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Research on Educational Impact of Games
A Literature Review

Institute for Games for Learning
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Gaming Literature Coding

In response to researchers' calls for more systematic investigations of the use of games for learning, we conducted an extensive literature review on this topic. By surveying prior research, we examined the themes that emerged, the methodology employed, and the findings yielded, the ultimate goal being to identify knowledge gaps in the literature. To this end, we reviewed the relevant research conducted in the last 15 years by following the procedures outlined below.

(a) Using the widely used social science database PsycINFO, we searched for articles which focused on both games and learning. The keywords chosen were "gam*" and either "learn*", "teach*", or "educat*" (the wildcard * can stand for any of a defined subset of all possible characters; for example "gam*" includes "game," "games," "gaming," etc.). This generated about 4000 peer-reviewed articles from the earliest date (i.e., before 1960) to the end of 2008.

(b) Given that studies conducted a decade ago tended to be less rigorous methodologically or yield obsolete results, we decided to focus our attention on more recent research. Once we narrowed down the time period to the years of 1995 to 2008, about 2400 peer-reviewed articles were left in the search results.

(c) A quick survey of the 2400 articles revealed that many of them were not about games for educational purposes (e.g., research on game theory). Therefore, we screened the 2400 articles and eliminated those that were not relevant. This further reduced the number of articles to about 300.

(d) We examined the 300 articles and identified if they were empirical or purely conceptual articles. About half of the articles belong to each category.

(e) After carefully reading each of the empirical articles (about 150), information about each article was entered into an excel sheet in the form of an annotated bibliography. Information extracted included the game and platform used in the research, the subject area examined (if used to enhance knowledge on a particular subject), and the method used (participants, study design and procedures, data collected, and results).

(f) When we reviewed the empirical articles, we employed the snowballing technique to supplement our database with additional articles found in the reference section. Moreover, efforts were made to conduct searches in PsycInfo periodically to look for relevant articles published in 2009.

(g) We developed a coding system to classify the articles into different categories. The purpose was to convert the rich information in the bibliography into a more quantifiable format. We used the coding system to code some articles and revise the coding system as needed.

(h) Using the coding system we developed, we coded each of the articles along several dimensions (see below). This allowed us to identify patterns that emerged in the literature.

Literature Review: Coding System

Category	Code	Code Label	Description/Example
Game Type	1	Educational, off the shelf	Educational games that are available in the market. They are designed to be educational. E.g., Quest Atlantis
	2	Educational, in-house	Educational games, self-designed (usually for research) and not in the market.
	3	Non-educational, off the shelf (COTS)	Non-educational games that are available in the market. They are NOT designed to be educational. E.g., Halo, Tomb Raider
	4	Non-educational, in-house	Non-educational games, self-designed (usually for research) and not in the market. E.g., a plane-shooting game developed by the researchers to study aggression. These games are often used as stimuli.
	5	Other (general)	About games in general. Mostly in survey studies or used as stimuli in studies. E.g., a survey study asked students to report how often they played games each day.
	6	Other (game is designed by subjects themselves)	Mostly in the field of information technology
	7	Other (unclear)	The article does not specify whether it is educational or non-education; nor is information about whether the game was already off the shelf or developed in-house provided. Or the article states it is a game-like program.
Platform	1	Computer	Includes PC and Mac
	2	Browser	
	3	Console	Includes PS, Xbox, etc.
	4	Handheld	
	5	General	Survey studies
	6	Unclear	Does not specify

