Viability of Using Digital Games for Improving Team Cohesion: A Systematic Review of the Literature

Juraj Kovalčík, Magdaléna Švecová, Michal Kabát

Mgr. Juraj Kovalčík, PhD.
University of Ss. Cyril and Methodius in Trnava
Faculty of Mass Media Communication
Námestie J. Herdu 2
917 01 Trnava
SLOVAK REPUBLIC
juraj.kovalcik@ucm.sk

Juraj Kovalčík is an assistant professor at the Department of Digital Games at the Faculty of Mass Media Communication, University of Ss. Cyril and Methodius in Trnava, Slovakia. His research focuses on the history of games and gaming in Slovakia, game narratives and aesthetics, and relations between digital games and other audio-visual media.

Mgr. Magdaléna Švecová, PhD.
University of Ss. Cyril and Methodius in Trnava
Faculty of Mass Media Communication
Námestie J. Herdu 2
917 01 Trnava
SLOVAK REPUBLIC
magdalena.svecova@ucm.sk

Magdaléna Švecová is the head of the Department of Digital Games at the Faculty of Mass Media Communication, University of Ss. Cyril and Methodius in Trnava, Slovakia. Her research is focused on gamification of education, ethical aspects of digital games and game journalism.

Mgr. Michal Kabát, PhD.
University of Ss. Cyril and Methodius in Trnava
Faculty of Mass Media Communication
Námestie J. Herdu 2
917 01 Trnava
SLOVAK REPUBLIC
michal.kabat@ucm.sk

Michal Kabát is an assistant professor at the Department of Digital Games at the Faculty of Mass Media Communication, University of Ss. Cyril and Methodius in Trnava, Slovakia. His academic interests are particularly focused on mapping the history of local gaming experience in post-socialist countries and the current development of virtual worlds. He is involved in game jams, eSport and video-streaming activities at the university.

ABSTRACT:
Team cohesion, teamwork and team building are important constructs regarding teams and their performance in various organizations and environments. In this review, we summarize the current state of research on the influence of digital games on team cohesion and related constructs. We found a total of 7 studies that fit the criteria, resulting in 18 outcomes. Among the 18 outcomes that improved throughout the intervention, 15 reported significant improvement from the intervention and 3 reported no significant differences. Specifically, team communication, task delegation, atmosphere, trust, team flow, team performance and goal commitment were the most improved sub-constructs by team building video gaming interventions. The majority (n = 9) of those with significant improvements post-test were from randomly controlled trials (RCTs) with single or two control groups. Overall, we found that team video gaming may be effective in supporting team cohesion or team building; however, to enhance the understanding of the relationship between digital games and team cooperation, it is recommended to extend or vary gameplay intervention times, prioritize diverse outcome measures, address reporting biases, conduct follow-up assessments, include diverse populations and report demographics, and recognize the specific effects of different game features on outcomes.

Introduction

A well-developed effective team is an asset to any business enterprise[1] and can be defined as a group of individuals who come together to work collaboratively towards a common goal or objective.[2] Moreover, the team is characterized by interdependence, shared responsibility and role specification.[3] One of the basic parameters of a well-functioning team is team cohesion. Cohesion, in general, mirrors a particular system of attraction or bond – driven by either the team members or the team tasks and encourages the team to persevere together.[4] Team cohesion is an essential element for teams, since the lack of a sense of cohesion within a team can result in unmotivated behaviour and a lack of participation by its members.[5] There have been several meta-analyses of team

---

1   HIRIYAPPA, B.: *Team Building and Group Dynamics Management*. Bloomington, IN : Booktango, 2013, p. 8.
2   For more information, see: DYER Jr., W. G., DYER, J. H., DYER, W. G.: *Team Building Proven Strategies for Improving Team Performance*. San Francisco, CA : John Wiley and Sons, 2013.
3   See: ZHANG, X., KWAN, H. K.: Team behavioral integration links team interdependence with team performance: an empirical investigation in R&D teams. In *Frontiers of Business Research*, Vol. 13, No. 7, p. 193-211.
4   See also: CASEY-CAMPBELL, M., MARTENS, M. L.: Sticking it all together: A critical assessment of the group cohesion-performance literature. In *International Journal of Management Reviews*, 2019, Vol. 11, No. 2, p. 223-246.
5   For example, see: MYSIRLAKI, S., PARASKEVA, F.: Virtual Team Effectiveness: Insights from the Virtual World Teams of Massively Multiplayer Online Games. In *Journal of Leadership Studies*, 2019, Vol. 13, No. 1, p. 34-55.

cohesion[6] suggesting team cohesion is positively related to team effectiveness, and that the relationship is strengthened by task interdependence, such as the relationship between cohesion and effectiveness is stronger when team members are more interdependent.[7] Team cohesion has a positive relationship with team performance.[8] For instance, previous studies have shown that group cohesion can improve athletes' sports performance,[9] in project teams[10] or among students.[11]

One way to increase team cohesion is to organize team-building activities. Team building refers to a systematic and intentional process aimed at enhancing the effectiveness and cohesiveness of a team.[12] Team building involves a wide range of activities, designed for improving team performance.[13] Current research is inclined to the idea that team building does improve team outcomes. Specifically, process and affective outcomes were most improved by team-building interventions. Moreover, all the components (i.e., role clarification, goal setting, interpersonal relations, and problem solving) of team building had a moderate effect on outcomes but the goal-setting and role-clarification components had the largest effect.[14] Traditional team-building activities are often conducted in physical settings. In today's rapidly evolving work landscape, where remote teams have become increasingly prevalent, it may be challenging to implement traditional team-building activities. However, the rise of digital games with competitive or cooperative elements offers a promising alternative for fulfilling the role of classic team-building activities. As the number of global users of digital games is rising (with an estimated 3.1 billion users in 2027), there is a chance that employees will use them as a team development activity and also that they will be digitally skilled to operate them.[15] Due to their capabilities around easy communication, emotional engagement, and social interaction, 3D virtual worlds and team video gaming (TVG) offer a potential avenue for fostering (virtual) team development.[16] Also, according to a survey conducted in Slovakia, respondents perceive

6   BEAL, D. J. et al.: Cohesion and performance in groups: a meta-analytic clarification of construct relations. In *Journal of applied psychology*, 2003, Vol. 88, No. 6, p. 989.; For more information, see: CARRON, A. V. et al.: Cohesion and Performance in Sport: A Meta Analysis. In *Journal of Sport and Exercise Psychology*, 2002, Vol. 24, No. 2, p. 168-188.; EVANS, C. R., DION, K. L.: Group cohesion and performance: A meta-analysis. In *Small Group Research*, 1989, Vol. 22, No. 3, p. 175-186.; GULLY, S. M., DEVINE, D. J., WHITNEY, D. J.: A Meta-Analysis of Cohesion and Performance: Effects of Level of Analysis and Task Interdependence. In *Small Group Research*, 1995, Vol. 26, No. 2, p. 497-520.
7   COOKE, N. J., HILTON, M. L.: *Enhancing the effectiveness of team science.* Washington, D.C. : National Academies Press, 2015, p. 56.
8   See: GROSSMAN, R. et al.: The team cohesion-performance relationship: A meta-analysis exploring measurement approaches and the changing team landscape. In *Organizational Psychology Review*, 2022, Vol. 12, No. 2, p. 181-238.
9   See: GU, S., XUE, L.: Relationships among Sports Group Cohesion, Psychological Collectivism, Mental Toughness and Athlete Engagement in Chinese Team Sports Athletes. In *International Journal of Environmental Research and Public Health*, 2022, Vol. 19, No. 9, p. 1-14. [online]. [2023-02-15]. Available at: <https://doi.org/10.3390/ijerph19094987>.
10   For example, see: CHIOCCHIO, F., ESSIEMBRE, H.: Cohesion and Performance: A Meta-Analytic Review of Disparities Between Project Teams, Production Teams, and Service Teams. In *Small Group Research*, 2009, Vol. 40, No. 4, p. 382-420.
11   For more information, see: LENT, R. W., SCHMIDT, J., SCHMIDT, L.: Collective efficacy beliefs in student work teams: Relation to self-efficacy, cohesion, and performance. In *Journal of Vocational Behavior*, 2006, Vol. 68, No. 3, p. 73-84.
12   See also: BELBIN, R. M.: *Management Teams: Why they succeed or fail*. London, New York, NY : Routledge, 2010.
13   See: FAPOHUNDA, T. M.: Towards Effective Team Building in the Workplace. In *International Journal of Education and Research*, 2013, Vol. 1. No. 4, p. 1-12. [online]. [2023-02-15]. Available at: <https://www.ijern.com/images/April-2013/23.pdf>.
14   For example, see: KLEIN, C. et al.: Does Team Building Work?. In *Small Group Research*, 2009, Vol. 40, No. 2, p. 181-222.
15   CLEMENT, J.: *Number of users of video games Worldwide 2017-2027.* Released on 1st June 2023. [online]. [2023-02-22]. Available at: <https://www.statista.com/statistics/748044/number-video-gamers-world/>.
16   ELLIS, J. B. et al.: Games for Virtual Team Building. In MARSDEN, G., LADEIRA, I., KOTZÉ, P. (eds.): *DIS '08: Proceedings of the 7th ACM conference on Designing interactive systems*. New York, NY : ACM, 2008, p. 295.

