Educational Technology Research Journals

Cognition and Instruction, 2003–2012

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In this study, the authors examined the journal *Cognition and Instruction* to discover trends from the past decade (2003–2012). They looked at trends in article topics, research methods, authorship, and article citations by analyzing keyword frequencies, performing phrase counts of article abstracts, classifying studies according to various methods, and analyzing data generated by Google Scholar. The article provides evidence of the journal's focus on the *how* of learning throughout the decade, particularly in K–16 settings, and highlights an increase in theoretical articles from 2008 to 2012. The authors conclude by comparing their findings with the stated aims and scope of the journal.

Cognition and Instruction is a multidisciplinary journal that "focuses on the 'how' of learning and intellectual practice" (*Aims & scope*, n.d., para. 1). Established in 1984, the journal was created in response to the genesis of the cognitive science of instruction, a science focused on developing human competence and expertise (Resnick, 1984). Lauren Resnick, the journal's first editor, described her vision of the journal as a forum for "new understanding into the nature of learning as a process responsive to instruction" (p. 4).

Cognition and Instruction publishes articles that cross several disciplines, including educational technology. The journal Website describes "*Cognition and Instruction's* distinctive niche as the rigorous study of foundational issues concerning the mental, socio-cultural, and meditational process and conditions of learning and intellectual competence" (*Aims & scope*, n.d., para. 1.). The journal encourages submissions on topics such as (*Aims & scope*, n.d.):

- Design experiments
- The development and nurturing of interest and identity
- Teaching preparation and performance
- The nature of knowledge and meta-knowledge
- The relations between in- and out-of-school knowledge and performance
- Skilled performance in professional contexts
- Classroom and broader cultural practices fostering equitable access to learning
- Old and new literacies; the role of representation in individual and communal thought
- Well-motivated theoretical innovation

Furthermore, our keyword analysis will show that many studies published in this journal are based on the application of technological tools to learning.

Hall and Phillips (2013) recently published another analysis of the journal that described the methodological categories, subject matters and domains, population of people studied, and geographic locations of the first author for each article. Although our study produced similar methodological and subject matter results, we build upon their work by offering further analysis, including an analysis of keywords and abstract phrase counts, reporting information on specific authors and their contributions to the journal, and including a citation analysis.

Methods

From 2003–2012, the journal published four issues each year, except 2007, which included three issues. Each issue presented three to five articles, and the journal published an average of 13.5 articles per year during this period. In 2012, 75% of manuscripts submitted to *Cognition and Instruction* were sent out for peer review, and 17.8% of reviewed articles were published (Hall & Phillips, 2013). Of the 141 pieces published between 2003 and 2012, we analyzed 135 research articles. We excluded from our analysis three editor's notes (2007, 2008, 2012), two editor's introductions (both in 2004), and one author index (2008).

Journal Topics

For the topical analysis, we analyzed each article's keywords. We used author-provided keywords where available; otherwise, we used subject terms from the Educational Resources Information Center (ERIC) EBSCO database. To prevent inflation, we eliminated nearly synonymous terms in single articles, such as in an article that included keywords *Mathematics* and *Mathematics–study and teaching*. We combined these keywords into broad subject areas (such as *Mathematics* and *Science*), including a *Technology* term for keywords and subject terms that refer to technological tools. Then we utilized a spreadsheet to count the most frequent subjects and terms.

We also analyzed the papers' abstracts for the most frequently used two- and three-word phrases using a word-counting tool available at *http://www.writewords.org.uk/phrase_count.asp* . We eliminated phrases that included prepositions, pronouns, or articles and phrases that did not relate to the subject matter of the article (such as *shared proposition table*).

Table 1. Frequency of subject-related keywords.

Topic	Frequency
Mathematics-related terms	43
Science-related terms	22
Technology-related terms	11
Literacy-related terms	10
Problem solving	10
Logic	9
Group work in education	8
Concept learning	6
Interaction process analysis	6
Academic achievement	5
Teaching methods	5
Inquiry methods	4
Spatial	4
History	3

Table 2. Most common three-word phrases in article abstracts.

