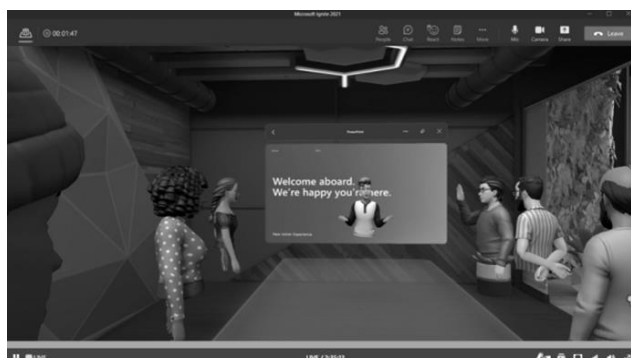


Fig 2. Microsoft Teams 3D virtual meeting space
Source: [30]

The common pillars of games and work are the need to meet the established rules, the necessity of immediate feedback and sub-goals. Gamification can implement these elements into a virtual world using the tools mentioned earlier. It is a great advantage that these rules can be changed arbitrarily within certain limits – the physical strength of a person no longer matters if the avatar he controls can lift huge weights (which is actually performed by a robot). You don't have to spend hours traveling every day, if the avatar can appear virtually

immediately at another site, you don't have to draw on a whiteboard for minutes, you can paste the content you want with one click, and so on. The consequences can also be visualized immediately, you don't have to wait until an error report arrives and goes through the "chain of command" - the feedback system can also be automated and immediate.

A more advanced, almost realistic communication would be a great advantage over the communication methods of traditional, “distance” work. As Blšťáková points out, communication within gaming situations is of paramount importance [18]. Our avatars can also be provided with additional information: name, position, current tasks, contact information, area of work - which may vary depending on our privileges. We can even give the user the freedom to customize their own look. It can also be applicable in the case of workgroups and teams. And here we are thinking not only of the team members but also of the characters in the computer world called NPCs (Non-Playable Character). These characters may have many different roles in a game, they can give assistance and guidance to players, they can tell a story to them, motivate them and so on [22]. Their “job” is to make the world more realistic with their mere presence. Communicating with them also contributes to a realistic experience.

In reality, communication is not just about speech, but also about body language, facial expressions and microexpressions - which are much easier and more realistic to display on an avatar's "face" in a three-dimensional, virtual environment. It would no longer take time to find the right person, we don't need to be embarrassed asking questions – all the necessary information is visible on the avatar's status panel. Many people are also inspired to see that their virtual abilities, rank, and classification within the group change positively – in fact, it is one of the main drivers of gamification.

It's important to note that, in addition to feedbacks, the first impressions are also important (as an initial phase). This process is called onboarding, which “concerns the first interaction a player has with a game. Most games, particularly video games, have tutorials, which aim to guide players through the initial first few minutes of play” [15]. According to the above-mentioned study, we can distinguish four approaches of “freedom”: the freedom to fail (the user's actions take place only in the simulation at first), the freedom to effort (we can test our abilities in different situations without consequences), the freedom to explore (without risk and harm we can experiment with new solutions and methods in a kind of "sandbox") and the freedom to assume different identities (we can try ourselves at any time in a new job or at a higher level of responsiveness). Our virtual selves can be used perfectly even in the learning phase – and the efficiency is not comparable to the tutorial videos and manuals used in the home office.

VI. PROPOSED MODEL FOR DEVELOPMENT OF GAMIFIED 3D VIRTUAL TEAMWORK ENVIRONMENTS

Because of the fact that numerous factors can influence teamwork processes and they can strongly vary depending on the circumstances, achieving an optimal performance with a team is fairly difficult. However, a regular problem is that

employees often lose their interest in the joint goals, which reduces their motivation to collaborate. In the following, we will try to propose a model for the development of gamified 3D spaces suitable for teamwork. We focus on a typical everyday situation, where independent teams compete to each other in order to achieve a better team performance.

Game components appear to be a potential tool for promoting teamwork. The design of game features for teamwork can be influenced by organizational psychology, where many conditions for excellent team performance have been suggested [26]. Interdependence and team cohesion, among other things, are cited in relation to team performance [27], therefore these variables are suitable beginning points for developing gamified components for 3D virtual teamwork.

Task cohesion (commitment to the goals and tasks of a team) and social cohesion are two types of team cohesion. The importance of interdependence relies on that team members help each other to a greater extent when tasks are more interdependent.