these gaming and gamification aspects to be important for the future to a greater extent than they have actually applied them in the present.[17]

Thanks to continuous research in this area, the image of digital gaming as a negative phenomenon and a pointless activity is also gradually changing and its positive aspects are coming to the forefront of public opinion.[18] Authors like J. McGonigal promote their research communicating gamers as expert problem solvers and collaborators, since they cooperate with other players to overcome daunting virtual challenges.[19] Also, players' in-game motivational experiences can contribute to affective well-being, but they do not affect the degree to which play time relates to well-being.[20] Many features have been shown to have a positive impact on the development of various skills not only in children, but also in adults.[21] Moreover, compared to conventional learning, game-based learning has several benefits that make it effective such as control over gaming experience, a sense of immersion and involvement, practicing knowledge and skills repeatedly, collaboration and knowledge-sharing among players and quantifiable achievements.[22] Naming particular skills, game-based learning is not only about increasing motivation to learn,[23] improving cognitive abilities[24] and gaining hard skills, but also a wide range of soft (including social) skills. The positive impact of digital games on social behaviour has been proven and players seem to acquire important prosocial skills when they play games that are specifically designed to reward effective cooperation, support, and helpful behaviour.[25] Another research suggests that researchers and practitioners should consider using prosocial digital games to promote a variety of prosocial behaviours and skills that are crucial for young people's social-emotional development and the well-being of society.[26] Studies have also associated altruistic personality and helpful behaviours in cooperative or competitive video game play.[27]

It goes without saying, therefore, that this potential of digital games has already been used to promote team cohesion and various teamwork skills as well, for instance team efficiency, leadership, etc.[28] G. S. Anderson and S. Hilton demonstrated in their study that engagement in collaborative video games has the potential to enhance team cohesion.[29] Also, the promotion of cohesion through cooperative team-play activates trust norms,

17   STACHO, Z. et al.: Gamefikácia v procese adaptácie zamestnancov. In *REFLEXIE – Kompendium teórie a praxe podnikania*, 2022, Vol. 6, No. 2, p. 84.

18   For more information, see: GRANIC, I., LOBEL, A., ENGELS, R. C. M. E.: The Benefits of Playing Video Games. In *American Psychologist*, 2014, Vol. 69, No. 1, p. 66-78.

19   For example, see: McGONIGAL, J.: *Reality Is Broken: Why Games Make Us Better and How They Can Change the World.* New York, NY : Penguin Books, 2011.

20   See also: JOHANNES, N., VUORRE, M., PRZYBYLSKI, A. K.: Video game play is positively correlated with well-being. In *Royal Society Open Science*, 2021, Vol. 8, No. 2, p. 1-14. [online]. [2023-02-15]. Available at: <https://doi.org/10.1098/rsos.202049>.

21   For more information, see: CONNOLLY, T. M. et al.: A systematic literature review of empirical evidence on computer games and serious games. In *Computers & Education*, 2012, Vol. 59, No. 2, p. 661-686.

22   See: BOWMAN Jr., R. F.: A "Pac-Man" Theory of Motivation: Tactical Implications for Classroom Instruction. In *Educational Technology*, 1982, Vol. 22, No. 9, p. 14-17.

23   WICHADEE, S., PATTANAPICHET, F.: Enhancement of Performance and Motivation through Application of Digital Games in an English Language Class. In *Teaching English with Technology*, 2018, Vol. 18, No. 1, p. 87-88.

24   VICKERS, S. W.: *Digital gaming as a learning tool : a literature review.* [Master Thesis]. Cedar Falls, IA : University of Northern Iowa, 2012, p. 30.

25   See also: GRANIC, I., LOBEL, A., ENGELS, R. C. M. E.: The Benefits of Playing Video Games. In *American Psychologist*, 2014, Vol. 69, No. 1, p. 66-78.

26   SALEME, P. et al.: Prosocial digital games for youth: A systematic review of interventions. In *Computers in Human Behavior Reports*, 2020, Vol. 2, No. 1, p. 4-6. [online]. [2023-02-15]. Available at: <https://doi.org/10.1016/j.chbr.2020.100039>.

27   VELEZ, J. A., EWOLDSEN, D. R.: Helping Behaviors During Video Game Play. In *Journal of Media Psychology Theories Methods and Applications*, 2013, Vol. 25, No. 4, p. 198.

28   RIIVARI, E., KIVIJÄRVI, M., LÄMSÄ, A.-M.: Learning teamwork through a computer game: for the sake of performance or collaborative learning?. In *Educational Technology Research and Development*, 2021, Vol. 69, No. 3, p. 1765.

29   ANDERSON, G. S., HILTON, S.: Increase team cohesion by playing cooperative video games. In *Software Education Today*, 2015, Vol. 28, No. 1, p. 36.

resulting in an increase in cooperative behaviour.[30] The issue of the involvement of digital games in the development of team spirit, with an emphasis on improving team cohesion, is evolving gradually with the rise of esports, which are very closely linked to this issue. There is evidence that involvement in esports helps young players to develop skills that are needed in 21st century societies and which are increasingly valued by employers.[31] Mostly, competitive or cooperative digital games which are the foundation of electronic sports are a way to improve team functions through play. In gameplay scenarios involving teams competing against each other or solving specific challenges, the inclusion of agents as mechanisms to influence team behaviour becomes a significant factor. Additionally, game environments are particularly suitable for situations where manipulation of resource constraints, such as decision-making time, is desirable.[32] Also, esports players have experience which leads to significant benefits for communicative competencies.[33]

Due to the positive effects of esports and competitive play on behaviour in the context of increasing commitment and the formation of cohesive teams therefore, positive effects can also be assumed in the organizational environment. In addition, esports, and digital competitive gaming in general, develop necessary soft-skills, for example, problem-solving, schematic and conceptual thinking, working under pressure and leadership.[34] For this reason, we decided to design a research project called Using Competitive Digital Games to Develop Team Cohesion and Social Adaptation in Generation Z. Its aim is to develop a methodology for the effective use of competitive digital games. As part of the sub-objectives of this project, we are creating a competitive digital game that will be used for research purposes, in particular, conducting an experimental play of a competitive game, based on which we will investigate the degree of increase in team cohesion in the research sample. For this reason, we have decided to conduct this pre-research in the form of a literature review. The main aim of this study is to provide an overview and to summarize current data on the issue, what experiments on team video gaming have been carried out so far and what results they have produced in relation to team cohesion. We therefore formulated our research question as follows: What has been found so far in the literature about the impact of digital games on team cohesion and team building?

Methods

The literature review is conducted in relation to the research project mentioned above and in accordance with the principles of systematic reviews as described by J. Hendl and J. Mareš.[35] We have followed the PRISMA guidelines to ensure transparent

30   GREITEMEYER, T., COX, C.: There's no "I" in team: Effects of cooperative video games on cooperative behavior. In *European Journal of Social Psychology*, 2013, Vol. 43, No. 3, p. 227.

31   ZHONG, Y. et al.: The impact of esports participation on the development of 21st century skills in youth: A systematic review. In *Computers & Education*, 2022, Vol. 191, No. 8, p. 11. [online]. [2023-03-01]. Available at: <https://doi.org/10.1016/j.compedu.2022.104640>.

32   DI PIETRANTONIO, J., MENDONCA, D.: Opening the Black Box of Team Performance with Open-source Games: A Review and Recommendations. In *IEEE Transactions on Games*, 2022, Vol. 14, No. 2, p. 175-177.

33   HANGHØJ, T., NIELSEN, R. K. L.: Esports skills are people skills. In ELEAEK, L. et al. (eds): *13th European Conference on Games Based Learning (ECGBL 2019)*. Reading : Academic Conferences and Publishing International Limited, 2019, p. 541.

34   See: HEWETT, K. J. E.: Embracing Video Games for Strategic Thinking, Collaboration, and Communication Skills Practice. In KHOSROW-POUR, M. (ed.): *Research Anthology on Fandoms, Online Social Communities, and Pop Culture.* Hershey, PA : IGI Global, 2022, p. 296-314.

35   HENDL, J.: *Kvalitativní výzkum: Základní metody a aplikace*. Prague : Portál, 2005, p. 349-369.; MAREŠ, J.: Přehledové studie: jejich typologie, funkce a způsob vytváření. In *Pedagogická orientace*, 2013, Vol. 23, No. 4, p. 429-434.

and comprehensive reporting of our review process.[36] For inclusion in the review, papers were required to (a) evaluate the effects of a digital game on team cohesion, teamwork or team building; (b) include measurable, quantitative outcomes in the design and purpose of the study; (c) be published in or translated into English; (d) be peer-reviewed; (e) date from January 2010 to November 2022; and (f) have a nonclinical study population over the age of 18. As we were interested in teams forming and functioning in professional or higher education environments, we excluded studies focused on children or adolescents. Non-peer-reviewed reports, such as unpublished manuscripts or conference abstracts, were not eligible for inclusion.

