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A systematic literature review of design-based research from 2004 to 2013

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Abstract Design-based research (DBR) that blends designing learning environments and developing theories has proliferated in recent years. In order to gain insights into DBR, 162 studies related to DBR published from 2004 to 2013 were selected and reviewed. The major findings indicated that most of the studies focused on designing, developing, and redesigning learning environments through interventions. However, how to revise the intervention was not specified in detail. Also, the testing of an intervention was found to be still dependent on the measurement of cognitive outcomes. Furthermore, it was found that most DBR only conducted one cycle of iteration. This review of research not only identifies the progress of DBR, but also provides future directions of DBR for researchers and practitioners.

Keywords Design-based research · Research methodology · Intervention · Literature review

Introduction

Design-based research (DBR) has emerged as a new research methodology from the beginning of this century. Being situated in a real context, DBR focuses on examining a particular intervention by continuous iteration of design, enactment, analysis, and redesign (Brown 1992; Cobb et al. 2003; Collins 1992). The intervention can be an instructional approach, or a type of assessment, or a learning activity, or a technological intervention, namely testing the effectiveness of the particular learning environment or tool (Anderson and Shattuck 2012). With the aim

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of designing learning environments and developing theories, the DBR explicates how designs work in the real settings and how to better understand the teaching and learning issues involved (The Design-Based Research Collective 2003). As an emerging paradigm, DBR highlights how the design principles evolved by multiple iterations as well as what kinds of intervention can lead to improved outcomes. By linking processes to outcomes in particular contexts, DBR can get a better understanding of intervention as well as improved theoretical accounts (The Design-Based Research Collective 2003).

DBR has been used increasingly in educational field, especially in K-12 contexts with technological interventions (Anderson and Shattuck 2012). Although the promising benefits of DBR are acknowledged in the field of education, many critiques have been proposed in previous studies. It is doubtful that researchers can produce reliable and faithful statements in DBR because researchers themselves are involved in design, development, and implementation of interventions (Barab and Squire 2004). Thus, it is difficult to produce the high research validity in DBR. Furthermore, it is impossible to replicate an intervention in other settings because DBR is contextually dependent (The Design-Based Research Collective 2003; Fishman et al. 2004; Hoadley 2002). Therefore, it is very obvious that there are big gaps between the expectation and application of DBR. This phenomenon makes us question how DBR was adopted and realized in education research in the past decade. Has DBR been most effective in a particular learning domain or research settings? What kinds of methods were utilized in DBR? How researchers design and implement the interventions in DBR? In order to answer these questions, a systematic review of existing studies was conducted to gain insights into the research issues of DBR and provide valuable references for educators and practitioners in this study.

Previous studies have attempted to analyze the methodology, progress, and issues of DBR. For example, Anderson and Shattuck (2012) reviewed the characteristics and progress of DBR by analyzing the abstracts of 47 most cited papers from 2002 to 2011. McKenney and Reeves (2013) suggested that in-depth analysis of full text of DBR should be conducted in order to provide sufficient evidence for assessing the progress of a decade. However, little research has been conducted to thoroughly analyze demographics, the research methodology, intervention, and research outcomes in the field of DBR. Therefore, this study aims to provide an overview of DBR through the systematic analysis of 162 selected studies in the database of 219 social sciences citation index (SSCI) educational journals from 2004 to 2013.

As Noyons and van Raan (1998) reported, separating the published papers into two periods can provide insights into the variation of the particular topic. Several studies have analyzed the variation by splitting the data into different periods of time. For example, Tsai et al. (2011) examined the variation of science learning by analyzing 228 empirical studies during 2000–2004 and 2005–2009. Kinshuk et al. (2013) analyzed highly cited educational technology papers during 2003–2006 and 2007–2010. Zheng et al. (2014) investigated the research topics of computer-supported collaborative learning by analysis of 706 papers published during 2003–2007 and 2008–2012. Thus, an in-depth review of demographics, research methodology, intervention, and research outcomes concerning DBR has been conducted in the present study between the first 5

years (2004–2008) and the second 2 years (2009–2013). The purpose of this review is twofold. First, the authors investigate the status quo of DBR from 2004 to 2013. Second, the variations between the first 5 years (2004–2008) and the second 5 years (2009–2013) in demographics, research methods, intervention characteristics, and research outcomes have been explored based on the selected studies. Therefore, the research questions addressed in this study are as follows:

(1) What are the demographics of the selected studies from 2004 to 2013? And, what were the demographics variations between the first 5 years and the second 5 years?
(2) What research methodologies in DBR were selected in these selected studies from 2004 to 2013? And, what were the methodology variations during the two periods?
(3) What kinds of interventions were adopted in DBR from 2004 to 2013? And, what were the intervention variations during the two periods?
(4) What are the measured outcomes in DBR from 2004 to 2013? And, what were the measured outcomes variations during the two periods?

Methodology

This study adopted content analysis method to review the research papers regarding the DBR from 2004 to 2013. This section will describe the details of the paper selection process, coding scheme, and inter-rater reliability.