Three-word phrases	Count
deep level reasoning	7
think aloud protocols	5
problem based learning	4
knowledge building discourse	4
inquiry based science	4
ill structured problems	4
externally assisted condition	4

Table 3. Most common two-word phrases in article abstracts.

Two-word phrases	Count
grade students	13
high school	12
students' understanding	11
conceptual change	11
knowledge building	10
student learning	10
mathematical knowledge	9
think aloud	8
results suggest	8
case study	8
word problems	7
structured problems	7
scientific inquiry	7
participant structures	7
open ended	7
level reasoning	7
domain specific	7
deep level	7

Journal Methods

Cognition and Instruction publishes articles that use several types of methodologies. To analyze article methods and trends, we established methodological categories and coded each article according to these categories. We double-coded one year to establish agreement in definitions, then each author coded an assigned section, flagging articles he or she was uncertain of. Thirty-four of the 135 articles, or 25%, were flagged. These articles were discussed until at least two of the authors reached consensus.

We coded articles according to the following categories:

- *Theoretical*—non data-based articles, including discussions of new theories, models, or research methods.
- *Qualitative/interpretive*—articles based on interpreting qualitative research data, such as case studies and observation studies.
- *Quantitative/inferential*—articles based on applying inferential statistics to quantitative data.
- *Combined methods*—articles that show significant use of both quantitative and qualitative methods.
- *Content or discourse analysis*—articles that present an analysis of content or discourse using previously determined categories and reported descriptively, including analyses of textbooks.
- *Descriptive*—articles based on descriptive statistics, such as descriptions of survey results. No articles fit this category, so we omitted it from our results.

Authorship Analysis

We analyzed authorship by counting the number of articles each author published in the journal and then sorted to determine the most-contributing authors. We also applied an author significance ranking system by assigning the first author of each article three points, the second author two points, and the third author one point.

Citation Analysis

We utilized Google Scholar to identify the most cited articles of each year and to determine the average number of total citations per article as of October 15, 2013. While citation counts fluctuate over time, we believe our analysis accurately highlights the major contributions published in the journal each year.

Table 4. Breakdown of article methods.

Year	Theoretical	Interpretative	Inferential	Combined Methods	Content Analysis
2003	0	5	4	3	0
2004	1	7	5	0	0
2005	0	6	6	2	1
2006	0	7	6	0	0
2007	0	5	4	3	0
2008	1	6	1	3	1
2009	1	4	6	3	0
2010	2	4	4	3	1
2011	1	7	4	3	0
2012	1	3	4	3	2
Total	7	54	44	23	5
Percentage	5%	40%	33%	17%	4%

Note: Percentages have been rounded.

Table 5. Method comparison of five-year periods.

Years	Theoretical	Interpretative	Inferential	Combined Methods	Content Analysis
2003–2007	1%	45%	37%	12%	1%
2008–2012	9%	35%	28%	22%	6%

Note. Percentages have been rounded.

Findings

Topical Analysis

Similar to the findings of Hall and Phillips (2013), our keyword analysis indicates that *Cognition and Instruction* primarily published mathematics- and science-based articles during this decade, particularly in K–16 school settings (see *Table 1*). Other frequent subject areas included literacy, history, logic, and spatial reasoning. The high frequency count of technology-related terms shows the relevance of this journal to the educational technology field.

Other frequent keywords, together with abstract phrase counts, illustrate the journal's aim of discussing the *how* of learning and its focus on research-based articles. The frequency of the keywords *group work in education, concept learning,* and *inquiry methods* as well as phrases such as *deep level reasoning, think aloud protocols,* and *knowledge building discourse* shows that many articles have investigated the process of learning and structure analysis (see *Table 2* and *Table 3*). The high frequency of the terms *case study* and *results suggest* evidence of the journal's focus on research-based articles. The next section will explore this trend in more detail.

Analysis of Article Types and Methodologies

Our method analysis confirmed that *Cognition and Instruction* primarily published qualitative, quantitative, and combined method articles. As demonstrated in *Table 4*, these research-based articles accounted for 90% of all articles published from 2003 to 2012, while only 5% of the articles could be categorized as theoretical. However, an analysis comparing the years 2003–2007 with 2008–2012 showed notable increases in theoretical and content analysis articles as well as an increase in combined method studies (see *Table 5*).