The electronic databases searched for this review were Scopus and Web of Science. The search was conducted in November 2022. Search terms included ("team cohesion" OR "teamwork" OR "team building") AND ("video game" OR "digital game"). Applying the snowballing method, reference lists cited in study reports included in the review were also searched. Titles and abstracts were reviewed for eligibility and relevant articles were obtained in full and assessed against the inclusion criteria described above.

Each record's title and abstract were screened by one researcher, each retrieved report was then screened independently by two researchers, and any disagreements were resolved by discussion. Two reviewers working independently collected data from each report identified as eligible at the full text level. Discrepancies in the full-study coding were resolved by discussion.

Study factors were coded based on coding from past reviews of game-based social skill development[37]. Reports were coded in terms of: name of authors and date published; the main aims of study; the team outcomes; study design, follow-up, and duration; details of participants, their mean age, age range, education level, gender split, ethnicity breakdown; presence of facilitator; game creator involvement.

Results

The number of records at all stages of the review is reported using the PRISMA flow diagram (Picture 1). Among the reports assessed for eligibility, eleven were excluded from the final review for the following reasons: the games selected to study their effects on team cohesiveness, teamwork engagement/competence and/or team building were not digital games;[38] studies reported early versions of an ongoing research or used identical

36   PAGE, M. J. et al.: The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. In *International Journal of Surgery*, 2021, Vol. 372, No. 71, p. 6. [online]. [2023-01-17]. Available at: <https://doi.org/10.1016/j.ijsu.2021.105906>.

37   JANUARY, A. M., CASEY, R. J., PAULSON, D.: A Meta-Analysis of Classroom-Wide Interventions to Build Social Skills: Do They Work?. In *School Psychology Review*, 2011, Vol. 40, No. 2, p. 246-247.; CONNOLLY, T. M. et al.: A systematic literature review of empirical evidence on computer games and serious games. In *Computers & Education*, 2012, Vol. 59, No. 2, p. 663-664.; ABDUL JABBAR, A. I., FELICIA, P.: Gameplay Engagement and Learning in Game-Based Learning: A Systematic Review. In *Review of Educational Research*, 2015, Vol. 85, No. 4, p. 748-749.; CLARK, D. B., TANNER-SMITH, E. E., KILLINGSWORTH, S. S.: Digital Games, Design, and Learning: A Systematic Review and Meta-Analysis. In *Review of Educational Research*, 2016, Vol. 86, No. 1, p. 89-90.; QIAN, M., CLARK, K. R.: Game-based Learning and 21st century skills: A review of recent research. In *Computers in Human Behavior*, 2016, Vol. 63, No. 1, p. 52-53.; ZHENG, L. R. et al.: Serious Games as a Complementary Tool for Social Skill Development in Young People: A Systematic Review of the Literature. In *Simulation & Gaming*, 2021, Vol. 52, No. 6, p. 690-692.

38   See: BOZANTA, A. et al.: Effects of serious games on perceived team cohesiveness in a multi-user virtual environment. In *Computers in Human Behaviour*, 2011, Vol. 59, No. 1, p. 380-388.; MARTÍN-HERNÁNDEZ, P. et al.: Fostering University Students' Engagement in Teamwork and Innovation Behaviors through Game-Based Learning (GBL). In *Sustainability*, 2021, Vol. 13, No. 24, p. 1-16. [online]. [2023-02-02]. Available at: <https://doi.org/10.3390/su132413573>.

experiments to other studies included in the final review;[39] studies researched the influence of team cohesion on in-game team performance, not the effects of playing games on team cohesion;[40] studies reported pilot studies, trial runs or preliminary research and/or did not include quantifiable outcomes.[41]
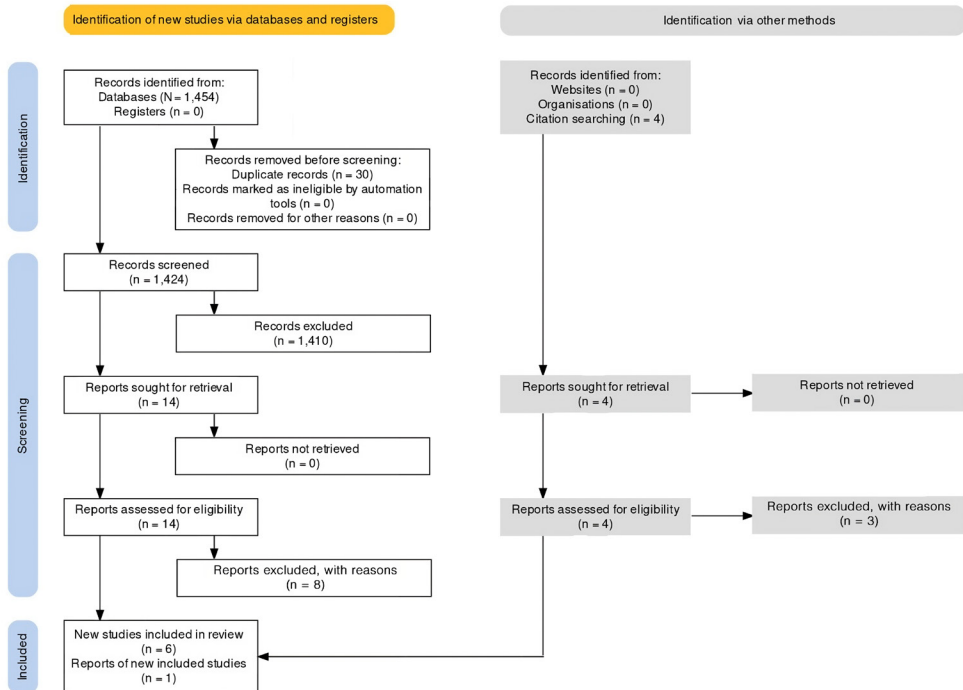
Picture 1: PRISMA flow diagram of the study selection process
Source: own processing; HADDAWAY, N. R. et al.: PRISMA2020: An R package and Shiny app for producing PRISMA 2020-compliant flow diagrams, with interactivity for optimised digital transparency and Open Synthesis. In *Campbell Systematic Reviews,* 2022, Vol. 18, No. 2, p. 5. [online]. [2023-05-12]. Available at: <https://doi.org/10.1002/cl2.1230>.

---

39   See also: ANDERSON, G.: *The Impact of Cooperative Video Games on Team Cohesion.* [Dissertation Thesis]. Terre Haute, IN : Indiana State University, 2010.; GREITEMEYER, T., TRAUT-MATTAUSCH, E., OSSWALD, S.: How to ameliorate negative effects of violent video games on cooperation: Play it cooperatively in a team. In *Computers in Human Behaviour,* 2012, Vol. 28, No. 4, p. 1465-1470.; KEITH, M. J. et al.: Team Video Gaming for Team Building: Effects on Team Performance. In *AIS Transactions on Human-Computer Interaction,* 2018, Vol. 10, No. 4, p. 205-231.
40   For more information, see: MAYER, I. et al.: Stealth Assessment of Teams in a Digital Game Environment. In DE GLORIA, A. (ed.): *Games and Learning Alliance: Second International Conference, GALA 2013.* Cham : Springer, 2014, p. 224-235.; MAYER, I.: Assessment of Teams in a Digital Game Environment. In *Simulation & Gaming,* 2018, Vol. 49, No. 6, p. 602-619.
41   For example, see: WATTS, C., SHARLIN, E., WOYTIUK, P.: Exploring Interpersonal Touch-Based Interaction and Player Socialization in Prism Squad: GO!. In PRAKASH, E. C. (ed.): *Proceedings of the 3rd annual International Conference [on] Computer Games, Multimedia & Allied Technology (CGAT 2010).* Singapore : APTF, 2010, p. 1-8. [online]. [2023-06-02]. Available at: <https://utouch.cpsc.ucalgary. ca/docs/PrismSquadGO-CGAT2010-CW.pdf>.; VON THIENEN, J. et al.: Leveraging Video Games to Improve IT-Solutions for Remote Work. In PREUSS, M. (ed.): *2021 IEEE Conference on Games (CoG).* Piscataway, NJ : IEEE, 2021, p. 1-8. [online]. [2023-03-12]. Available at: <https://www.researchgate.net/ publication/353482804_Leveraging_Video_Games_to_Improve_IT-Solutions_for_Remote_Work>.; NELSON, M., AHN, B.: Use of games to teach teamwork and communication skills to engineering students. In *2021 IEEE Frontiers in Education Conference (FIE).* Piscataway, NJ : IEEE, 2021, p. 1-9. [online]. [2023-03-16]. Available at: <https://doi.org/10.1109/FIE49875.2021.9637377>.; PRATTICÓ, F. G. et al.: Asteroid Escape: A Serious Game to Foster Teamwork Abilities. In CIGNONI, P., MIGUEL, E. (eds.): *40th Annual Conference of the European Association for Computer Graphics, Eurographics 2019 – Short Papers.* Eindhoven : The Eurographics Association, 2019, p. 53-56.