Paper selection processes

In order to conduct a systematic literature review on DBR, this study selected papers relevant to DBR in the database of 219 education and educational research SSCI indexed journals from 2004 to 2013. More specifically, the paper identification process proceeded in three stages. In the first stage, 479 papers related on DBR were selected using keyword and paper title searches within the 219 journals. The search terms included "design research" and its synonyms (viz. "design-based research," "developmental research," "design experiment," "design based research," "design experiments," "design research," "development research," "developmental research," and "formative research"). In the second stage, the authors selected papers based on the following six criteria:

First, only papers that were categorized as "articles" in the SSCI database were analyzed in this study. So non-research publications such as "book reviews," "editorials," and "letters" were excluded from this study.

Second, conceptual papers closely related to DBR were included so as to produce a comprehensive understanding of DBR.

Third, the studies had to adopt DBR method to conduct the empirical study.

Fourth, the measured outcome variable(s) in the empirical study was related to student outcomes (cognitive outcomes, attitude, and psychomotor skills).

Fifth, the empirical study needs to follow appropriate methodology (Jitendra et al. 2011). The research sample groups, settings, learning domains, data sources, and data analysis procedure need to be specified in the empirical study.

Sixth, the paper had to be written in English and published from 2004 to 2013.

Failure to satisfy any of these criteria cannot be included in the literature review. Finally, the search and identification resulted in 162 selected articles.

Coding scheme

To answer the aforementioned four research questions, the coding scheme was developed for the purposes of reviewing DBR in the past decade. To address the first research question concerning the demographics in DBR, the category included: research sample group, research settings, and research learning domains. To analyze research methodology in DBR, we focus on the research methods and data sources adopted in selected studies. To answer the third research question regarding the intervention characteristics, the category included: intervention type, revision of intervention, iteration frequency, and iteration duration. To explore what measured outcomes were assessed, we adopted the coding scheme proposed by Wang et al. (2014), namely cognitive outcomes, attitude, psychomotor skills, integrated, and others. Some of these categories, namely research sample groups, research settings, research learning domains, research methods, data sources, and measured outcomes have also been applied in other reviews (Hsu et al. 2012; Wang et al. 2014). Following sections illustrate the details of each sub-dimension.

Research sample groups

Research sample groups were classified into one of the following sub-categories: (1) preschool, (2) primary school, (3) junior and senior high school, (4) higher education, (5) vocational education, (6) teachers, (7) mixed group, and (8) non-specified.

Research settings

Research settings refer to the contexts in which the research was mainly conducted. Research settings were coded as follows: (1) face-to-face classroom, (2) workplace, (3) distance learning setting, (4) blended learning setting, and, (5) non-specified. If a study took place in workplace mixed with a distance learning setting, it was coded into workplace.

Research learning domains

Research learning domains were classified into the following sub-categories: (1) natural science (including science, mathematics, physics, chemistry, biology,

geography, and environment science), (2) social science (including politics, education, psychology, and linguistics), (3) engineering and technological science (including engineering and computer science), (4) medical science, (5) mixed learning domain, and (6) non-specified.

Research method

Research method was coded as follows: (1) qualitative method, (2) quantitative method, and, (3) qualitative and quantitative method. Qualitative method refers to the one in which investigators use narratives, ethnographies, case studies, and so on to develop knowledge. Quantitative method means that investigators adopt experiments, surveys, and so on to develop knowledge (Cresswell 2009).

Data sources

Within DBR, multiple data sources can be used to analyze the outcomes of an intervention and to refine it (Cobb et al. 2003; The Design-Based Research Collective 2003; Wang and Hannafin 2005). In this study, the data sources were coded as follows: (1) process data, including video and audio records, log data, think-aloud protocols, (2) outcome data, including test and various kinds of artifacts, (3) miscellaneous data, including questionnaire, interview data, notes (such as field notes, journals, written reflections, observation records), and (4) non-specified.

Intervention type

The intervention type was coded as follows: (1) instructional method (such as collaborative learning, project-based instruction), (2) scaffolding (conceptual scaffolding, procedural scaffolding, and metacognitive scaffolding), (3) integrated teaching models (such as knowledge-building activity), (4) technological intervention, namely testing the effectiveness of the learning environment or the particular tool), and (5) other models or methods (such as professional development model or heuristic task analysis method).

Revision of intervention

Revision of intervention refers to whether the intervention was revised and specified. In terms of revision of intervention, it was coded as follows: (1) revised, and (2) no revision. With respect to specifying how the intervention was revised, it was coded as follows: (1) reported, and, (2) no report.

Iteration frequency

Iteration frequency refers to the number of times the intervention is implemented during the whole research. In this study, the value of iteration frequency was coded as once, twice, thrice, four times, five times, and more than five times.

Iteration duration

Iteration duration refers to how long the intervention is conducted in the whole research. This time span can range from several days to several years.

Measured outcomes

The measured outcomes refer to the investigated crucial variables. Three major domains are selected as the measured outcomes for this study, namely cognitive outcomes, attitude, and psychomotor skills. In addition, if some studies measure multiple kinds of variables, then they are categorized as "Integrated." If the measured outcomes did not belong to these four domains, they are classified as 'others.' Therefore, the measure outcomes are coded as follows: (1) cognitive outcomes, (2) attitude, (3) psychomotor skills, (4) integrated, and (5) others.

Inter-rater reliability

Three raters manually and independently coded all of the articles based on the aforementioned schemes. The percent agreement was used to calculate the inter-rater reliability. The agreement rate between coders was above 0.9, regarded as reliable and stable results (Landis and Koch 1977). The three raters resolved all discrepancies after face-to-face discussion.