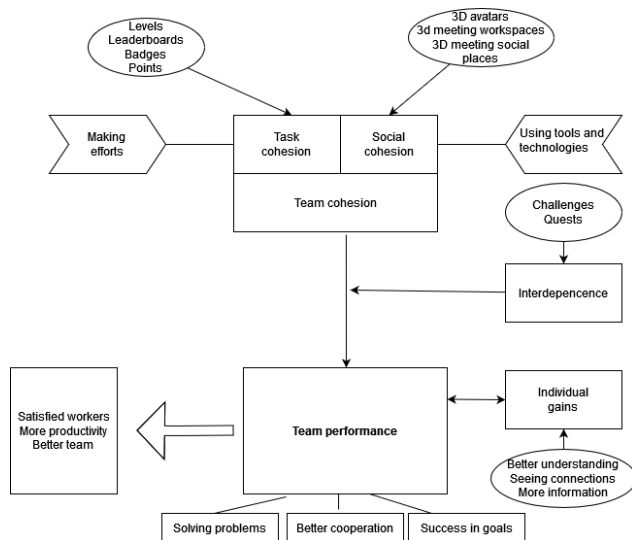


Fig 3. Proposed model for implementation of gamified elements in 3D virtual teamwork environments

The model on Fig 3. highlights the potential gamification elements that can be applied to a 3D environment to enhance team performance. While most of the common gamification elements (i.e. points, badges, levels and leaderboards) are able to strengthen task cohesion, 3D space specific elements (3D avatars, 3D spaces for work meetings and social events) can significantly support social cohesion.

Gamification can help the teamwork process by establishing explicit goals and guiding players toward competitive or cooperative behavior through game rules.

Users' motives are frequently emphasized as a key aspect in gamified environments. It would be difficult to develop an efficient gamified 3D platform if game components do not address elements that inspire team members. As a result, we propose a bottom-up approach in which employees' needs and desires are prioritized.

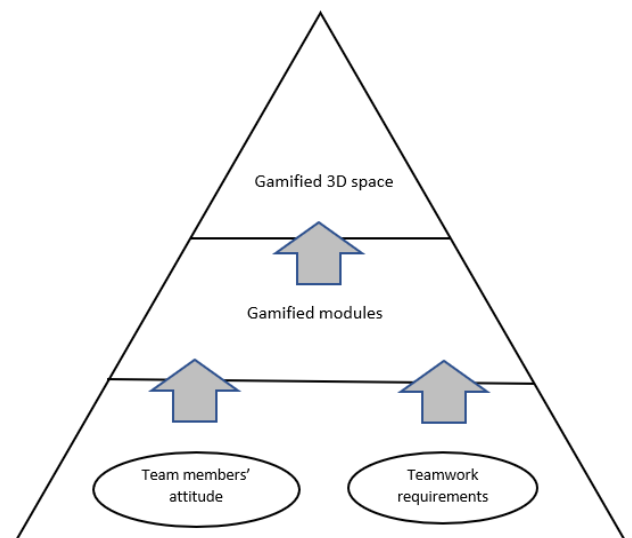


Fig 4. The bottom-up approach of gamified 3D virtual teamwork environment development

With the bottom-up approach, it is possible to develop a 3D virtual environment suited to the actual team's characteristics. The development of reusable low-level components can be the basis of a successful framework. Then these components need to be interconnected to constitute high-level constructs.

VII. BARRIERS OF 3D GAMIFICATION

Of course, the three-dimensional representation of gamification is a novel experience, not only for home users but also in the world of work. Spectacular visualization can not only make progress in increasing user activity in the area of social interactions but can further strengthen addiction.

Despite the advantages described earlier and the potential of the technology, we can expect that the spread of the metaverse will not be smooth. This is the case with all new ideas: at first, there is strong resistance to the new, especially at workplaces. For most of society, the majority is quite conservative when it comes to compulsion. As we can see in many areas of digitization, there is significant resistance to the new, especially at the middle management level. According to some gamification experts, the management usually argues against gamification, because it could be a distraction and could reduce productivity [16]. The new generation is slowly making a difference, and the members of the older generation, who are adhering to traditional methods, are slowly being replaced by members of the Y and Z generations.

Lack of interest from the above can also be an obstacle – this is exactly what 3D virtual reality can change, aiming to make the virtual world even more realistic than the real one – only better! At the same time, it is important to strike the right balance, especially in relation to gamification mechanics. We need to be aware that people need to be motivated differently when they are in the same team. Leaderboards can be extremely successful in pushing some team members to improve their behavior. For other team members opportunities to collaborate

and empathize with other members would be more appealing [28].

As for the 3D visualization, the main reason for the previously poor performance was the excessive hardware requirements – the problem is on its way to be resolved, thanks to the hardware and software development. Lack of access to technology can also be a barrier, mainly due to the high cost of the equipment required. A recent survey showed that only 65% of urban households and 28% of rural households have computers and/or internet access [13]. Nevertheless, we can be sure that with its proliferation, VR-enabled devices will become cheaper. Based on the general definition of convergence, both gamification and virtual reality are exponentially accelerating technologies [29] – so we can reasonably expect rapid proliferation and rapid cost reductions.