We found a total of 7 studies that fit the criteria, resulting in 18 outcomes. Study characteristics are included in Table 1. The studies resulted in the following outcomes related to team cohesion, teamwork or team building: team cohesion,[42] social relationships, i.e. cohesion, communication, task delegation (giving and taking), atmosphere,[43] cooperative behaviour,[44] trust,[45] team flow,[46] goal commitment,[47] team performance,[48] teamwork skills.[49]

Table 1: Characteristics of studies included in literature review (n = 7)[50]

Type of study		N	Total
Randomly controlled trials	*Waitlist control*	*0*	*4*
	Single control	*3*	
	Two control	*1*	
Quasi-experimental	*Single control*	*1*	*4*
	No control	*3*	

42 See: ANDERSON, G. S., HILTON, S.: Increase team cohesion by playing cooperative video games. In *CrossTalk*, 2015, Vol. 28, No. 1, p. 33-37.; GREITEMEYER, T., COX, C.: There's no "I" in team: Effects of cooperative video games on cooperative behavior. In *European Journal of Social Psychology*, 2013, Vol. 43, No. 3, p. 224-228.; KEITH, M. J. et al.: The Effects of Video Gaming on Work Group Performance. In ÅGERFALK, P. J., LEVINA, N., KIEN, S. S. (eds.): *Proceedings of the International Conference on Information Systems – Digital Innovation at the Crossroads, ICIS 2016*. Atlanta, GA : Association for Information Systems, 2016, p. 1-20. [online]. [2023-06-02]. Available at: <https://aisel.aisnet.org/icis2016/HumanBehavior/ Presentations/21/>.; KEITH, M. J. et al.: Team Building Through Team Video Games: Randomized Controlled Trial. In *JMIR Serious Games*, 2021, Vol. 9, No. 4, p. 1-16. [online]. [2023-02-02]. Available at: <https://doi.org/10.2196/28896>.

43 For example, see: GARCIA, M. B. et al.: Promoting Social Relationships Using a Couch Cooperative Video Game: An Empirical Experiment with Unacquainted Players. In *International Journal of Gaming and Computer-Mediated Simulations,* 2022, Vol. 14, No. 1, p. 1-18. [online]. [2023-06-03]. Available at: <https:// doi.org/10.4018/IJGCMS.303106>.

44 See also: GREITEMEYER, T., COX, C.: There's no "I" in team: Effects of cooperative video games on cooperative behaviour. In *European Journal of Social Psychology*, 2013, Vol. 43, No. 3, p. 224-228.; WENDEL, V. et al.: Designing A Collaborative Serious Game For Team Building Using Minecraft. In VAZ DE CARVALHO, C., ESCUDEIRO, P. (eds.): *Proceedings of the 7th European Conference on Games Based Learning*. Reading : Academic Conferences Limited, 2013, p. 569-578.

45 Ibidem.

46 See: KEITH, M. J. et al.: The Effects of Video Gaming on Work Group Performance. In ÅGERFALK, P. J., LEVINA, N., KIEN, S. S. (eds.): *Proceedings of the International Conference on Information Systems – Digital Innovation at the Crossroads, ICIS 2016*. Atlanta, GA : Association for Information Systems, 2016, p. 1-20. [online]. [2023-06-02]. Available at: <https://aisel.aisnet.org/icis2016/HumanBehavior/ Presentations/21/>.; KEITH, M. J. et al.: Team Building Through Team Video Games: Randomized Controlled Trial. In *JMIR Serious Games*, 2021, Vol. 9, No. 4, p. 1-16. [online]. [2023-02-02]. Available at: <https://doi.org/10.2196/28896>.

47 For example, see: KEITH, M. J. et al.: The Effects of Video Gaming on Work Group Performance. In ÅGERFALK, P. J., LEVINA, N., KIEN, S. S. (eds.): *Proceedings of the International Conference on Information Systems – Digital Innovation at the Crossroads, ICIS 2016*. Atlanta, GA : Association for Information Systems, 2016, p. 1-20. [online]. [2023-06-02]. Available at: <https://aisel.aisnet.org/icis2016/HumanBehavior/ Presentations/21/>.

48 See: KEITH, M. J. et al.: The Effects of Video Gaming on Work Group Performance. In ÅGERFALK, P. J., LEVINA, N., KIEN, S. S. (eds.): *Proceedings of the International Conference on Information Systems – Digital Innovation at the Crossroads, ICIS 2016*. Atlanta, GA : Association for Information Systems, 2016, p. 1-20. [online]. [2023-06-02]. Available at: <https://aisel.aisnet.org/icis2016/HumanBehavior/ Presentations/21/>.; KEITH, M. J. et al.: Team Building Through Team Video Games: Randomized Controlled Trial. In *JMIR Serious Games*, 2021, Vol. 9, No. 4, p. 1-16. [online]. [2023-02-02]. Available at: <https://doi.org/10.2196/28896>.

49 For more information, see: WANG, D.-Y., CHEN, Y.-A.: Training Teamwork Skills Using MMORPGs. In *2012 IEEE Fourth International Conference on Digital Game and Intelligent Toy Enhanced Learning*. Piscataway, NJ : IEEE, 2012, p. 94-98.

50 Remark by the authors: The studies encompassed various measures and assessments, resulting in a total that does not add up to 7. Types of study also exceed 7, because one study reported two experiments with different control group conditions. In *Mention sample demographics*, *no breakdown* offers general statement about demographics, *breakdown* specifies the percentage of racial or ethnic groups.

Measure format	Survey	7	11
	Task Assessment	4	
Reporter (survey)	Self-report	7	7
Facilitator present	Reported	1	7
	Not reported	6	
Creator as author		2	2
Follow-up conducted		0	0
Participant age	18-29	5	7
	Mixed	1	
	Not reported	1	
Education	College/university students or higher	5	7
	Not reported	2	
Continent	North America	3	7
	Europe	2	
	Asia	2	
Gender	0-45% female	4	7
	45-55% female	0	
	55-100% female	1	
	Not reported	2	
Mention sample demographics	Yes, no breakdown	0	7
	Yes, breakdown	1	
	No	6	

Source: own processing

Most of the studies (n = 5) used previously designed games: *Halo 3*[51], *Mario Kart: Double Dash!!*[52], *Halo 4*[53], *Rock Band*[54], *World of Warcraft*[55], *Minecraft*[56]. One study used a game designed specifically for the purposes of the study (*Quick Fix*[57]) and one used a specifically designed modification of the pre-existing popular game Minecraft[58] (Table 2). All studies used surveys and four of them added task assessment as another measure of outcome. None of the studies included follow-up and they were conducted in the United States (n = 3), Europe (n = 2) or Asia (n = 2). Study duration was mostly not reported (n = 5). The duration of gameplay in those studies that reported it (n = 4) was between 15 and 45 minutes.

51   BUNGIE: *Halo 3*. [digital game]. Redmond, WA : Microsoft Game Studios, 2007.
52   NINTENDO EAD: *Mario Kart: Double Dash!!*. [digital game]. Kyoto : Nintendo, 2003.
53   343 INDUSTRIES: *Halo 4*. [digital game]. Redmond, WA : Microsoft Studios, 2012.
54   HARMONIX, PI STUDIOS: *Rock Band*. [digital game]. New York, NY : MTV Games, 2007.
55   BLIZZARD ENTERTAINMENT: *World of Warcraft*. [digital game]. Irvine, CA : Blizzard Entertainment, 2004.
56   MOJANG STUDIOS: *Minecraft*. [digital game]. Stockholm : Mojang Studios, 2011.; Remark by the authors: There was used a special game mod for the experiment.
57   Remark by the authors: The game is not available publicly.; See also: GARCIA, M. B. et al.: Promoting Social Relationships Using a Couch Cooperative Video Game: An Empirical Experiment with Unacquainted Players. In *International Journal of Gaming and Computer-Mediated Simulations*, 2022, Vol. 14, No. 1, p. 1-18. [online]. [2023-06-03]. Available at: <https://doi.org/10.4018/IJGCMS.303106>.
58   See: WENDEL, V. et al.: Designing A Collaborative Serious Game For Team Building Using Minecraft. In VAZ DE CARVALHO, C., ESCUDEIRO, P. (eds.): *Proceedings of the 7th European Conference on Games Based Learning*. Reading : Academic Conferences Limited, 2013, p. 569-578.