Results

Demographics of the selected studies

Table 1 shows the descriptive data for the demographics results of the selected studies in the first 5 years (2004–2008) and the second 5 years (2009–2013).

Research sample groups

As shown in Table 1, researchers most often selected the higher education group in both periods. On the other hand, preschool sample was the least selected group during both periods. Additionally, the most significant increase was found in the sample group of vocational education ($x^2 = 1.97, p < 0.05$) and the most significant decrease in the group of junior and senior high school ($x^2 = 2.01,\ p < 0.05$) between these two periods. No significant differences were found in other sample groups.

Research settings

Table 1 also shows that most of the research works were conducted in face-to-face classroom. However, there was significant decrease in face-to-face classroom ($x^2 = 2.51, p < 0.05$) between the first 5 years and the second 5 years. In addition,

Table 1 The descriptive data for the results of demographics of the selected studies

	Total *n* (%)	2004–2008 *n* (%)	2009–2013 *n* (%)
Research sample groups			
Preschool	1 (0.6)	0 (0)	1 (0.85)
Primary school	31 (19.13)	9 (20.00)	22 (18.80)
Junior and senior high school	26 (16.05)	10 (22.22)	16 (13.68)
Higher education	47 (29.01)	13 (28.89)	34 (29.06)
Vocational education	11 (6.79)	1 (2.22)	10 (8.55)
Teachers	29 (17.91)	5 (11.11)	24 (20.51)
Mixed group	13 (8.03)	5 (11.11)	8 (6.84)
Non-specified	4 (2.48)	2 (4.44)	2 (1.71)
Research settings			
Face-to-face classroom	110 (67.9)	35 (77.78)	75 (64.10)
Distance learning setting	22 (13.58)	2 (4.44)	20 (17.09)
Blended learning setting	19 (11.73)	4 (8.89)	15 (12.82)
Workplace	5 (3.09)	0 (0)	5 (4.27)
Lab	2 (1.23)	1 (2.22)	1 (0.85)
Non-specified	4 (2.47)	3 (6.67)	1 (0.85)
Research learning domains			
Natural science	61 (37.65)	19 (42.22)	42 (35.90)
Social science	50 (30.86)	11 (24.44)	39 (33.33)
Engineering and technological science	10 (6.17)	3 (6.67)	7 (5.98)
Medical science	4 (2.47)	1 (2.22)	3 (2.56)
Mixed	18 (11.11)	7 (15.56)	11 (9.40)
Non-specified	19 (11.73)	4 (8.89)	15 (12.82)

there was significant increase in distant learning setting between the two periods ($x^2 = 4.73$, $p < 0.05$). With respect to the blended learning setting and workplace, there were more growths in these two periods. However, no significant difference was found in blended learning setting ($x^2 = 0.53$, $p > 0.05$) and workplace ($x^2 = 1.85$, $p > 0.05$).

Research learning domains

In DBR, researchers selected different learning domains to investigate how the interventions function through several cycles. During the past decades, natural science was selected the most often and medical science was selected the least. However, no significant difference was found in natural science ($x^2 = 0.68$, $p > 0.05$), social science ($x^2 = 1.24$, $p > 0.05$), engineering and technological science ($x^2 = 0.06$, $p > 0.05$), medical science ($x^2 = 0.01$, $p > 0.05$), and mixed learning domains ($x^2 = 1.22$, $p > 0.05$) between these two periods.

Research methodology

Research method

Table 2 shows the descriptive results of research methods and data sources. With respect to research method, qualitative method was adopted the most and quantitative method was conducted the least. However, there was no significant difference in qualitative method ($x^2 = 0.25$, $p > 0.05$), quantitative method ($x^2 = 0.006$, $p > 0.05$), and qualitative and quantitative methods ($x^2 = 0.26$, $p > 0.05$).

Data sources

With regard to data sources, researchers collected various kinds of data to conduct the research. Miscellaneous data (such as interview data, questionnaires, and various kinds of notes) were utilized the most in the past decade. In addition, the process data increased from 11.82 to 14.54 %. The outcome data decreased from 27.27 to 18.44 %. However, there was no significant difference in process data ($x^2 = 0.25$, $p > 0.05$), outcome data ($x^2 = 0.61$, $p > 0.05$), and miscellaneous data ($x^2 = 0.50$, $p > 0.05$).

Intervention

Intervention type

Table 3 shows the descriptive data of intervention type, iteration frequency and duration, and the revision of intervention. In the past decade, the technological intervention was the major type of intervention used in DBR. However, there was no significant difference in the technological intervention ($x^2 = 0.46$, $p > 0.05$) over the two periods. In terms of other intervention types, the most significant

Table 2 Descriptive data for the results of research method and data sources

	Total *n* (%)	2004–2008 *n* (%)	2009–2013 *n* (%)
Research method			
Qualitative method	118 (72.84)	34 (75.56)	84 (71.79)
Quantitative method	0	0 (0)	0 (0)
Qualitative and quantitative methods	44 (27.16)	11 (24.44)	33 (28.21)
Data sources			
Process data	54 (13.78)	13 (11.82)	41 (14.54)
Outcome data	82 (20.92)	30 (27.27)	52 (18.44)
Miscellaneous data	254 (64.80)	66 (60.00)	188 (66.67)
Non-specified	2 (0.51)	1 (0.91)	1 (0.35)