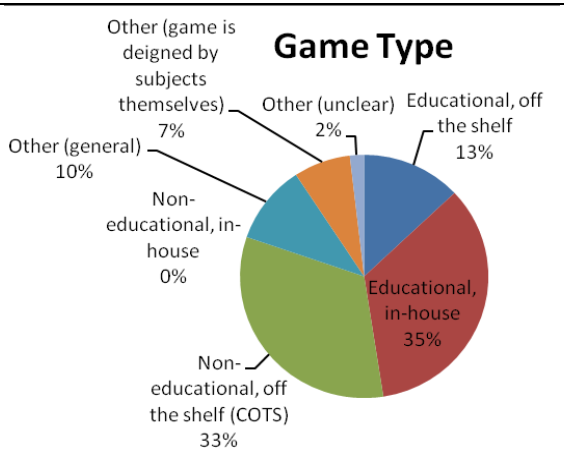
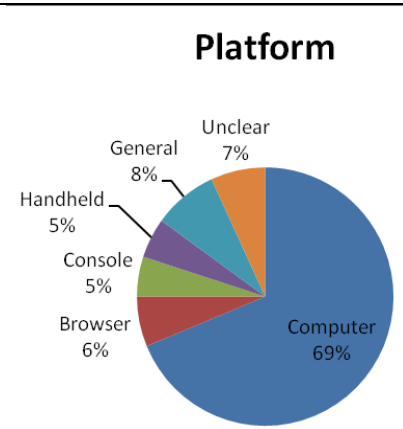
Curriculum-based or not	1	School: Math & Science	School means the games were used as part of/to develop the curriculum. E.g., games to teach pre-math skills to kindergarteners; games to teach physics; games to teach biology to high school students.
	2	School: Humanities & Social Science	E.g., games to teach European history.
	3	School: Medical	E.g., games to teach medical school students about surgery procedures.
	4	School: Business	E.g., games to teach project management.
	5	School: Language/Language Arts	Includes literacy. E.g., games to teach pre-literacy skills to kindergarteners; games to teach foreign language.
	6	School: Engineering	E.g., games to teach environmental engineering; IT skills, programming
	7	School: Other	Includes general curriculum, vocational learning, postgraduate pr distance programs which do not specify field or subject area, teacher education, etc.
	8	Non-curriculum knowledge	Non-curriculum. E.g., games to teach preschoolers about street safety; games to teach mothers nutrition
	9	Non-curriculum skills	Non-curriculum. Includes perceptual, cognitive, problem-solving, social skills, gaming skills, etc. E.g., games to train visual-spatial skills; cooperation.
	10	None	No learning happened. The game was not used in the article to help teachers/students in teaching/learning, or to help players acquire daily knowledge, or perceptual/cognitive skills. E.g. as in descriptive/correlational survey studies; game and aggression.

