

The impact of Science Literacy delivery methods - what works?

Gaps in impact assessment methodology

GROUP 3. Traditional publishing and journalism - print and broadcast

V 1.0 | 28 March 2019

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Mechanism	Subject and keywords	Gaps in the impact assessment (IA) methodology <u>Lack of (or insufficient):</u>	Possible methodological improvement(s) /Recommendations / Directions for future research	Challenges	Reference
17. Animations					NO GAPS IDENTIFIED
18. Books					NO REVIEWS
19. Brochures					NO REVIEWS
20. Cartoons	Health, health education [Healthcare and Medicine, Social science]	<p>- standard tools for the assessment of health literacy, thus it is difficult to compare levels of health literacy across the studies reviewed</p> <p>- appropriate measurement, e.g. dichotomous variable of years of education. Health literacy measurements may focus on assessing reading, comprehension, and numeracy, but years of education do not provide an accurate measurement of those components</p> <p>- intervention studies and an adequate number of participants for assessing the effectiveness of pictographic health care education</p>	<p>- need for more diverse health-related research studies using pictography-based health education materials for elderly</p> <p>- future researchers will need more meaningful and consistent health literacy assessment tools</p> <p>- most of the health education materials currently available are not appropriate for people with a low health literacy level, so improved materials are highly needed</p> <p>- more intervention studies and greater numbers of participants would enable generalizability</p> <p>- more research needs to be done on picture-based education in additional areas of healthcare (most of the pictographic health care education focused on medication) and on a wider range of diseases in order to evaluate its effectiveness</p> <p>- in order to address low health literacy needs, healthcare professionals should evaluate their current patient education for reading level and low-literacy</p>		<p>Effectiveness of using picture-based health education for people with low health literacy: An integrative review</p> <p>Park and Zuniga 2016</p>

			<p>acceptability. Reading levels can be assessed using the health measurements tools such as S-TOFHLA, and REALM. Patient education handouts should be on a reading level below 5th-grade level</p> <ul style="list-style-type: none"> - if there is a lack patient education materials tailored for low health literacy, healthcare professionals can create patient education material using picture-based information. Pictures should be simple, clear, and culturally tailored for easy to understand. Appropriate picture-based health education materials would make it easier for such people to understand health information, as opposed to text-based health education materials alone 		
21. Comics	<p>Science education, science communication [Social science]</p>	<ul style="list-style-type: none"> - carefully designed empirical studies that are required to understand the full effects of comics on learning, engagement and attitude toward science - consistent quality of the studies and, at times, objectivity on the analysis of results 	<ul style="list-style-type: none"> - future research should aim to distil the fundamental components of visual narratives, and explore how each of them can benefit the communication of science - an area of future investigation could be to compare different types of visual narratives (e.g., comics and animations are often associated in popular culture but they probably rely on different cognitive mechanisms) - more studies will be required in order to determine which visual strategies are more effective, on which topics and for which audiences - integrating empirical evidence in this field with the insights of visual communicators, educators and cognitive scientists will facilitate the creation and adoption of comics for science communication, 	<ul style="list-style-type: none"> - existing studies have focused excessively on stereotypical perceptions of comics, such as their 'humorous' nature and their appeal to children (partly because many studies were conducted in the classroom) 	<p>The potential of comics in science communication Farinella 2018</p>

			allowing the emerging field of 'graphic science' to reach its full potential		
22. Games	Education [Social science]	<p>- sound empirical evidence, conclusive results and overarching methodology for effectiveness research on digital game-based learning (DGBL)</p> <p>- validity of the current effectiveness research on DGBL (e.g. educational research requires rigorous standards of reliability and validity, implying that tests developed by researchers should be piloted and include checks on their internal consistency. The mere use of subjective tests such as self-efficacy is considered as problematic, considering student opinion on learning has previously been found to be unreliable and conflicting with direct measures, questioning their validity)</p> <p>- empirical evidence on the possible impact of confounding elements (e.g. addition of elements to the game used for the intervention, presence of an instructor, practice effects when the same test is implemented pre- and post-intervention) in the context of DGBL research</p>	<p>- a common methodology for assessing the effectiveness of DGBL would: create the opportunity to compare results and thus the quality of the different educational interventions across studies; claims regarding the effectiveness of DGBL could be made on a more general level; set a baseline for quality, which could serve as an evaluation tool for published studies and as a starting point for researchers desiring to conduct an effectiveness study on DGBL</p> <p>- formulate a clear definition of effectiveness in the context of DGBL, not solely be based on literature reviews, but including the conceptualization of effectiveness by different stakeholders (e.g. game designers, game researchers, adopters and governmental institutions providing funding)</p> <p>- development of a validated scale for assessing motivation (i.e. toward the educational intervention and towards learning or the educational content)</p> <p>- research on the impact of several factors such as support by intermediaries, program elements and extra material provided is required</p> <p>- according to several authors, an analysis of covariance (ANCOVA) with pre-test scores as a covariate, is a preferable method (it reduces error variance and in the context of nonrandomized designs and</p>		<p>Measuring Effectiveness in Digital Game-Based Learning: A Methodological Review</p> <p>All, Nunez Castellar, and Van Looy 2014</p>