Table 3 Descriptive data of intervention types, iteration frequency and duration, and revision of intervention

	Total *n* (%)	2004–2008 *n* (%)	2009–2013 *n* (%)
Intervention type			
Instructional method	22 (13.58)	9 (20.00)	13 (11.11)
Scaffold	2 (1.23)	0 (0)	2 (11.11)
Integrated teaching models	26 (16.05)	7 (15.56)	19 (16.24)
Technological intervention	86 (53.09)	22 (48.89)	64 (54.70)
Other model	26 (16.05)	7 (15.56)	19 (16.24)
Iteration frequency			
Once	81 (50)	22 (48.89)	59 (50.43)
Twice	52 (32.1)	13 (28.89)	39 (33.33)
Thrice	21 (12.96)	7 (15.56)	14 (11.97)
Four times	4 (2.47)	1 (2.22)	3 (2.56)
Five times	2 (1.23)	1 (2.22)	1 (0.85)
More than five times	2 (1.23)	1 (2.22)	1 (0.85)
Iteration duration			
One month	31 (19.14)	8 (17.78)	23 (19.66)
Six months	38 (23.46)	10 (22.22)	28 (23.93)
One year	42 (25.93)	10 (22.22)	32 (27.35)
Two years	25 (15.43)	8 (17.78)	17 (14.53)
Three years	12 (7.41)	4 (8.89)	8 (6.84)
More than 3 years	7 (4.32)	3 (6.67)	4 (3.42)
Non-specified	7 (4.32)	2 (4.44)	5 (4.27)
Revision of intervention			
Revised	120 (74.07)	36 (80)	84 (71.79)
No revision	42 (25.93)	9 (20)	33 (28.21)
Report on revision			
Reported	98 (60.49)	32 (71.11)	66 (56.41)
No report	64 (39.51)	13 (28.89)	51 (43.59)

increase was found in the intervention of scaffold ($x^2 = 5.37$, $p > 0.05$) and the least significant decrease was found in the intervention of instructional method ($x^2 = 2.25$, $p < 0.05$). Although there were increases in the integrated teaching models and other models (from 15.56 to 16.24 %), no significant differences were found in these two types of interventions.

Revision of intervention

In the last decade, 74.07 % of DBR revised the intervention. During the two 5-year periods, there was growing tendency towards intervention without revision and decreasing trend in revision of intervention. However, there was no significant

difference in intervention with revision ($x^2 = 1.35$, $p > 0.05$) and without revision ($x^2 = 1.08$, $p > 0.05$). Furthermore, we examined whether the studies provided detailed reports of how to revise the intervention. As shown in Table 3, 60.49 % of DBR in the past decade reported what had been revised in terms of intervention. However, there was significant decrease in terms of intervention with revision ($x^2 = 3.08$, $p < 0.05$) and significant increase in terms of intervention without revision ($x^2 = 2.02$, $p < 0.05$) in these two periods.

Iteration frequency

In terms of iteration frequency, 50 % of the DBR only conducted one cycle in the past decade. There was a slight increase in the iteration frequency of once, twice, and four times. Also, there was a slight decrease in the iteration frequency of three and five times. However, there was no significant difference in any kinds of iteration frequency between the two 5-year periods.

Iteration duration

Most of DBR spent less than 1 year (42.6 %) or only 1 year (25.93 %) to design and test an intervention. 15.43 % of DBR spent 2 years to examine an intervention. Only a small proportion of DBR studies (4.32 %) were conducted for more than 3 years. As shown in Table 3, the iteration duration of 2, 3 years, and more than 3 years decreased from the first 5 years to the second 5 years. The short iteration durations including 1 month, 6 months, and 1 year slightly increased from the first 5 years to the second 5 years. However, no significant difference was found in any kinds of iteration duration between these two periods.

Measured outcomes

Among the 162 studies, most studies focused on the measurement of cognitive outcomes (see Table 4). Some studies examined the integrated skills, for example, problem solving, inquiry abilities, and so on. Only few studies measured learners' attitude and psychomotor skills. However, there was significant increase in the attitude between the first 5 years and the second 5 years ($x^2 = 2.77$, $p < 0.05$). No significant differences were found in the measurement of cognitive process

Table 4 Descriptive data of measured outcomes

	Total *n* (%)	2004–2008 *n* (%)	2009–2013 *n* (%)
Measured outcomes			
Cognitive outcomes	78 (48.16)	23 (51.11)	55 (47.01)
Attitude	7 (4.31)	0 (0)	7 (5.98)
Psychomotor skills	7 (4.31)	2 (4.44)	5 (4.27)
Integrated	46 (28.40)	14 (31.11)	32 (27.35)
Others	24 (14.82)	6 (13.33)	18 (15.38)

($x^2 = 0.21$, $p > 0.05$), psychomotor skills ($x^2 = 0.01$, $p > 0.05$), integrated skills ($x^2 = 0.26$, $p > 0.05$), and others ($x^2 = 0.11$, $p > 0.05$).

Discussion

The study presented in this paper describes the status of DBR in the past decade based on the selected 162 SSCI papers. The demographics of the selected studies revealed that the higher education sample group was the most commonly used group in DBR. In terms of research settings, distant learning settings significantly increased and face-to-face classroom settings significantly decreased during the two time periods. Also, DBR was more common in natural science learning domain.