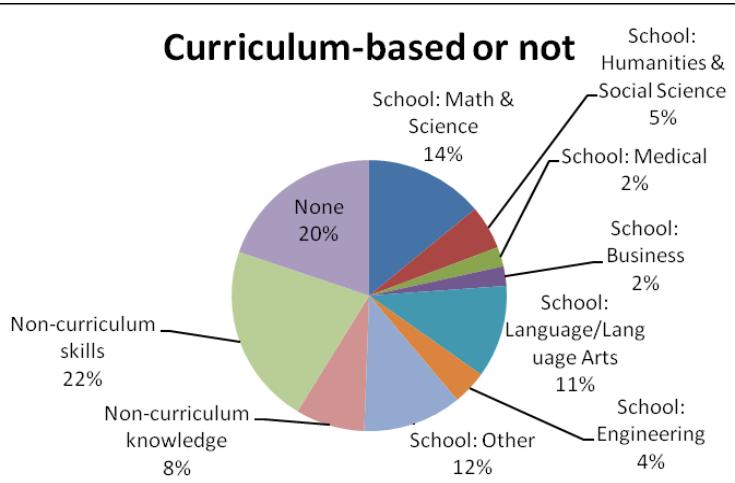
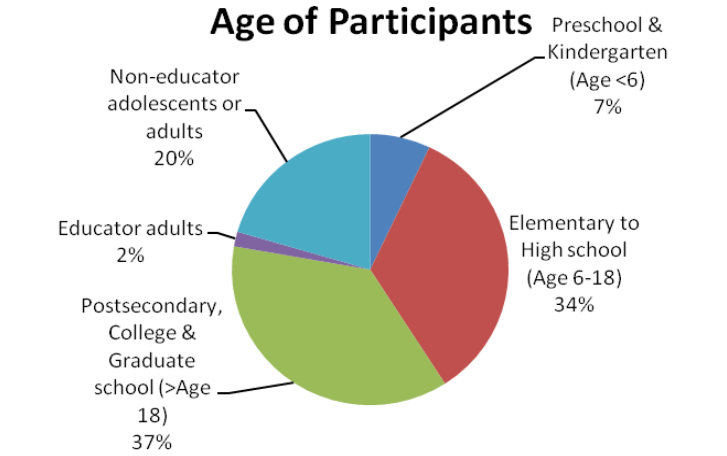
Age of Participants	1	Preschool & Kindergarten (Age <6)	
	2	Elementary to High school (Age 6-18)	
	3	Postsecondary, College & Graduate school (>Age 18)	
	4	Educator adults	E.g., high school teachers
	5	Non-educator adolescents or adults	E.g., community stakeholders, mothers, cancer-patients, hockey players, gamers with no specified information about educational level
Sample Size	1	Very small	<10 (total number of participants, not participants per cell)
	2	Small	11-30
	3	Medium	31-100
	4	Large	101-300
	5	Very large	>300
	6	Not clear	Not specified in the article
Research Design	1	Experimental	Manipulation was used with random assignment. Often involves comparing more than one condition.
	2	Quasi-experiment	Manipulation was used without random assignment (including those that did not clearly state the use of random assignment). Often involves comparing more than one condition.
	3	Correlational	Mostly survey studies.
	4	Descriptive/Exploratory	Purely descriptive.
	5	Case studies	E.g., a study interviewed two teachers and asked about their experience or attitude towards gaming.
	6	Design experimental	Mostly involves more than one experiment and the later ones take place because the earlier ones were not successful

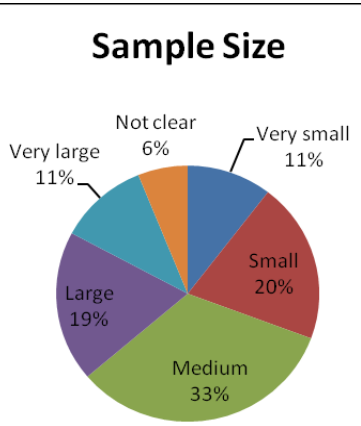
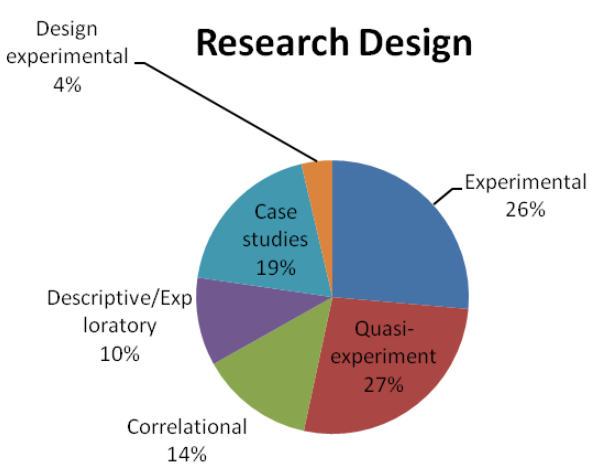
Research Timeframe	1	Concurrent	One time point. E.g., measure gaming & school grades at the same time.
	2	Longitudinal	Two time points. E.g., measure gaming at Time 1, then school grades 6 months later at Time 2.
	3	Cross-sectional	Involves comparing two cohorts. E.g., comparing third graders in a school with fifth graders in the same school.
General Method	1	Empirical: Quantitative	Involves mostly quantitative analyses and outcomes.
	2	Empirical: Qualitative	Involves mostly qualitative analyses and outcomes.
	3	Empirical: Mixed	Involves both quantitative and qualitative analyses and outcomes.
	4	Conceptual	No data was collected.
Data			
Self-report	1	Interview, focus group	
	2	Journal/Essay/Qualitative survey	
	3	Quantitative non-performance survey	E.g., 5-point Likert scale on motivation; statement survey asking participants to choose among some statements.
Observation	4	Audiotape/Discourse analysis	Includes think-aloud protocol.
	5	Observation on subjects' behavior, with or without videotape	
	6	Computer log	E.g., actions recorded by computer logging (including minutes played, etc)
Performance	7	Academic tests or assessments	E.g., Math school grades, standardized test, graded portfolio
	8	Gameplay performance	Includes in-game evaluation. E.g., task completion in the game; number of targets shot; number of trivia questions answered correctly
	9	Skills/daily knowledge tests	E.g., IQ test, cognitive test, visual-spatial test
Other	10	Other	Physiological data E.g., heart rate, clinical data. Reaction time to stimuli E.g., identification of emotion.