			<p>adjusts mean scores of the post-test to differences between groups on pre-test scores)</p> <ul style="list-style-type: none"> - suboptimal study designs are a result of confounding variables (e.g. addition of elements to the game used for the intervention, presence of an instructor, practice effects when the same test is implemented pre- and post-intervention) influencing the results, leading to insecurity about whether or not the effects found can be attributed to the game-based intervention or other elements added to the intervention during implementation. Confounds should therefore be eliminated as much as possible 		
22. Games	Health promotion [Healthcare and Medicine]	- scope and methodologies of existing IA	<ul style="list-style-type: none"> - need for further high-quality systematic reviews of RCTs and research, especially on sedentary health games with large sample sizes, homogeneity of interventions, settings, and outcomes - need for evaluation of the long-term effects of games in health promotion - important to evaluate the use of active and sedentary video games with different patient groups and in a wider range of health issues - further research is required to find out more about the possibilities of games in children's health promotion and to provide evidence needed for clinical decision-making, as games may be a remarkable resource in the future for promoting the health of children with different backgrounds 		<p>Promoting Children's Health with Digital Games: A Review of Reviews Parisod et al. 2014</p>

22. Games	Diet & Nutrition [Healthcare and Medicine]	- scope, content and methodology	<ul style="list-style-type: none"> - stronger measures are needed to more effectively assess effects of health games on nutrition and healthy eating - more intensive collaborations between interdisciplinary academic researchers and commercial game companies would mutually propel both fields of health game research and health game production forward - sample size, research design, and outcome measurement all need improvement - closer collaboration between academic researchers and professional game development companies could result in more reusable games that can be applied to a wider audience for a longer duration to achieve more meaningful impact 		Digital games for nutrition and healthy eating Lu, Kharrazi, and Baranowski 2016
22. Games	Science education [Social science]	<ul style="list-style-type: none"> - evidence for the effectiveness of games in science instruction or learning - (little or inconclusive) evidence that games can promote developing scientific skills, understanding of science content, or an understanding of the nature of science 	<ul style="list-style-type: none"> - since the current state of research on the use of video games to support learning in science is “inconclusive”, additional research is necessary to demonstrate the effectiveness of games in educational contexts - need to conduct high-quality research on the effects of particular video games on specific science education outcomes - need for precise research questions - need for video games to scaffold skills in science education - need to see games as cultural tools for science education, rather than potential replacements for science instruction 		Gaming science: the “Gamification” of scientific thinking Morris et al. 2013