With regard to research methodology, most researchers selected qualitative method to conduct DBR. This result is consistent with prior research that indicated that DBR can be descriptive and explanatory in nature (McKenney and Reeves 2012). In terms of data sources, miscellaneous data such as interview data, questionnaires, and various kinds of notes were adopted in most DBR. This is in line with previous research studies that reported that DBR is typically conducted using multiple forms of data (Dede 2004; Wang and Hannafin 2005). Furthermore, multivocal analysis in DBR was called for in order to obtain the trustworthy and credible conclusion (Fujita 2013).

Results of the present study indicated that most researchers tested technological intervention through designing, developing, implementing, and revising particular technological tools. Furthermore, results also revealed that although most of the research studies revised the intervention, significant decrease was found in specifying how the intervention was revised. This indicated that there was a tendency among researchers towards not providing the details of revising the design and intervention. In addition, most of the research studies only tested the intervention by one cycle in DBR. Also, the iteration duration was only 1 year in most DBR. This can be explained by the findings of Anderson and Shattuck (2012) that multiple iterations and cycles indeed go beyond the time and resources available to researchers.

With respect to the measured outcomes, the results indicated that the effectiveness of design and intervention was captured by measuring cognitive processes of learners, such as learning achievements, conceptual change, and artifacts. Very few studies measured attitudes and psychomotor skills of learners in DBR.

The theoretical and practical implications for future research are proposed as follows. First, this study suggests that much more effort needs to be put to make DBR more sound and reliable because good research requires objectivity, reliability, and validity (Norris 1997). Second, the findings of the present study suggest that multiple iterations are required in DBR so as to refine the theory, methods, or tools. Third, caution should be made when generalize the results of DBR because findings are drawn from the local context (The Design-Based Research Collective 2003).

Fourth, the design activities that can yield very interesting outcomes have been paid less attention in DBR (Reimann 2011). It is suggested that the design itself and how the design functions should be emphasized in future study. Finally, educational research has been required to create useful knowledge and provide scientific claims (Lagemann 2002; National Research Council 2002). Therefore, DBR needs to be improved so as to produce useful and replicable knowledge in the future.

Conclusion

This study thoroughly examined the research sample groups, research settings, research learning domains, research methods, data sources, intervention type, revision of intervention, iteration frequency, iteration duration, and measured outcomes in DBR. The main conclusion is that technological intervention is dominated in most of DBR studies. However, there is a tendency among researchers towards not reporting the details of how to revise the intervention in DBR. Also, only one cycle of iteration is conducted in most studies. In addition, the qualitative approach and miscellaneous data were adopted in most DBR.

This study contributes towards better understanding about the status of DBR. The thorough analysis of variation between the two periods (2004–2008 and 2009–2013) can provide directions for the potential research topics. Furthermore, this study proposes the need for new approaches that would emphasize the design process and highlight the value of replicability of research.

Results of this study are influenced by several constraints. First, this study only analyzed the demographics, research methods, interventions, and research outcomes. It would be very valuable to thoroughly analyze how design functions and evolves in different cycles. Second, only journal articles published from 2004 to 2013 were examined in this study. Future studies should extend the data sources to conduct a more deliberate analysis. Finally, it would also be very useful to thoroughly analyze the highly cited papers that have high influence and valuable contribution in the field of DBR, which can provide important insights into future directions for educators and researchers.

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Appendix

See Table 5.

Table 5 The list of the 162 selected papers

Years	Journal titles	Paper titles
2004	Educational Psychologist	Methodological alignment in design-based research
2004	Educational Psychologist	The practice of design-based research: uncovering the interplay between design, research, and the real-world context
2004	The Journal of the Learning Science	Design research: theoretical and methodological issues
2004	Educational Technology Research and Development	Designing E-learning environments for flexible activity and instruction
2004	The Journal of the Learning Science	Ontological innovation and the role of theory in design experiments
2004	International Journal of Human–Computer Studies	Supporting serendipitous integration in mobile computing environments
2004	American Educational Research Journal	Modeling natural variation through distribution
2004	Teaching and Teacher Education	Deepening the exchange of student teaching experiences: implications for the pedagogy of teacher education of recent insights into teacher behavior
2004	The Journal of the Learning Science	Ontological innovation and the role of theory in design experiments
2005	Medical Education	How can medical students learn in a self-directed way in the clinical environment? Design-based research
2005	British Journal of Educational Technology	Formative research on an early stage of the systemic change process in a small school district
2005	Journal of Engineering Education	Designing cognitive apprenticeships for biomedical engineering
2005	Journal of Computer Assisted learning	Preservice elementary teachers as information and communication technology designers: an instructional systems design model based on an expanded view of pedagogical content knowledge
2005	The Journal of the Learning Science	The game, the pieces, and the players: generative resources from two instructional portrayals of experimentation
2006	Computer-Supported Collaborative Learning	Collaborative knowledge building using the Design Principles Database
2006	Computer-Supported Collaborative Learning	Situating CoWeb: a scholarship of application
2006	Computer-Supported Collaborative Learning	Knowledge-building activity structures in Japanese elementary science pedagogy
2007	The Journal of the Learning Science	Confronting analytical dilemmas for understanding complex human interactions in design-based research from a cultural–historical activity theory (CHAT) framework
2007	Computer-Supported Collaborative Learning	Argumentation in a changing world
2007	Educational Technology and Society	I design; therefore I research: revealing DBR through personal narrative
2007	Journal of Computer Assisted Learning	Promoting thinking and conceptual change with digital dialogue games