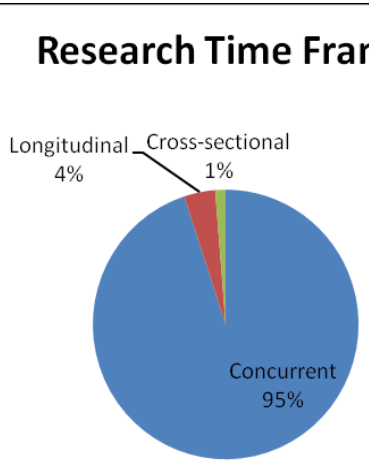
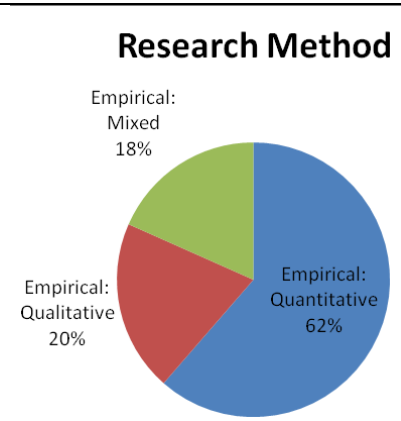
Results	1	Measured/observed learning outcome	Focus is on how much the game promotes learning. Learning outcome was actually assessed. E.g., measure how the game help the participants gained spatial/cognitive skills or improve school grades
	2	Expected/perceived learning outcome	Focus is on how much the game promotes learning. Learning outcome not actually assessed. E.g., ask participants to report on how they THINK the game will help them learn.
	3	Motivation, perception, attitudes, satisfaction, etc	Focus is on how much the game promotes motivation, etc. in the subject. E.g., increased interest in the subject, enjoyment of the class.
	4	Other outcome	Focus is on other outcomes. Includes aggressive cognition and behavior, interpersonal relationship. E.g., examine how playing a shooting game promotes aggressive behavior.
	5	Game design: User characteristics	Focus is on game development. E.g., personality, age, socioeconomic background, gender.
	6	Game design: Acceptability	Focus is on game development. E.g. interest in playing the game, enjoyment during the game.
	7	Game design: Usability	Focus is on game development
	8	Game design: Other	E.g., what are the features in games that promote cognitive skills; game comparison
	9	Game: General	For instance, survey correlation, attitudes toward gaming and games in general; gamers' behavior in games, etc