<p>22. Games</p>	<p>Education [Social science]</p>	<p>- longitudinal studies (where information is repeatedly collected, over time, on the same sample of individuals) in the digital games for learning literature</p>	<ul style="list-style-type: none"> - more RCTs are required, a greater amount of comparisons are required using traditional teaching approaches, a greater amount of studies are required examining collaborative gameplay and a greater amount of studies are required investigating the pedagogical benefits of using 2D or 3D games - more studies are required to appropriately investigate the long term effects of computer games on learning - further Randomised Controlled Trial (RCTs) should be performed where possible comparing Games-based Learning (GBL) to traditional teaching approaches to ascertain if GBL are a viable teaching approach in Primary Education (PE) level. Quasi-experimental designs can also compare GBL to traditional approaches and could be beneficial where RCTs are not practically possible depending on the research circumstances - further longitudinal studies are required as only one was discovered in this systematic literature review - further studies are required looking at whether there are pedagogical benefits of using 2D or 3D games at PE level to identify the benefits or disadvantages of using 2D or 3D games. 3D games are reputed to be more immersive than 2D games and it would be beneficial to see if advanced graphics and sound are required for an effective learning experience - further studies are also required to perform comparisons between single and 		<p>A systematic literature review of games-based learning empirical evidence in primary education Hailey et al. 2016</p>
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			collaborative play to identify pedagogical benefits		
22. Games	Education [Social science]	<ul style="list-style-type: none"> - Randomised Controlled Trial (RCTs) (it is difficult to select appropriate conditions for a meaningful and comparable control because of the complexity of gaming systems) - studies following students' progress to show if the games really maintain their impacts and outcomes over time (important as participants may require more-diversified sets of knowledge and skills over time) 	<ul style="list-style-type: none"> - observing gameplay longitudinally can decrease the risk of misinterpreting short-term changes in behaviour 	<ul style="list-style-type: none"> - small sample sizes provide a convenient study sample but results may have limited relevance and generalizability 	Gameplay Engagement and Learning in Game-Based Learning: A Systematic Review Abdul Jabbar and Felicia 2015
22. Games	Science education [Social science]	<ul style="list-style-type: none"> - understanding between students' possible learning experience in the games and their learning outcomes being assessed - evaluations of student's learning outcomes are still limited to knowledge learning although game designs were guided by different theories or models to provide a variety of learning opportunities - examinations of how or to what degree game-based learning could promote the affect and engagement of science learning 	<ul style="list-style-type: none"> - potential and advantages of multi-player games are not fully investigated (e.g. collaborative learning) - affordance of game environments to facilitate science learning has not been fully explored and needs further investigation - necessary to explore whether the arrangement of specific game elements would influence students' learning outcomes or other game playing experiences and performance if one would like to develop an effective and popular educational game for science learning - more studies are needed to systematically develop and improve game design by adopting design-based research method, as the majority of the studies emphasized game implementation and the comparisons between different game mechanisms and between game and other learning methods - future investigations should be 		Game-Based Learning in Science Education: A Review of Relevant Research Li and Tsai 2013

			<p>conducted to gain more knowledge of students' behaviours during game playing, advanced and systematic analysis of behavioural patterns (e.g., quantitative content analysis, lag sequential analysis, and cluster analysis)</p> <ul style="list-style-type: none"> - the relationships among in-game performance, game playing experience, gaming behaviours, and science learning outcomes need to be analyzed to validate the assumption that students learned when they played the digital games - need for examination of the relationships among different learning outcomes and between learning performance and behaviours 		
22. Games	Education [Social science]		<ul style="list-style-type: none"> - researchers should be encouraged to choose appropriate assessments based on learning goals but should report reliability and validity information for author-created or -modified instruments - researchers should carefully weigh the benefits of experimental designs in light of fundamental issues of ecological validity, authenticity, and specific requirements of the research questions under exploration. In studies where quasi-experimental designs are implemented, researchers must provide more substantial information about the group attributes and account for those attributes in analyses - ongoing development and research should focus more heavily on accurate and reliable assessment of higher order learning outcomes 	<ul style="list-style-type: none"> - higher-order cognitive, intrapersonal, and interpersonal processes and skills prove more challenging to measure accurately and reliably than do lower order cognitive skills and rote knowledge 	<p>Digital Games, Design, and Learning: A Systematic Review and Meta-Analysis Clark, Tanner-Smith, and Killingsworth 2016</p>

22. Games	Science education [Social science]	- studies exploring students' affective outcomes or learning processes	- future research should focus not only on participants' cognitive learning outcomes but also on their learning processes and affective aspects - the use of qualitative methods in further research will be helpful		The use of serious games in science education: a review of selected empirical research from 2002 to 2013 Cheng et al. 2015
22. Games	Science education [Social science]	- scope and methodology	- continued research on specific games, apps and online reading and math programs would be beneficial to educators - more longitudinal studies are also recommended to measure the long-term effects relating to the use of online math games and e-books to student achievement		The effects of on-line math games and e-books use on elementary student achievement Carnahan 2014
23. Graphics					n.d.
24. Posters	Health promotion [Healthcare and Medicine]	- studies that evaluated the effectiveness of posters in direct comparison with other educational intervention - studies that have evaluated the effectiveness of the poster presentation in actively changing user knowledge, attitudes or behaviour. Given that posters have been discussed within associated literature for an excess of 20 years and poster presentation are accepted as a valid form of transferring academic knowledge, it is remarkably disappointing that such an established practice within the healthcare disciplines is entirely lacking in its supporting evaluative evidence	- well-designed empirical studies are required to establish an evidence base to inform how posters may best be developed and implemented in order to achieve successful knowledge transfer - research is required to identify the effectiveness of incorporating aspects of information technology into poster presentations. This may promote an interactive learning environment for users and counter the current passive nature of poster design		What is the evidence that poster presentations are effective in promoting knowledge transfer? A state of the art review Ilic and Rowe 2013
25. Publications					NO REVIEWS