Table 5 continued

Years	Journal titles	Paper titles
2007	Science Education	Situationally embodied curriculum relating formalisms and contexts
2007	Educational Technology Research and Development	The effects of a web-based learning environment on student motivation in a high school earth science course
2007	Chemistry Education Research and Practice	Using an advance organizer to facilitate change in students' conceptualization of the role of creativity in science
2007	Computers in Human Behavior	Supporting the instructional design process for team training
2007	Educational Technology Research and Development	Designing a computer support system for multimedia curriculum development in Shanghai
2007	Educational Technology Research and Development	ID model construction and validation: a multiple intelligences case
2007	International Journal of Science Education	Classroom discourse as a tool to enhance formative assessment and practice in science
2008	Computers and Education	The evolution of a collaborative authoring system for non-linear hypertext: a design-based research study
2008	Higher Education Research and Development	A methodological framework for understanding and describing discipline-based scholarship of teaching in higher education through design-based research
2008	Educational Technology, Research and Development	Managing cognitive load in educational multi-user virtual environments: reflection on design practice
2008	Science Education	An analysis of the supports and constraints for scientific discussion in high school project-based science
2008	Educational Technology, Research and Development	Environmental Detectives: the development of an augmented reality platform for environmental simulations
2008	Computers and Education	IDR: a participatory methodology for interdisciplinary design in technology enhanced learning
2008	Research in the Teaching of English	Learning from teachers' conceptions of technology integration: what do blogs, instant messages, and 3D chat rooms have to do with it?
2008	Computers in Human Behavior	Managing programmed instruction and collaborative peer tutoring in the classroom: applications in teaching Java
2008	Interactive Learning Environments	Narratives in teacher education
2008	Journal of Science Education and Technology	Rapid feedback assessment methods: can we improve engagement and preparation for exams in large-enrollment courses?
2008	Journal of Curriculum Studies	Sociotechnical cultural activity: expanding an understanding of emergent technology practices
2008	Journal of Science Education and Technology	Students' conceptions of sound waves resulting from the enactment of a new technology-enhanced inquiry-based curriculum on urban bird communication
2008	Computers and Education	The development of a cognitive tool for teaching and learning fractions in the mathematics classroom: a design-based study
2008	Teaching and Teacher Education	Taking the next step: connecting teacher education, research on teaching, and programme assessment

Table 5 continued

Years	Journal titles	Paper titles
2008	Computers in Human Behavior	Supporting reflective web searching in elementary schools
2008	Computer-Supported Collaborative Learning	Context-oriented communication and the design of computer-supported discursive learning
2008	IEEE Transactions on Education	Virtual laboratory for creative control design experiments
2009	Educational Technology Research and Development	Designing and implementing a PBL course on educational digital video production: lessons learned from a design-based research
2009	International Journal of Science Education	Design-based research: case of a teaching sequence on mechanics
2009	Elementary School Journal	Design research as a means for building a knowledge base for teachers and teaching in mathematics education
2009	Educational Researcher	Design research perspectives on transitioning from individual microgenetic interviews to a whole-class teaching experiment
2009	Educational Technology, Research and Development	Design and development research: a model validation case
2009	Asia–Pacific Education Review	Heuristic task analysis on e-learning course development: a formative research study
2009	Journal of Science Education and Technology	Affordances and limitations of immersive participatory augmented reality simulations for teaching and learning
2009	Computers and Education	An experience of teaching for learning by observation: remote-controlled experiments on electrical circuits
2009	Innovations in Education and Teaching International	Analysis of a ubiquitous performance support system for teachers
2009	Educational Researcher	Design tools in didactical research: instrumenting the epistemological and cognitive aspects of the design of teaching sequences
2009	Educational Technology, Research and Development	Designing and implementing a case-based learning environment for enhancing ill-structured problem solving: classroom management problems for prospective teachers
2009	Journal of Science Education and Technology	Designing assessments and assessing designs in virtual educational environments
2009	Science Education	Developing preservice elementary teachers' knowledge and practices through modeling-centered scientific inquiry
2009	Educational Studies in Mathematics	Embodied design: constructing means for constructing meaning
2009	Science Education	Enhancement of pre-service teachers' teaching interventions with the aid of historical examples
2009	Journal of Computer Assisted Learning	From bar diagrams to letter-symbolic algebra: a technology-enabled bridging
2009	Science Education	Learning to teach elementary school science as argument
2009	Interactive Learning Environments	Location matters: leveraging knowledge building with mobile devices and Web 2.0 technology