Table 2: Description of digital games used in interventions

Title	Description
Halo 3	*A commercially available action game and a first-person shooter. One to four players participate on one of four teams thus creating a cooperative environment where team members must defend and protect each other against the enemy. If desired, four teams of four players can participate at one time playing against the other teams*
Mario Kart: Double Dash!!	*A commercially available racing game. In the cooperative mode, one player controls the kart while the other controls the use of items used to slow down the other competitors or gain an advantage over them. The two players may switch roles at any time by simultaneously pressing a button on their respective controllers. In the single mode, the player controls both the kart and the items.*
Halo 4	*A commercially available action game and a first-person shooter. In multiplayer mode, the players must coordinate their attacks in order to beat the other group.*
Rock Band	*A commercially available music game. The players must coordinate their activities to perform the songs correctly.*
World of Warcraft	*A leader among the current generation of MMORPGs (commercially available). The players are allowed to choose the race and class (profession) of the role they want to play. Every race and every character class has different abilities, and players will be faced with a variety of tasks and situations in the game. In order to achieve high scores, they need to adopt heterogeneous grouping in the game.*
Quick Fix	*A couch cooperative video game, developed for this study (not commercially available). The game mechanics emulate the model of an auto repair simulator, where players perform repairs and other services on vehicles. In line with the goal, the in-game tasks imitate a sequential team-building design, playable by 2-4 players. Players have the freedom to distribute task assignments. The formulation of teamwork is dependent on how players intercommunicate with one another during gameplay.*
Minecraft	*A commercially available sandbox game. The players' task is to save the 'last gnome on earth'. Only one player at a time can carry the gnome. This player will continuously slow down until he/she cannot move at all. Furthermore, this player cannot jump. This mechanic forces players to hand the gnome to each other in order to be able to move the gnome forward and to overcome certain obstacles.*

Source: own processing

Outcomes that improved throughout the intervention included team cohesion, social relationships, trust, cooperative behaviour, team flow and performance and goal commitment. Team cohesion was the outcome most commonly measured across studies, with five studies including it as an outcome measure. Post-test, out of the 18 outcomes, 15 reported significant improvement from the intervention and 3 reported no significant differences from the intervention. Of those with significant improvements post-test (n = 15), most (n = 9) were from randomly controlled trials (RCTs) with single or two control groups. Details of all studies, measures, and team cohesion improvements are summarized in Table 3.

Discussion

In this review, we summarize the current existing literature on digital games' influence on team cohesion and related constructs (teamwork and team building). We found significant team improvements in studies that targeted team cohesion, team communication, task delegation, atmosphere, trust, team flow, goal commitment and team performance. However, overall few studies have been conducted and peer-reviewed in the literature on the subject. Those few that have been, use considerably different methods and outcome measures that are not easily unifiable. There are also certain contradictory results. In V. Wendel et al., the outcome 'cooperative behaviour' is measured by using self-report surveys and task assessments. While the survey reports improved cooperation after TVG treatment, the assessment of the prisoner's dilemma game shows no significant effect (p > .20).[59] Using a similar measure of two-person give-some dilemma, T. Greitemeyer and C. Cox reported a significant improvement in cooperative behaviour, including the effect size (very large, d = 1.12).[60] The lack of effect in the results of V. Wendel et al. can be explained by familiarity between participants, who knew each other and cooperated before the study, so the 25 minute- long treatment could not make a meaningful impact in this area.[61] D.-Y. Wang and Y.-A. Chen failed to show significant improvement in teamwork skills using World of Warcraft in their quasi-experimental design (no control group). As if to compensate, authors resort to anecdotal evidence: "For instance, one team had a poor atmosphere in the beginning. [...] Afterwards, the team's atmosphere was changed." Based on this and contrary to their own experimental results, they "still believe that games are effective in training teamwork skills." Such a conclusion is obviously uncalled-for.[62]

The group of researchers around M. J. Keith is represented in our results by two studies. M. J. Keith and his colleagues are consistently interested in the social effects of digital games.[63] G. S. Anderson, co-author of another reviewed study from 2015, is also a co-author of both M. J. Keith-led studies. In a sense, this is a review of evolution in their common research, of refinement in their theoretical backgrounds, experimental methods, outcome measures and overall quality of reporting. For example, G. S. Anderson's study from 2015 has quasi-experimental design and does not report effect sizes,[64] both M. J. Keith-led studies are RCT designs, report effect sizes and the study from 2021 is the only one in this review to analyze the demography of its participants. Remarkably, while both G. S. Anderson's study from 2015 and the M. J. Keith-led study from 2016 report significant improvement in self-reported team cohesion, their latest study from

59   WENDEL, V. et al.: Designing A Collaborative Serious Game For Team Building Using Minecraft. In VAZ DE CARVALHO, C., ESCUDEIRO, P. (eds.): *Proceedings of the 7th European Conference on Games Based Learning. Reading : Academic Conferences Limited*, 2013, p. 575-576..

60   GREITEMEYER, T., COX, C.: There's no "I" in team: Effects of cooperative video games on cooperative behavior. In *European Journal of Social Psychology*, 2013, Vol. 43, No. 3, p. 226.

61   For example, see: WENDEL, V. et al.: Designing A Collaborative Serious Game For Team Building Using Minecraft. In VAZ DE CARVALHO, C., ESCUDEIRO, P. (eds.): *Proceedings of the 7th European Conference on Games Based Learning. Reading : Academic Conferences Limited*, 2013, p. 569-578.

62   WANG, D.-Y., CHEN, Y.-A.: Training Teamwork Skills Using MMORPGs. In *2012 IEEE Fourth International Conference on Digital Game and Intelligent Toy Enhanced Learning*. Piscataway, NJ : IEEE, 2012, p. 96.

63   See: KEITH, M. J. et al.: The Effects of Video Gaming on Work Group Performance. In ÅGERFALK, P. J., LEVINA, N., KIEN, S. S. (eds.): *Proceedings of the International Conference on Information Systems – Digital Innovation at the Crossroads, ICIS 2016*. Atlanta, GA : Association for Information Systems, 2016, p. 1-20. [online]. [2023-06-02]. Available at: <https://aisel.aisnet.org/icis2016/HumanBehavior/Presentations/21/>.; KEITH, M. J. et al.: Team Building Through Team Video Games: Randomized Controlled Trial. In *JMIR Serious Games*, 2021, Vol. 9, No. 4, p. 1-16. [online]. [2023-02-02]. Available at: <https://doi.org/10.2196/28896>.

64   See also: ANDERSON, G. S., HILTON, S.: Increase team cohesion by playing cooperative video games. In *CrossTalk*, 2015, Vol. 28, No. 1, p. 33-37.

2021, based on similar methods and the same outcome measure (Group Environment Questionnaire),[65] shows no significant results (p = .49).[66] This is not concerning for the authors, because they have developed a different social construct of team flow that, according to their results, is manipulated by TVG (unlike cohesion) and better accounts for heightened team performance (team building).

Our review only relied on self-report surveys in all of the studies, which could provide a limited viewpoint on the impact of the digital game and the changes it may bring. On the whole, studies avoided reporting biases. None of the studies conducted follow-up procedures. As social constructs, team cohesion or team flow may take a longer time to appear in assessment. Team building implies gradual process in its name, but only one study used more than one hour of gameplay time. Without conducting follow-ups, existing literature is unable to say anything about the possible lasting team effects of video gaming.

Only one of the studies included demographic information about its participants. If the backgrounds of participants are not taken into account, the outcomes of interventions could exhibit bias towards particular races or ethnicities.[67] Most studies (n = 5) took place in the United States or Europe. Partly due to the small sample and missing demographic information we could not establish any specific correlation between the outcome of the study and the location or demographics of the study. Acknowledging and addressing the study sample is an essential initial measure in comprehending the variations in how diverse demographics react to interventions.[68]

According to S. L. Marlow et al. the general limitation in studying the impact of games on learning outcomes is the challenge of distinguishing the distinct effects of various game characteristics.[69] Typically (as in our review), studies employ commercial off-the-shelf (COTS) games that come with predetermined features,[70] making it difficult to modify attributes according to specific researchers' needs. Improving team cohesion or teamwork can be compared to learning outcomes, therefore this limitation is relevant to our review. On the other hand, even if one attribute can be changed, it often leads to unintentional alterations in other game features.[71] The studies cannot provide the complete mechanism by which digital games enable the desired results and the specific game attributes are not linked to teamwork behaviours.[72]

The submitted review also has certain limitations in its design. We have focused on quantitative research on the efficacy of digital games for improving team cohesion, while overlooking qualitative studies. Our data synthesis was inadequate for meta-analysis due

65   For more information, see: CARRON, A. V. et al.: Cohesion and performance in sport: A meta-analysis. In *Journal of Sport and Exercise Psychology*, 2002, Vol. 24, No. 2, p. 168-188.

66   KEITH, M. J. et al.: Team Building Through Team Video Games: Randomized Controlled Trial. In *JMIR Serious Games*, 2021, Vol. 9, No. 4, p. 9. [online]. [2023-02-02]. Available at: <https://doi.org/10.2196/28896>.

67   DELUCA, S. M., KELMAN, A. R., WAELDE, L. C.: A Systematic Review of Ethnoracial Representation and Cultural Adaptation of Mindfulness - and Meditation-Based Interventions. In *Psychological Studies*, 2018, Vol. 63, No. 2, p. 125.; HOFFMANN, D. M.: Reflecting on Social Emotional Learning: A Critical Perspective on Trends in the United States. In *Review of Educational Research*, 2009, Vol. 79, No. 2, p. 540-542.; MAHFOUZ, J., ANTHONY-STEVENS, V.: Why Trouble SEL? The Need for Cultural Relevance in SEL. In *Occasional Paper Series*, 2020, Vol. 11, No. 43, p. 61-62.