VIII. CONCLUSIONS

As we have highlighted, gamified 3D virtual collaboration has a huge potential in virtual teamwork. In this article, we studied the possibilities of applying different gamification elements and techniques in 3D virtual collaboration. As there hasn't any related framework published yet, we provided a novel model for implementation of gamified elements in 3D virtual teamwork environments. We realized that virtual 3D space specific elements can significantly support the social cohesion effects of team members. Of course, this topic requires further quantitative and qualitative research to establish an effective gamified 3D collaboration space for teamwork.

REFERENCES

- [1] A. M. Townsend, S. M. DeMarie, and A. R. Hendrickson, "Virtual teams: Technology and the workplace of the future," *Academy of Management Executive*, vol. 12, no. 3, pp. 17–29, 1998.
- [2] M. M. Montoya, A. P. Massey, and N. S. Lockwood, "3D Collaborative Virtual Environments: Exploring the Link between Collaborative Behaviors and Team Performance," *Decision Sciences*, vol. 42, no. 2, pp. 451–476, 2011. **DOI:** 10.1111/j.1540-5915.2011.00318.x
- [3] C. Weidig, Á. Csapó, J. C. Aurich, B. Hamann, and O. Kreylos, "VirCA NET and CogInfoCom: Novel Challenges in Future Internet Based Augmented/Virtual Collaboration," in *Proceedings of the 3rd IEEE International Conference on Cognitive Infocommunications*, Kosice, Slovakia, pp. 267–272, 2012. **DOI:** 10.1109/CogInfoCom.2012.6421992
- [4] S. Pick, S. Gebhardt, B. Weyers, B. Hentschel and T. Kuhlen, "A 3D collaborative virtual environment to integrate immersive virtual reality into factory planning processes," *2014 International Workshop on Collaborative Virtual Environments (3DCVE)*, Minneapolis, USA, 2014, pp. 1–6. **DOI:** 10.1109/3DCVE.2014.7160934
- [5] W. J. Sarmiento, A. Maciel, L. Nedel and C. A. Collazos, "Measuring the collaboration degree in immersive 3D collaborative virtual environments," *2014 International Workshop on Collaborative Virtual Environments (3DCVE)*, Minneapolis, USA, 2014, pp. 1–6. **DOI:** 10.1109/3DCVE.2014.7160931
- [6] E. Lógó, K. Hercegfí and B. P. Hámornik, "Methodologies for subjective performance assessment of collaboration," *2015 6th IEEE International Conference on Cognitive Infocommunications (CogInfoCom)*, 2015, pp. 403–406. **DOI:** 10.1109/CogInfoCom.2015.7390627
- [7] F. Erdős and G. Kallós, "Economic aspects of 3D virtual collaboration," *2017 8th IEEE International Conference on Cognitive Infocommunications (CogInfoCom)*, 2017, pp. 333–338. **DOI:** 10.1109/CogInfoCom.2017.8268266
- [8] D. Geszten, A. Komlódi, K. Hercegfí, B. Hámornik, A. Young, A., M. Köles, and W. G. Lutters, "A content-analysis approach for exploring usability problems in a collaborative virtual environment," *Acta Polytechnica Hungarica*, vol. 15, no. 5, pp. 67–88, 2018. **DOI:** 10.12700/APH.15.5.2018.5.5
- [9] S. Deterding, D. Dixon, R. Khaled, and L. Nacke, "From game design elements to gamefulness: Defining "Gamification"," *Proceedings from MindTrek'11 (ACM)*, Tampere, Finland, pp. 9–15, 2011. **DOI:** 10.1145/2181037.2181040
- [10] P. Baranyi, Á. Csapó, T. Budai and Gy. Wersényi, "Introducing the Concept of Internet of Digital Reality - Part I," *Acta Polytechnica Hungarica*, vol. 18, no. 7, 2021, pp. 225–240. **DOI:** 10.12700/APH.18.7.2021.7.12
- [11] V. Wendel, M. Gutjahr, and P. Battenberg, "Designing a Collaborative Serious Game for Team Building Using Minecraft," *7th European Conference on Games Based Learning*, 2013, pp. 569–578
- [12] L. C. de Oliveira et al., "Gamification for online training of court professionals in a Labour Court in São Paulo, Brazil," *Eccos*, pp. 172–2018. **DOI:** 10.5585/eccos.n46.6497
- [13] J. Xu et al., "Psychological interventions of virtual gamification within academic intrinsic motivation: A systematic review," *Journal of Affective Disorders*, vol. 293, pp. 444–465, 2021. **DOI:** 10.1016/j.jad.2021.06.070