Table 5 continued

Years	Journal titles	Paper titles
2009	Australasian Journal of Educational Technology	Sharing quality resources for teaching and learning: a peer review model for the ALTC Exchange in Australia
2009	Computers in Human Behavior	The role of design-principles in designing courses that promote collaborative learning in higher-education
2009	Educational Technology and Society	Visualisation of interaction footprints for engagement in online communities
2009	Computer Assisted Language Learning	Designing and implementing virtual enactive role-play and structured argumentation: promises and pitfalls
2009	The Journal of Applied Theatre and Performance	Drama is like reversing everything': intervention research as teacher professional development
2010	Journal of Teacher Education	Lifting off the ground to return anew mediated praxis, transformative learning, and social design experiments
2010	Educational Technology, Research and Development	Development research of a teachers' educational performance support system: the practices of design, development, and evaluation
2010	Australasian Journal of Educational Technology	A dialogic approach to online facilitation
2010	Journal of Research Science Teaching	A framework for teaching scientific inquiry in upper secondary school chemistry
2010	Computers and Education	Collaborative activities enabled by Group Scribbles (GS): an exploratory study of learning effectiveness
2010	Thinking Skills and Creativity	Creative and playful learning: learning through game co-creation and games in a playful learning environment
2010	Computers and Education	Design exemplars for synchronous e-learning: a design theory approach
2010	Journal of Science Education and Technology	Design of online professional development in science content and pedagogy: a pilot study in Florida
2010	Computers and Education	Designing collaborative knowledge building environments accessible to all learners: impacts and design challenges
2010	Educational Technology Research and Development	Developing a Web 2.0-based system with user-authored content for community use and teacher education
2010	Computers in Human Behavior	Dynamics of social roles in a knowledge management community
2010	Computers and Education	From handheld collaborative tool to effective classroom module: embedding CSCL in a broader design framework
2010	BMC Medical Education	Introducing an online community into a clinical education setting: a pilot study of student and staff engagement and outcomes using blended learning
2010	English Teaching-Practice and Critique	Using a studio-based pedagogy to engage students in the design of mobile-based media
2010	Educational Technology and Society	Students' personal and social meaning making in a Chinese idiom mobile learning environment
2010	Australasian Journal of Educational Technology	The development of social presence in online Arabic learning communities

Table 5 continued

Years	Journal titles	Paper titles
2010	Educational Researcher	Transformational play: using games to position person, content, and context
2010	Journal of Research Science Teaching	How do technology-enhanced inquiry science units impact classroom learning?
2010	Educational Technology Research and Development	Developing a Web 2.0-based system with user-authored content for community use and teacher education
2010	Journal of the Learning Science	Effect of an animated classroom story embedded in online discussion on helping mathematics teachers learn to notice
2010	Educational Research	Developing a five-stage model of learning in Second Life
2010	Journal of Engineering Education	Using educational research in the design of evaluation tools for open-ended problems
2011	Computers in Human Behavior	Improving the scaffolds of a mobile-assisted Chinese character forming game via a design-based research cycle
2011	Instructional Science	Exploring evidence of reflective thinking in student artifacts of blogging-mapping tool: a design-based research approach
2011	Innovations in Education and Teaching International	Design-based research: designing a multimedia environment to support language learning
2011	Journal of Curriculum Studies	Redesigning vocational education: the possibilities of design-based research
2011	British Journal of Educational Technology	Usability testing for e-learning material for new employee training: a design-based research approach
2011	Instructional Science	A design study of a multimedia instructional grammar program with embedded tracking
2011	Computers and Education	Web-based Personalised System of Instruction: an effective approach for diverse cohorts with virtual learning environments?
2011	Educational Technology Research and Development	Contrasts in student engagement, meaning-making, dislikes, and challenges in a discovery-based program of game design learning
2011	Science Education	Designing project-based instruction to foster generative and mechanistic understandings in genetics
2011	Computers and Education	Developing multi-dimensional evaluation criteria for English learning websites with university students and professors
2011	Instructional Science	Effects of hierarchical versus sequential structuring of teaching content on creativity in Chinese writing
2011	Journal of Research Science Teaching	Elementary students' views of explanation, argumentation, and evidence, and their abilities to construct arguments over the school year
2011	Australasian Journal of Educational Technology	From socialisation to internalisation: cultivating technological pedagogical content knowledge through problem-based learning
2011	Educational Technology Research and Development	Integrating physical activity data technologies into elementary school classrooms

Table 5 continued

Years	Journal titles	Paper titles
2011	Internet and Higher Education	Integrating to learn and learning to integrate: a case study of an online master's program on science–mathematics integration for middle school teachers
2011	Computer-Supported Collaborative Learning	Perspective taking and synchronous argumentation for learning the day/night cycle
2011	Internet and Higher Education	Promoting awareness of Internet safety in Taiwan in-service teacher education: a ten-year experience
2011	Educational Technology and Society	Redesigning a web-conferencing environment to scaffold computing students' creative design processes
2011	Computer-Supported Collaborative Learning	The Singapore experience: synergy of national policy, classroom practice and design research
2011	Journal of Computer Assisted Learning	Collaborative learning with a wiki: differences in perceived usefulness in two contexts of use
2011	Journal of Educational Computing Research	Dynamic modeling as a cognitive regulation scaffold for developing complex problem-solving skills in an educational massively multiplayer online game environment
2011	Journal of Educational Computing Research	A study of a social annotation modeling learning system
2011	International Review of Research in Open and Distance Learning	Frameworks for understanding the nature of interactions, networking, and community in a social networking site for academic practice
2011	International Review of Research in Open and Distance Learning	Proposing an integrated research framework for connectivism: utilising theoretical synergies
2011	Distance Education	Synchronous collaboration competencies in web-conferencing environments: their impact on the learning process
2011	International Journal of Science Education	Analysis of the Educational Potential of a Science Museum Learning Environment: visitors' experience with and understanding of an immersion exhibit
2011	International Journal of Science Education	Improving students' revision of physics concepts through ICT-based co-construction and prescriptive tutoring
2011	Technology, Pedagogy and Education	Using a game environment to foster collaborative learning: a design-based study
2011	International Journal of Science Education	Evaluation of a design principle for fostering students' epistemological views on models and modelling using authentic practices as contexts for learning in chemistry education
2011	The Journal of Learning Science	E-moderation of synchronous discussions in educational settings: a nascent practice
2012	Instructional Science	A design-based research case study documenting a constructivist ID process and instructional solution for a cross-cultural workforce
2012	Asia–Pacific Education Researcher	Design-based research: understanding its application in a teacher professional development study in Indonesia
2012	Australasian Journal of Educational Technology	Design-based research principles for student orientation to online study: capturing the lessons learnt