In 2004, Lehrer and Palincsar included a special introduction to Andrea diSessa's theoretical article, "Metarepresentation: Native Competence and Targets for Instruction." In this introduction, Lehrer and Palincsar extended a special request for research essay submissions. However, our analysis did not show an increase in theoretical articles until 2008, when diSessa himself was the journal's editor. From 2009 to 2011, diSessa published a series of three brief articles he called "theory bites." Each article was a commentary on a previously published article. The articles highlighted the authors'

Table 6. Most-contributing authors by number of publications.

Publications	Author
5	L. Verschaffel
4	A. diSessa
3	A. Baroody, P. Herbst, W. Van Dorren, M. Hegarty
2	D. Ball, A. Barros, C. Brach, B. Casey, D. Chazan, M. Chi, D. Clements, D. DeBock, M. Ding, S. Hattikudur, L. Herrenkohl, A. Izsak, K. Kastens, D. Krill, D. Kuhn, R. Lehrer, L. Liben, L. Linnenbrink-Garcia, P. Mantzicopoulos, J. Mejia-Ramos, M. Nathan, S. Nolen, A. Samarapungavan, D. Schwartz, A. Sfard, S. Siler, M. Stieff, B. White, U. Wilensky

theoretical perspectives and provided alternate views on the topics (see footnote in Sfard, 2010). The theory bites account for some, but not all, of the increase in theoretical articles from 2008 to 2012. We will discuss this trend in the concluding section.

Authorship

From 2003 through 2012, 251 authors published research or commentaries in *Cognition and Instruction*. Of the 141 articles published, 75% had multiple authors. The majority of authors published only once during this period, although 35 authors published at least twice (see **Table 6**).

With five articles, Dr. Lieven Verschaffel, a professor in Educational Sciences at the University of Leuven, Belgium, was the most published author. He is just one of many scholars based outside of the United States to publish in *Cognition and Instruction*. Thirty of the 141 articles published during the decade credited authors from outside of the U.S., and 11 of those 30 articles were produced through international collaboration. Countries represented included Austria, Canada, Greece, Israel, the Netherlands, Norway, Singapore, Spain, Turkey, United Arab Emirates, and the United Kingdom.

Though he ranked behind Verschaffel in total number of articles published, Andrea diSessa, from the University of California at Berkeley, was the most published author according to the priority ranking count (see **Table 7**) and was listed as first author on three articles and as second author on one article. Additionally, diSessa served as the journal's editor between 2007 and 2013.

Citation Analysis

By recording the number of citations for each article during this decade, as reported by Google Scholar, and dividing this by the number of *C&I* articles reported in the Google Scholar database during this time period, we calculated an average of 35.7 citations per article over the decade studied. The top-cited articles for 2003 to 2012 are listed in **Table 8**. Within the top-cited articles, three applied inferential methods, five interpretive methods, and two combined methods. These findings are not surprising considering that our methods analysis identified qualitative, quantitative, and combined as the primary methods in the journal

As we have highlighted an interesting increase of theoretical articles after 2007, it is relevant to note that, of the theory-based articles, diSessa's (2004) "Metarepresentation: Native Targets and Targets of Instruction" has been cited 189 times; and Carlson, Oehrtman, and Engelke's (2010) article "The Precalculus Concept Assessment: A Tool for Assessing Students' Reasoning Abilities and Understandings" has been cited 15 times. No other theoretical article in this decade has been cited more than three times.

Table 7. Most-contributing authors by priority count totals.