- [14] C. H. Chung, Y. Y. Lin, "Online 3D gamification for teaching a human resource development course," *Journal of Computer Assisted Learning*, 2021; pp 1–15. **DOI:** 10.1111/jcal.12641
- [15] Oxford Analytica, World Government Summit In Cooperation with "Gamification and the Future of Education," pp. 7, 2016. [Online] Available: <https://www.worldgovernmentsummit.org/api/publications/>
- [16] TalentLMS: "The 2019 Gamification at Work Survey", 2019. [Online] Available: <https://www.talentlms.com/blog/gamification-survey-results/>
- [17] F. Laroui, "The state of gamification in the workplace: use cases and future trends," 2020. [Online] Available: <https://www.exoplatform.com/blog/gamification-in-the-workplace-use-cases-and-future-trends-exo-platform/>
- [18] J. Blštáková, K. Piwowar-Sulej, "Gamification as an Innovative Idea within Human Resources Management," In: P. Maresova, P. Jedlicka, I. Soukal (editors), 2019, p. 77–88. [Online] Available: <http://hdl.handle.net/20.500.12603/87>, pp. 10, 2019.
- [19] A. Bozanta, B. Kutlu, N. Nowlan, and S. Shirmohammadi, "Effects of serious games on perceived team cohesiveness in a multi-user virtual environment," *Computers in Human Behavior*, no. 59, pp. 380–388, 2016. **DOI:** 10.1016/j.chb.2016.02.042
- [20] D. Alanah, M. John, O. Dawn, K. Deepak, and Z. Ilze "Avatars, People, and Virtual Worlds: Foundations for Research in Metaverses," *Journal of the Association for Information Systems*, vol. 10, no. 2, pp. 90–117, 2009. **DOI:** 10.17705/1jais.00183
- [21] F. Erdős, and R. Németh (2019): "AMT-Based Real-Time, Inter-Cognitive Communication Model", *Acta Polytechnica Hungarica*, no. 6, pp. 115–127, 2019. **DOI:** 10.1109/CogInfoCom.2018.8639912
- [22] R. Rismanto, R. Ariyanto, A. Setiawan, M. E. Zari, "Sugeno Fuzzy for Non-Playable Character Behaviors in a 2D Platformer Game", *International Journal of Engineering & Technology*, vol. 7, no. 4.44, pp. 1447–1452, 2018. **DOI:** 10.14419/ijet.v7i4.36.29005
- [23] F. Niebuhr, P. Borle, F. Börner-Zobel and S. Voelter-Mahlknecht, "Healthy and Happy Working from Home? Effects of Working from Home on Employee Health and Job Satisfaction," *International Journal of Environmental Research and Public Health*, vol 19, no. 3, pp. 1–14, 2022. **DOI:** 10.3390/ijerph19031122
- [24] A. A. Feldmann, et al. "The Lockdown Effect: Implications of the COVID-19 Pandemic on Internet Traffic," *Proc. Internet Measurement Conference (IMC '20)*, Pittsburgh, USA, 2020. **DOI:** 10.1145/3419394.3423658
- [25] L. Chiariglione, and Cs. A. Szabó "Multimedia Communications: Technologies, Services, Perspectives Part II. Applications, Services and Future Directions", *Infocommunications Journal*, vol. 6, no. 3, pp. 51–59, 2014.
- [26] D. R. Igen, Hollenbeck, M. J. R. Johnson, M., and D. Jundt, "Teams in organizations: From input-process-output models to IMOI models," *Annual review of psychology*, 56, pp. 517–543, 2005. **DOI:** 10.1146/annurev.psych.56.091103.070250

- [27] D. J. Beal, M. J. Burke, C. L. McLendon and R. R. Cohen, "Cohesion and performance in groups: A meta-analytic clarification of construct relations," *Journal of applied psychology*, vol. 88, no. 6, pp 989–1004, 2003. **doi:** 10.1037/0021-9010.88.6.989
- [28] K. Robson, et al., "Game on: Engaging customers and employees through gamification", *Business Horizons*, vol. 59, no. 1, pp. 29–36. 2015. **doi:** 10.1016/j.bushor.2015.08.002
- [29] S. Kotler, and P. Diamandis, "The Future is Faster Than You Think," Simon & Schuster, New York, USA, 2021.
- [30] Microsoft, "Mesh for Microsoft Teams aims to make collaboration in the 'metaverse' personal and fun", November 2, 2021 [Online] Available: <https://news.microsoft.com/innovation-stories/mesh-for-microsoft-teams/>
- [31] S. Deterding, "Gamification: Designing for Motivation," *Interactions*, vol. 19, no. 4, pp. 14–17, 2012. **doi:** 10.1145/2212877.2212883
- [32] P. Wolfe: "The neuroscience of teaching and learning: A trainer's manual," Orlando, FL:ASCD, 2018.



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