Table 5 continued

Years	Journal titles	Paper titles
2012	Australasian Journal of Educational Technology	Challenges in integrating a complex systems computer simulation in class: an educational design research
2012	Journal of Research Science Teaching	Assessment as learning: enhancing discourse, understanding, and achievement in innovative science curricula
2012	Computers and Education	Challenge of supporting vocational learning: empowering collaboration in a scripted 3D game: how does teachers' real-time orchestration make a difference?
2012	Journal of Computer Assisted Learning	Designing social media for informal learning and knowledge maturing in the digital workplace
2012	Journal of Computer Assisted Learning	Evolutionary development: a model for the design, implementation, and evaluation of ICT for education programmes
2012	Computers and Education	Exploring the characteristics of an optimal design for inquiry-based geography education with Geographic Information Systems
2012	Journal of Research Science Teaching	Large-scale science education intervention research we can use
2012	Internet and Higher Education	Linking online course design and implementation to learning outcomes: a design experiment
2012	International Journal of Technology and Design Education	Middle-school teachers' understanding and teaching of the engineering design process: a look at subject matter and pedagogical content knowledge
2012	IEEE Transactions on Learning Technologies	Multiliteracies and active learning in CLIL: the development of LearnWeb2.0
2012	Educational Technology and Society	self-regulated workplace learning: a pedagogical framework and semantic web-based environment
2012	Educational Technology and Society	Design of a motivational scaffold for the Malaysian e-learning environment
2012	The Asia–Pacific Education Researcher	A collaborative professional development model for rapid collaborative knowledge improvement in Singapore schools
2012	Research in Science and Technological Education	Developing a science teacher education course that supports student teachers' thinking and teaching about the nature of science
2013	British Journal of Educational Technology	Design-based research on the use of a tangible user interface for geometry teaching in an inclusive classroom
2013	Teaching and Teacher Education	Design based research to develop the teaching of pupils with moderate learning difficulties (MLD): evaluating lesson study in terms of pupil, teacher and school outcomes
2013	Journal of Science Education and Technology	Science teacher efficacy and extrinsic factors toward professional development using video games in a design-based research model: the next generation of STEM learning
2013	International Review of Research in Open and Distance Learning	Using a design-based research study to identify principles for training instructors to teach online

Table 5 continued

Years	Journal titles	Paper titles
2013	English Teaching-Practice and Critique	The affordances of design-based research for studying multicultural literature instruction: reflections and insights from a teacher–researcher collaboration
2013	Journal of the Learning Sciences	Informing design research: learning from teachers' designs of social infrastructure
2013	Learning Media and Technology	Texting as a channel for personalized youth support: participatory design research by city youth and teachers
2013	Computer-Supported Collaborative Learning	Advancing understanding using Nonaka's model of knowledge creation and problem-based learning
2013	American Educational Research Journal	Beyond breadth-speed-test: toward deeper knowing and engagement in an advanced placement course
2013	Australasian Journal of Educational Technology	Design of a blended learning environment: considerations and implementation issues
2013	Science Education	Design of chemistry teacher education course on nature of science
2013	IEEE Transactions on Learning Technologies	Designing technology for content-independent collaborative mobile learning
2013	British Journal of Educational Technology	Emerging technologies as cognitive tools for authentic learning
2013	Journal of Engineering Education	Engineering design-based science, science content performance, and science attitudes in elementary school
2013	Research in the Teaching of English	English teacher candidates developing dialogically organized instructional practices
2013	Research in Science Education	Fifth graders' learning about simple machines through engineering design-based instruction using LEGO™ materials
2013	Instructional Science	Fostering students' evaluation behaviour while searching the internet
2013	Educational Technology Research and Development	Learning from and with museum objects: design perspectives, environment, and emerging learning systems
2013	Journal of Engineering Education	Out-of-school media representations of science and technology and their relevance for engineering learning
2013	Language Learning	The role of metalanguage in supporting academic language development
2013	Australasian Journal of Educational Technology	Towards a TPACK-fostering ICT instructional process for teachers: lessons from the implementation of interactive whiteboard instruction
2013	Computer-Supported Collaborative Learning	Vocational education approach: new TEL settings—new prospects for teachers' instructional activities?
2013	Australasian Journal of Educational Technology	Enhancing an instructional design model for virtual reality based learning
2013	Educational Studies in Mathematics	Learning to solve addition and subtraction word problems in English as an imported language
2013	British Journal of Educational Studies	Technology-mediated collaborative learning environments for young culturally and linguistically diverse children: Vygotsky revisited

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