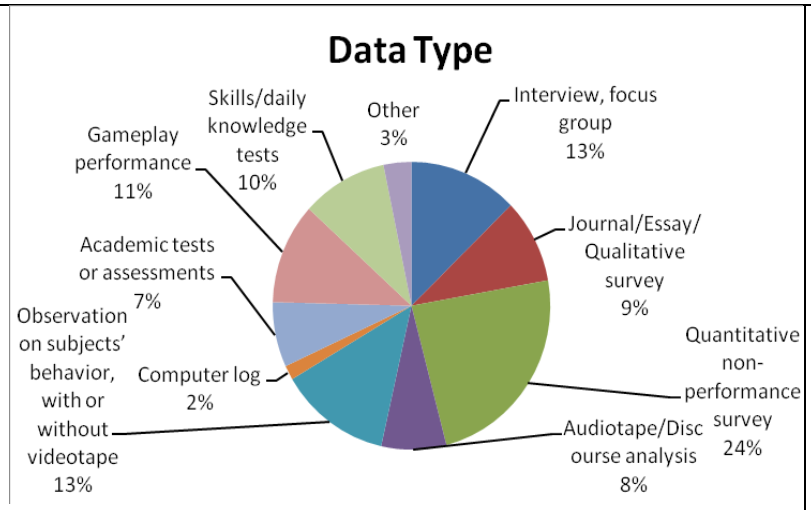
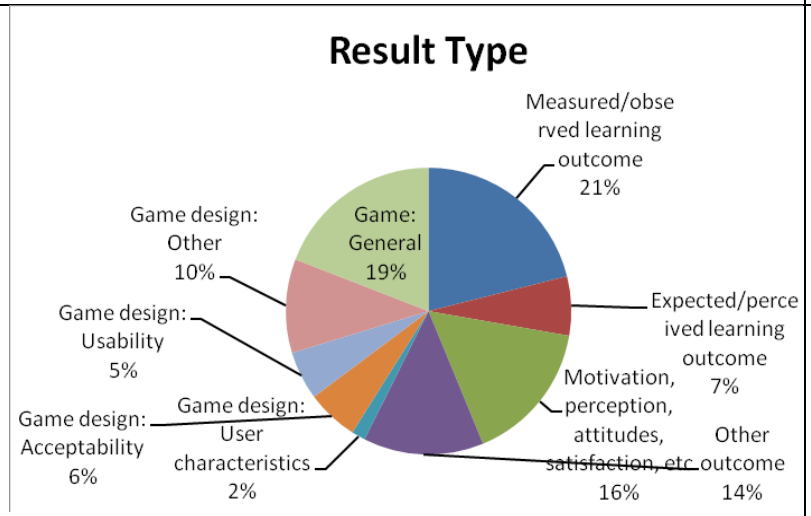
When coding was completed, for each code categories, the frequencies of the different codes were examined and presented in pie charts. The results are presented below.

Game Type		In terms of the type of games used or examined in prior research, the majority of the games were either educational games developed in-house for the study, or non-educational off-the-shelf games.
Platform		About 70% of the studies examined reported using personal computers as game platforms.

Curriculum -based or not		Half of the articles reviewed used games as part of the school curricula and/or for the purpose of developing the curricula. Among those that were curriculum-based, the subjects on which they focused varied, with language and literacy-related subjects, and math and science being the most popular subjects.
Age of Participants		Regarding the age groups studied in prior research, about one-third involved postsecondary students, another one-third involved elementary and high school students, and one-fifth involved non-educator adolescents or adults.

Sample Size		Studies varied much regarding their sample sizes. Generally speaking, prior research is equally divided between the use of relatively small sample sizes of fewer than 30 participants, medium sample sizes of about 30 to 100 participants, and relatively large sample sizes of 100 participants or more.
Research Design		Different research designs have been employed in prior research. About half of the articles reviewed employed an experimental or quasi-experimental design, with the rest using either correlational design, descriptive or case studies.

Research Timeframe		With the exception of a few longitudinal and cross-sectional studies, all the articles reviewed involved concurrent design.
General Method		More than half of the prior research reviewed used quantitative methods only. About one-fifth used qualitative methods only, and the rest used a mix of the two.

Data		Prior research varied considerably in terms of the type of data collected. More than half of the studies reviewed obtained data via self reports, with quantitative surveys used in a quarter of all the studies reviewed. Examples of other common type of data include focus group or interview data, behavioral observation, and assessment of game play performance or specific skills and knowledge.
Results		The articles reviewed focused on diverse outcomes. About a quarter of them focused on game design factors, such as usability. Almost half of the studies reviewed focused on whether and the extent to which games promoted learning or motivation.

Reviewed Empirical Articles on Games and Learning

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