68   PARRISH, P., LINDER-VANBERSCHOT, J.: Cultural dimensions of learning: Addressing the challenges of multicultural instruction. In *The International Review of Research in Open and Distributed Learning*, 2010, Vol. 11, No. 2, p. 10-16.

69   MARLOW, S. L. et al.: Eliciting teamwork with game attributes: A systematic review and research agenda. In *Computers in Human Behavior*, 2016, Vol. 55, No. 1, p. 421.

70   BOWERS, C. A., JENTSCH, F.: Use of commercial, off-the-shelf, simulations for team research. In SALAS, E. (ed.): *Advances in Human Performance and Cognitive Engineering Research, Vol. 1*. Bingley : Emerald Group Publishing, 2001, p. 296.

71   BEDWELL, W. L. et al.: Toward a Taxonomy Linking Game Attributes to Learning: An Empirical Study. In *Simulation & Gaming*, 2012, Vol. 43, No. 6, p. 734.

72   MARLOW, S. L. et al.: Eliciting teamwork with game attributes: A systematic review and research agenda. In *Computers in Human Behavior*, 2016, Vol. 55, No. 1, p. 421.

to restricted data availability, variations in interventions and constructs evaluated. The instruments employed for some of the outcomes lacked validation or explicit description. As a result, the findings derived from these possibly invalid and unreliable measures may not accurately represent the actual impacts of the intervention.

There are many ways to improve research in digital games' effects on team cohesion. Study design can be improved by extending or varying the gameplay intervention times (or at least reporting them); prioritizing other outcome measures than self-report surveys; reporting biases; conducting follow-ups; sampling from diverse populations; reporting demographics; and recognizing the distinct effects of various game features on the outcomes.

Conclusion

Our literature review highlights the current state of research on the influence of digital games on team cohesion and on related constructs such as teamwork and team building. Although several studies demonstrate significant improvements in team-related factors, there are notable limitations and inconsistencies within the existing literature.

The review revealed that only a limited number of studies have been conducted and peer-reviewed in this area, and they employ diverse methodologies and outcome measures, making it challenging to establish unified conclusions. Contradictory results were observed in certain cases, such as the disparity between self-report surveys and task assessments in measuring cooperative behaviour, or discrepancies in the results regarding self-reported team cohesion between studies using identical methods and outcome measures.

One significant limitation of the reviewed studies is their heavy reliance on self-report surveys, which may offer a limited perspective on the impact of digital games and the changes they bring. Additionally, the absence of follow-up procedures and limited gameplay time hindered the understanding of lasting team effects and the gradual process of team building. Demographic information was lacking in most studies, which raises concerns about potential biases in intervention outcomes concerning certain races or ethnicities. Moreover, the majority of studies were conducted in the United States or Europe. Limitations such as restricted data availability for meta-analysis and insufficient validation or explicit description of outcome measures underscore the need for improved study designs and methodology in future research.

Team video gaming may be effective in supporting team cohesion or team building. However, this finding is only preliminary due to the factors mentioned above. To enhance the understanding of digital games' impact on team cohesion, it is recommended to extend or vary gameplay intervention times, prioritize diverse outcome measures, address reporting biases, conduct follow-up assessments, include diverse populations and report demographics, and recognize the specific effects of different game features on outcomes. By addressing these recommendations, future research can provide more robust and comprehensive insights into the relationship between digital games and team cohesion, facilitating the development of effective interventions and strategies to enhance teamwork and collaboration in various contexts.

Table 3: Study details (n = 7)

Study / game(s)	Participants	Design	Outcome measure(s)	
G. S. Anderson, S. Hilton (2015) / Halo 3	56 participants in the United States Age: 18-29 Gender: 13% Female Ethnicity: not reported	Quasi-experimental No control No follow-up Facilitator not reported	Self-report team cohesion Measure: Group Environment Questionnaire (modified from A. V. Carron et al. 2002; validated)	Improved at post in all 4 submeasures (ATG-T, ATG-S, GI-T, GI-S) No significant difference in gameplay duration (1h/6h)
M. B. Garcia et al. (2022) / Quick Fix	61 participants in the Philippines Gender: Not reported Education: Not reported. Ethnicity: Not reported Age: Not reported	Quasi-experimental No control No follow-up Facilitator not reported	Self-report social relationships (cohesion, communication, task delegation, atmosphere) Measure: Evaluation of Social Systems Scale (C. Aguilar-Raab, D. Grevenstein, J. Schweitzer, 2015; validated)	Improved Cohesion p = .019 Task delegation p = .041 Communication p = .041 Atmosphere p = .037
T. Greitemeyer, C. Cox (2013) / Mario Kart: Double Dash!!	56 participants in Great Britain Gender: 63% female Education: University students Ethnicity: Not reported Age: 18-29 (assumed)	RCT Single control – single-player game No follow-up Facilitator not reported	Self-report cohesion Measure: Not specified Self-report trust Measure: Not specified Behavioural assessment of cooperative behaviour Measure: two-person give-some dilemma (modified from P. A. M. Van Lange, 1999)	Improved t(33) = 4.89, p < .001, d = 1.65 Improved t(33) = 2.23, p < .05, d = .68 Improved β = .47, p < .01, d = 1.12
M. J. Keith et al. (2016) / Halo 4, Rock Band	Experiment 1: 352 participants Gender: 21% Female Experiment 2: 372 participants Gender: 28% Female United States Education: University students Ethnicity: Not reported Age: 18-29 (assumed)	RCT Experiment 1: two controls – individual homework/goal training seminar Experiment 2: single control – individual homework No follow-up Facilitator not reported	Identical outcome measures for Experiments 1 and 2 except for goal commitment (absent from Experiment 2) Self-report team flow (referred to as group flow) Measure: Cognitive absorption (modified from R. Agarwal, E. Karahanna, 2000; validated) Self-report team cohesion (referred to as group cohesion) Measure: Group Environment Questionnaire (A. V. Carron et al. 1985; validated) Self-report (group) goal commitment Measure: not specified (H. J. Klein et al. 1999) Behavioural assessment of team (group) performance Measure: developed for study	Experiment 1 Improved β = .30, p < .001 Improved β = .29, p < .001 Improved β = .18, p < .05 Improved F = 5.282, p = .007

Study / Game	Sample	Design	Measure	Results
				Experiment 2 (summarized): All forms of video gaming (including individual, competitive, and cooperative) are an effective strategy for building group flow and group cohesion that in turn improve performance.
M. J. Keith et al. (2021) / Halo 4, Rock Band	586 participants in the United States. Gender: 24.2% Female. Education: University students. Age: 22.9 (mean). Ethnicity: 80.4% Caucasian, 10.1% Asian, 7% Hispanic	RCT. Single control – no team-building activity. No follow-up Facilitator present	Self-report team flow. Measure: Cognitive absorption (modified from R. Agarwal, E. Karahanna, 2000; validated). Self-report team cohesion. Measure: Group Environment Questionnaire (A. V. Carron et al., 1985; validated). Behavioural assessment of team performance. Measure: developed by researchers	Improved (via construct of challenge) $\beta = .451$, $p < .001$. No significant effect $\beta = -.004$, $p = .49$. Improved $F1 = 8.760$, $p = .004$
D.-Y. Wang, Y.-A. Chen (2012) / World of Warcraft	32 participants in Taiwan. Gender: not reported. Education: University students. Ethnicity: Not reported. Age: 18-29 (assumed)	Quasi-experimental. No control. No follow-up. Facilitator not reported	Self-report teamwork skills. Measure: Teamwork Skills Questionnaire (modified from M. C. Chien, 2000; validation N/A)	No significant effect
V. Wendel et al. (2013) / Minecraft (mod developed for the study)	28 participants in Germany. Gender: 8% Female. Education: University students and higher. Ethnicity: Not reported. Age: 21 to 45 years, mean 25.81	Quasi-experimental. Single control – solving puzzle. No follow-up. Facilitator not reported	Self-report cooperative behaviour (referred to as group cooperation). Measure: Group-cooperation Questionnaire developed for study; Not validated. Behavioural assessment of trust and cooperative behaviour. Measure: Prisoner's dilemma game (modified from B. Sheese, W. Graziano, 2005)	Improved $F(1.22) = 3.94$, $p = .060$. No significant effects ($p > .20$)

Source: own processing

BIBLIOGRAPHY

343 INDUSTRIES: *Halo 4*. [digital game]. Redmond, WA : Microsoft Studios, 2012.

ABDUL JABBAR, A. I., FELICIA, P.: Gameplay Engagement and Learning in Game-Based Learning: A Systematic Review. In *Review of Educational Research*, 2015, Vol. 85, No. 4, p. 740-779. ISSN 0034-6543.

ANDERSON, G.: *The Impact of Cooperative Video Games on Team Cohesion*. [Dissertation Thesis]. Terre Haute, IN : Indiana State University, 2010.

ANDERSON, G. S., HILTON, S.: Increase team cohesion by playing cooperative video games. In *CrossTalk*, 2015, Vol. 28, No. 1, p. 33-37. ISSN 2160-1577.