26. Radio					NO REVIEWS
27. Reports					NO REVIEWS
28. Television					NO GAPS IDENTIFIED
29. Videos					NO GAPS IDENTIFIED

Bibliography

- Abdul Jabbar, Azita Iliya, and Patrick Felicia. "Gameplay Engagement and Learning in Game-Based Learning: A Systematic Review." *Review of Educational Research* 85, no. 4 (December 2015): 740–79. <https://doi.org/10.3102/0034654315577210>.
- All, Anissa, Elena Patricia Nunez Castellar, and Jan Van Looy. "Measuring Effectiveness in Digital Game-Based Learning: A Methodological Review." *International Journal of Serious Games* 1, no. 2 (June 19, 2014). <https://doi.org/10.17083/ijsg.v1i2.18>.
- Carnahan, Mel. "The Effects of On-Line Math Games and e-Books Use on Elementary Student Achievement." Master's thesis, University of Northern Iowa, 2014. <https://scholarworks.uni.edu/cgi/viewcontent.cgi?article=1148&context=grp>.
- Cheng, Meng-Tzu, Jhih-Hao Chen, Sheng-Ju Chu, and Shin-Yen Chen. "The Use of Serious Games in Science Education: A Review of Selected Empirical Research from 2002 to 2013." *Journal of Computers in Education* 2, no. 3 (2015): 353–75.
- Clark, Douglas B., Emily E. Tanner-Smith, and Stephen S. Killingsworth. "Digital Games, Design, and Learning: A Systematic Review and Meta-Analysis." *Review of Educational Research* 86, no. 1 (March 2016): 79–122. <https://doi.org/10.3102/0034654315582065>.
- Farinella, Matteo. "The Potential of Comics in Science Communication." *Journal of Science Communication* 17, no. 1 (January 23, 2018): Y01. <https://doi.org/10.22323/2.17010401>.
- Hainey, Thomas, Thomas M. Connolly, Elizabeth A. Boyle, Amanda Wilson, and Aisya Razak. "A Systematic Literature Review of Games-Based Learning Empirical Evidence in Primary Education." *Computers & Education* 102 (November 2016): 202–23. <https://doi.org/10.1016/j.compedu.2016.09.001>.
- Ilic, Dragan, and Nicholas Rowe. "What Is the Evidence That Poster Presentations Are Effective in Promoting Knowledge Transfer? A State of the Art Review." *Health Information & Libraries Journal* 30, no. 1 (March 2013): 4–12. <https://doi.org/10.1111/hir.12015>.
- Li, Ming-Chaun, and Chin-Chung Tsai. "Game-Based Learning in Science Education: A Review of Relevant Research." *Journal of Science Education and Technology* 22, no. 6 (December 2013): 877–98. <https://doi.org/10.1007/s10956-013-9436-x>.

- Lu, A.S., H. Kharrazi, and T. Baranowski. "Digital Games for Nutrition and Healthy Eating." *Gesundheit Spielend Fördern? Potentiale Und Herausforderungen von Digitalen Spieleanwendungen Für Die Gesundheitsförderung Und Prävention (Health Promotion through Gaming? Potentials and Challenges of Digital Games for Health Promotion and Prevention*, 2016, 261–81.
- Morris, Bradley J., Steve Croker, Corinne Zimmerman, Devin Gill, and Connie Romig. "Gaming Science: The 'Gamification' of Scientific Thinking." *Frontiers in Psychology* 4 (2013). <https://doi.org/10.3389/fpsyg.2013.00607>.
- Parisod, Heidi, Anni Pakarinen, Lotta Kauhanen, Minna Aromaa, Ville Leppänen, Tapani N. Liukkonen, Jouni Smed, and Sanna Salanterä. "Promoting Children's Health with Digital Games: A Review of Reviews." *Games for Health Journal* 3, no. 3 (June 2014): 145–56. <https://doi.org/10.1089/g4h.2013.0086>.
- Park, Jungmin, and Julie Zuniga. "Effectiveness of Using Picture-Based Health Education for People with Low Health Literacy: An Integrative Review." Edited by Albert Lee. *Cogent Medicine* 3, no. 1 (November 29, 2016): 1–14. <https://doi.org/10.1080/2331205X.2016.1264679>.