Points	Author	Affiliation
11	A. diSessa	University of California, Berkeley
8	J. Baroody	University of Illinois at Urbana-Champaign
8	M. Hegarty	University of California, Santa Barbara
8	L. Vershaffel	University of Leuven, Belgium
7	P. Herbst	University of Michigan
7	W. Van Dooren	University of Leuven, Belgium
6	A. Izsak	University of California, Berkeley; University of Georgia
6	M. Nathan	University of Wisconsin, Madison; University of Colorado, Boulder
6	S. Nolen	University of Washington
6	A. Sfard	University of Haifa and Michigan State University
6	J. Torbeyns	University of Leuven, Belgium

Table 8. Top-cited articles

Year	Citations	Author(s)	Title
2012	19	A. Reisman	Reading like a historian: A document-based history curriculum intervention in urban high schools.
2011	37	P. Herbst, T. Nachlieli, & D. Chazan	Studying the practical rationality of mathematics teaching: What goes into "installing" a theorem in geometry?
2010	22	A. J. Hackenberg	Students' reasoning with reversible multiplicative relationships.
2009	68	R. E. Scherr & D.Hammer	Student behavior and epistemological framing: Examples from collaborative active-learning activities in physics.
2008	229	H. C. Hill, M. L. Blunk, C. Y. Charalambous, J. M. Lewis, G. C. Phelps, L. Sleep, & D. L. Ball	Mathematical knowledge for teaching and the mathematical quality of instruction: An exploratory study.
2007	66	S. B. Nolen	Young children's motivation to read and write: Development in social contexts.
2006	199	U. Wilensky & K. Reisman	Thinking like a wolf, a sheep, or a firefly: Learning biology through constructing and testing computational theories—an embodied modeling approach.
2005	214	W. A. Sandoval & K. A. Millwood	The quality of students' use of evidence in written scientific explanations.
2004	267	D.L. Schwartz & T. Martin	Inventing to prepare for future learning: The hidden efficiency of encouraging original student production in statistics instruction.
2003	232	K. VanLehn, S. Siler, C. Murray, T. Yamauchi, & W. B. Baggett	Why do only some events cause learning during human tutoring?

Discussion

As we have discussed, our analysis of *Cognition and Instruction* shows an increase of theory-based articles from 2008 to 2012. When the journal was introduced in 1984, the editor's vision was of a "journal in which many kinds of cognitive research relevant to instruction will appear and in whose pages the elements of a cognitive science of instruction can be refined through the process of scholarly explication, criticism, and argument" (Resnick, pp. 2–3). While Resnick expressed a desire for the journal to be a forum for critique and discussion, the first issues of the journal were almost entirely composed of qualitative, quantitative, and discourse analysis articles. This is, perhaps, not surprising in the formative years of a journal. However, the same pattern of publishing almost exclusively empirical research-based articles is seen in our analysis of 2003 to 2007, with the notable exception of diSessa's 2004 article,

"Metarepresentation: Native Competence and Targets for Instruction."

Our analysis shows that the percentage of theoretical articles in *Cognition and Instruction* rose from 1% in 2003–2007 to 9% in 2008–2012. While this pattern could be a trend in the field at large, analysis of two closely related journals do not support this conclusion. Henrie, Williams, and West (2013) reported a decrease in theoretical articles published in *Instructional Science* in 2002–2011; whereas Randall, Bishop, Alexander, and West (2011) showed no methodological shift in *The Journal of the Learning Sciences* in 2001–2010. However, theoretical articles already accounted for 27% of all articles published in that journal during 2001–2010.

When Andrea diSessa became editor in 2008, he commented, "Empirical work is *sine qua non* for high-quality educational research, but theory is equally important" and

asked for "more dialog-like contributions to the journal." (p. 428). As previously noted, our analysis does indeed show an increase in theoretical content from 2008 to 2012. The increase in and emphasis on theoretical articles during diSessa's editorship may stem from a desire for *Cognition and Instruction* to fill a different role in the field. However, the low citation counts of the journal's theoretical articles shows that more work is needed to distinguish the journal as a forum for academic discourse.

When Hall and Phillips became editors of the journal in 2013, they emphasized that the focus of *Cognition and Instruction* is determined by the interests of its readers. Hall (2013) specifically thanked diSessa for encouraging theoretical writing and expressed the intention of continuing diSessa's "deliberate attention to theoretical concepts" (p. 1). A continued focus on theory will help fulfill Resnick's (1984) vision that *Cognition and Instruction* will be "the scientific forum for the development of this new cognitive science of instruction" (p. 1). □

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