BEAL, D. J. et al.: Cohesion and performance in groups: a meta-analytic clarification of construct relations. In *Journal of applied psychology*, 2003, Vol. 88, No. 6, p. 989-1004. ISSN 0021-9010.

BEDWELL, W. L. et al.: Toward a Taxonomy Linking Game Attributes to Learning: An Empirical Study. In *Simulation & Gaming*, 2012, Vol. 43, No. 6, p. 729-760. ISSN 1046-8781.

BELBIN, R. M.: *Management Teams: Why they succeed or fail*. London, New York, NY : Routledge, 2010.

BLIZZARD ENTERTAINMENT: *World of Warcraft*. [digital game]. Irvine, CA : Blizzard Entertainment, 2004.

BOWERS, C. A., JENTSCH, F.: Use of commercial, off-the-shelf, simulations for team research. In SALAS, E. (ed.): *Advances in Human Performance and Cognitive Engineering Research, Vol. 1*. Bingley : Emerald Group Publishing, 2001, p. 293-317.

BOWMAN Jr., R. F.: A "Pac-Man" Theory of Motivation: Tactical Implications for Classroom Instruction. In *Educational Technology*, 1982, Vol. 22, No. 9, p. 14-17. ISSN 0013-1962.

BOZANTA, A. et al.: Effects of serious games on perceived team cohesiveness in a multi-user virtual environment. In *Computers in Human Behaviour*, 2011, Vol. 59, No. 1, p. 380-388. ISSN 0747-5632.

BUNGIE: *Halo 3*. [digital game]. Redmond, WA : Microsoft Game Studios, 2007.

CARRON, A. V., WIDMEYER, W. N., BRAWLEY, L. R.: The development of an instrument to assess cohesion in sport teams: The Group Environment Questionnaire. In *Journal of Sport and Exercise Psychology*, 1985, Vol. 7, No. 3, p. 244-266. ISSN 0895-2779.

CARRON, A. V. et al.: Cohesion and performance in sport: A meta-analysis. In *Journal of Sport and Exercise Psychology*, 2002, Vol. 24, No. 2, p. 168-188. ISSN 1543-2904.

CASEY-CAMPBELL, M., MARTENS, M. L.: Sticking it all together: A critical assessment of the group cohesion-performance literature. In *International Journal of Management Reviews*, 2019, Vol. 11, No. 2, p. 223-246. ISSN 1468-2370.

CLARK, D. B., TANNER-SMITH, E. E., KILLINGSWORTH, S. S.: Digital Games, Design, and Learning: A Systematic Review and Meta-Analysis. In *Review of Educational Research*, 2016, Vol. 86, No. 1, p. 79-122. ISSN 0034-6543.

CLEMENT, J.: *Number of users of video games Worldwide 2017-2027.* Released on 1st June 2023. [online]. [2023-02-22]. Available at: <https://www.statista.com/statistics/748044/number-video-gamers-world/>.

CONNOLLY, T. M. et al.: A systematic literature review of empirical evidence on computer games and serious games. In *Computers & Education*, 2012, Vol. 59, No. 2, p. 661-686. ISSN 0360-1315.

COOKE, N. J., HILTON, M. L.: *Enhancing the effectiveness of team science.* Washington, D.C. : National Academies Press, 2015.

DELUCA, S. M., KELMAN, A. R., WAELDE, L. C.: A Systematic Review of Ethnoracial Representation and Cultural Adaptation of Mindfulness - and Meditation-Based Interventions. In *Psychological Studies*, 2018, Vol. 63, No. 2, p. 117–129. ISSN 0033-2968.

DI PIETRANTONIO, J., MENDONCA, D.: Opening the Black Box of Team Performance with Open-source Games: A Review and Recommendations. In *IEEE Transactions on Games*, 2022, Vol. 14, No. 2, p. 170-179. ISSN 2475-1502.

DYER Jr., W. G., DYER, J. H., DYER, W. G.: *Team Building Proven Strategies for Improving Team Performance*. San Francisco, CA : John Wiley and Sons, 2013.

ELLIS, J. B. et al.: Games for Virtual Team Building. In MARSDEN, G., LADEIRA, I., KOTZÉ, P. (eds.): *DIS '08: Proceedings of the 7th ACM conference on Designing interactive systems*. New York, NY : ACM, 2008, p. 295-304.

EVANS, C. R., DION, K. L.: Group cohesion and performance: A meta-analysis. In *Small Group Research*, 1989, Vol. 22, No. 3, p. 175-186. ISSN 1552-8278.

FAPOHUNDA, T. M.: Towards Effective Team Building in the Workplace. In *International Journal of Education and Research*, 2013, Vol. 1. No. 4, p. 1-12. ISSN 2201-6740. [online]. [2023-02-15]. Available at: <https://www.ijern.com/images/April-2013/23.pdf>.

GARCIA, M. B. et al.: Promoting Social Relationships Using a Couch Cooperative Video Game: An Empirical Experiment with Unacquainted Players. In *International Journal of Gaming and Computer-Mediated Simulations,* 2022, Vol. 14, No. 1, p. 1-18. ISSN 1942-3888. [online]. [2023-06-03]. Available at: <https://doi.org/10.4018/IJGCMS.303106>.

GRANIC, I., LOBEL, A., ENGELS, R. C. M. E.: The Benefits of Playing Video Games. In *American Psychologist*, 2014, Vol. 69, No. 1, p. 66-78. ISSN 1935-990X.

GREITEMEYER, T., COX, C.: There's no "I" in team: Effects of cooperative video games on cooperative behavior. In *European Journal of Social Psychology*, 2013, Vol. 43, No. 3, p. 224-228. ISSN 1099-0992.

GREITEMEYER, T., TRAUT-MATTAUSCH, E., OSSWALD, S.: How to ameliorate negative effects of violent video games on cooperation: Play it cooperatively in a team. In *Computers in Human Behaviour*, 2012, Vol. 28, No. 4, p. 1465-1470. ISSN 0747-5632.

GROSSMAN, R. et al.: The team cohesion-performance relationship: A meta-analysis exploring measurement approaches and the changing team landscape. In *Organizational Psychology Review*, 2022, Vol. 12, No. 2, p. 181-238. ISSN 2041-3874.

GU, S., XUE, L.: Relationships among Sports Group Cohesion, Psychological Collectivism, Mental Toughness and Athlete Engagement in Chinese Team Sports Athletes. In *International Journal of Environmental Research and Public Health*, 2022, Vol. 19, No. 9, p. 1-14. ISSN 1660-4601. [online]. [2023-02-15]. Available at: <https://doi.org/10.3390/ijerph19094987>.

GULLY, S. M., DEVINE, D. J., WHITNEY, D. J.: A Meta-Analysis of Cohesion and Performance: Effects of Level of Analysis and Task Interdependence. In *Small Group Research*, 1995, Vol. 26, No. 2, p. 497-520. ISSN 1552-8278.

HADDAWAY, N. R. et al.: PRISMA2020: An R package and Shiny app for producing PRISMA 2020-compliant flow diagrams, with interactivity for optimised digital transparency and Open Synthesis. In *Campbell Systematic Reviews*, 2022, Vol. 18, No. 2, p. 1-12. ISSN 1891-1803. [online]. [2023-05-12]. Available at: <https://doi.org/10.1002/cl2.1230>.

HANGHØJ, T., NIELSEN, R. K. L.: Esports skills are people skills. In ELEAEK, L. et al. (eds): *13th European Conference on Games Based Learning (ECGBL 2019)*. Reading : Academic Conferences and Publishing International Limited, 2019, p. 535-542.

HARMONIX, PI STUDIOS: *Rock Band*. [digital game]. New York, NY : MTV Games, 2007.

HENDL, J.: *Kvalitativní výzkum: Základní metody a aplikace*. Prague : Portál, 2005.

HEWETT, K. J. E.: Embracing Video Games for Strategic Thinking, Collaboration, and Communication Skills Practice. In KHOSROW-POUR, M. (ed.): *Research Anthology on Fandoms, Online Social Communities, and Pop Culture.* Hershey, PA : IGI Global, 2022, p. 296-314.

HIRIYAPPA, B.: *Team Building and Group Dynamics Management*. Bloomington, IN : Booktango, 2013.

HOFFMANN, D. M.: Reflecting on Social Emotional Learning: A Critical Perspective on Trends in the United States. In *Review of Educational Research*, 2009, Vol. 79, No. 2, p. 533-556. ISSN 0034-6543.

CHIOCCHIO, F., ESSIEMBRE, H.: Cohesion and Performance: A Meta-Analytic Review of Disparities Between Project Teams, Production Teams, and Service Teams. In *Small Group Research*, 2009, Vol. 40 No. 4, p. 382-420. ISSN 1552-8278.

JANUARY, A. M., CASEY, R. J., PAULSON, D.: A Meta-Analysis of Classroom-Wide Interventions to Build Social Skills: Do They Work?. In *School Psychology Review*, 2011, Vol. 40, No. 2, p. 242-256. ISSN 2372-966X.

JOHANNES, N., VUORRE, M., PRZYBYLSKI, A. K.: Video game play is positively correlated with well-being. In *Royal Society Open Science*, 2021, Vol. 8, No. 2, p. 1-14. ISSN 2054-5703. [online]. [2023-02-15]. Available at: <https://doi.org/10.1098/rsos.202049>.

KEITH, M. J. et al.: Team Building Through Team Video Games: Randomized Controlled Trial. In *JMIR Serious Games*, 2021, Vol. 9, No. 4, p. 1-16. ISSN 2291-9279. [online]. [2023-02-02]. Available at: <https://doi.org/10.2196/28896>.

KEITH, M. J. et al.: Team Video Gaming for Team Building: Effects on Team Performance. In *AIS Transactions on Human-Computer Interaction*, 2018, Vol. 10, No. 4, p. 205-231. ISSN 1944-3900.

KEITH, M. J. et al.: The Effects of Video Gaming on Work Group Performance. In ÅGERFALK, P. J., LEVINA, N., KIEN, S. S. (eds.): *Proceedings of the International Conference on Information Systems – Digital Innovation at the Crossroads, ICIS 2016*. Atlanta, GA : Association for Information Systems, 2016, p. 1-20. [online]. [2023-06-02]. Available at: <https://aisel.aisnet.org/icis2016/HumanBehavior/Presentations/21/>.

KLEIN, C. et al.: Does Team Building Work?. In *Small Group Research*, 2009, Vol. 40, No. 2, p. 181-222. ISSN 1552-8278.

LENT, R. W., SCHMIDT, J., SCHMIDT, L.: Collective efficacy beliefs in student work teams: Relation to self-efficacy, cohesion, and performance. In *Journal of Vocational Behavior*, 2006, Vol. 68, No. 3, p. 73-84. ISSN 0001-8791.

MAHFOUZ, J., ANTHONY-STEVENS, V.: Why Trouble SEL? The Need for Cultural Relevance in SEL. In *Occasional Paper Series*, 2020, Vol. 11, No. 43, p. 58-70. ISSN 2375-3668.

MAREŠ, J.: Přehledové studie: jejich typologie, funkce a způsob vytváření. In *Pedagogická orientace*, 2013, Vol. 23, No. 4, p. 427-454. ISSN 1805-9511.

MARLOW, S. L. et al.: Eliciting teamwork with game attributes: A systematic review and research agenda. In *Computers in Human Behavior*, 2016, Vol. 55, No. 1, p. 413-423. ISSN 0747-5632.

MARTÍN-HERNÁNDEZ, P. et al.: Fostering University Students' Engagement in Teamwork and Innovation Behaviors through Game-Based Learning (GBL). In *Sustainability*, 2021, Vol. 13, No. 24, p. 1-16. ISSN 2071-1050. [online]. [2023-02-02]. Available at: <https://doi.org/10.3390/su132413573>.

MAYER, I.: Assessment of Teams in a Digital Game Environment. In *Simulation & Gaming*, 2018, Vol. 49, No. 6, p. 602-619. ISSN 1046-8781.

MAYER, I. et al.: Stealth Assessment of Teams in a Digital Game Environment. In DE GLORIA, A. (ed.): *Games and Learning Alliance: Second International Conference, GALA 2013*. Cham : Springer, 2014, p. 224-235.

McGONIGAL, J.: *Reality Is Broken: Why Games Make Us Better and How They Can Change the World*. New York, NY : Penguin Books, 2011.

MOJANG STUDIOS: *Minecraft*. [digital game]. Stockholm : Mojang Studios, 2011.

MYSIRLAKI, S., PARASKEVA, F.: Virtual Team Effectiveness: Insights from the Virtual World Teams of Massively Multiplayer Online Games. In *Journal of Leadership Studies*, 2019, Vol. 13, No. 1, p. 34-55. ISSN 1935-262X.

NELSON, M., AHN, B.: Use of games to teach teamwork and communication skills to engineering students. In *2021 IEEE Frontiers in Education Conference (FIE)*. Piscataway, NJ : IEEE, 2021, p. 1-9. [online]. [2023-03-16]. Available at: <https://doi.org/10.1109/FIE49875.2021.9637377>.

NINTENDO EAD: *Mario Kart: Double Dash!!*. [digital game]. Kyoto : Nintendo, 2003.

PAGE, M. J. et al.: The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. In *International Journal of Surgery*, 2021, Vol. 372, No. 71, p. 1-9. ISSN 1743-9191. [online]. [2023-01-17]. Available at: <https://doi.org/10.1016/j.ijsu.2021.105906>.

PARRISH, P., LINDER-VANBERSCHOT, J.: Cultural dimensions of learning: Addressing the challenges of multicultural instruction. In *The International Review of Research in Open and Distributed Learning*, 2010, Vol. 11, No. 2, p. 1-19. ISSN 1492-3831.

PRATTICÓ, F. G. et al.: Asteroid Escape: A Serious Game to Foster Teamwork Abilities. In CIGNONI, P., MIGUEL, E. (eds.): *40th Annual Conference of the European Association for Computer Graphics, Eurographics 2019 – Short Papers*. Eindhoven : The Eurographics Association, 2019, p. 53-56.

QIAN, M., CLARK, K. R.: Game-based Learning and 21st century skills: A review of recent research. In *Computers in Human Behavior*, 2016, Vol. 63, No. 1, p. 50-58. ISSN 0747-5632.

RIIVARI, E., KIVIJÄRVI, M., LÄMSÄ, A.-M.: Learning teamwork through a computer game: for the sake of performance or collaborative learning?. In *Educational Technology Research and Development*, 2021, Vol. 69, No. 3, p. 1753-1771. ISSN 1556-6501.

SALEME, P. et al.: Prosocial digital games for youth: A systematic review of interventions. In *Computers in Human Behavior Reports*, 2020, Vol. 2, No. 1, p. 1-9. ISSN 2451-9588. [online]. [2023-02-15]. Available at: <https://doi.org/10.1016/j.chbr.2020.100039>.

STACHO, Z. et al.: Gamefikácia v procese adaptácie zamestnancov. In *REFLEXIE – Kompendium teórie a praxe podnikania*, 2022, Vol. 6, No. 2, p. 78-89. ISSN 2730-020X.

VELEZ, J. A., EWOLDSEN, D. R.*:* Helping Behaviors During Video Game Play. In *Journal of Media Psychology Theories Methods and Applications*, 2013, Vol. 25, No. 4, p. 190-200. ISSN 1864-1105.

VICKERS, S. W.: *Digital gaming as a learning tool : a literature review.* [Master Thesis]. Cedar Falls, IA : University of Northern Iowa, 2012.

VON THIENEN, J. et al.: Leveraging Video Games to Improve IT-Solutions for Remote Work. In PREUSS, M. (ed.): *2021 IEEE Conference on Games (CoG)*. Piscataway, NJ : IEEE, 2021, p. 1-8. [online]. [2023-03-12]. Available at: <https://www.researchgate.net/publication/353482804_Leveraging_Video_Games_to_Improve_IT-Solutions_for_Remote_Work>.

WANG, D.-Y., CHEN, Y.-A.: Training Teamwork Skills Using MMORPGs. In *2012 IEEE Fourth International Conference on Digital Game and Intelligent Toy Enhanced Learning*. Piscataway, NJ : IEEE, 2012, p. 94-98.

WATTS, C., SHARLIN, E., WOYTIUK, P.: Exploring Interpersonal Touch-Based Interaction and Player Socialization in Prism Squad: GO!. In PRAKASH, E. C. (ed.): *Proceedings of the 3rd annual International Conference [on] Computer Games, Multimedia & Allied Technology (CGAT 2010)*. Singapore : APTF, 2010, p. 1-8. [online]. [2023-06-02]. Available at: <https://utouch.cpsc.ucalgary.ca/docs/PrismSquadGO-CGAT2010-CW.pdf>.

WENDEL, V. et al.: Designing A Collaborative Serious Game For Team Building Using Minecraft. In VAZ DE CARVALHO, C., ESCUDEIRO, P. (eds.): *Proceedings of the 7th European Conference on Games Based Learning*. Reading : Academic Conferences Limited, 2013, p. 569-578.

WICHADEE, S., PATTANAPICHET, F.: Enhancement of Performance and Motivation through Application of Digital Games in an English Language Class. In *Teaching English with Technology*, 2018, Vol. 18, No. 1, p. 77-92. ISSN 1642-1027.

ZHANG, X., KWAN, H. K.: Team behavioral integration links team interdependence with team performance: an empirical investigation in R&D teams. In *Frontiers of Business Research*, Vol. 13, No. 7, p. 193-211. ISSN 1673-7431.

ZHENG, L. R. et al.: Serious Games as a Complementary Tool for Social Skill Development in Young People: A Systematic Review of the Literature. In *Simulation & Gaming*, 2021, Vol. 52, No. 6, p. 686-714. ISSN 1046-8781.

ZHONG, Y. et al.: The impact of esports participation on the development of 21st century skills in youth: A systematic review. In *Computers & Education*, 2022, Vol. 191, No. 8, p. 1-20. ISSN 0360-1315. [online]. [2023-03-01]. Available at: <https://doi.org/10.1016/j.compedu.2022.104640>.