

THE IMPACT OF BASIC RESEARCH IN THE SOCIAL SCIENCES: THE CASE OF EDUCATION

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Recent expert evaluations of the condition and funding of educational research in the USA assume that basic research in the social sciences is a crucial factor in increasing our understanding and ultimately improving the practice of education (see, for example, the 1977 report¹ of the National Academy of Sciences' Committee on Fundamental Research Relevant to Education). Past tests of this assumption, however, have generally relied upon argument by example or anecdote. In the present study, we analyze citation patterns in the education literature to test the corollary proposition that basic research in the social sciences has had a substantial impact on the literature in education. Empirical data collected on citation patterns in the education literature are found to be largely consistent with this proposition

Introduction

It is not uncommon to hear complaints that basic research in the social sciences* is irrelevant, *i.e.*, that it does not produce reliable data or knowledge which can be used to alleviate real world social problems. The history of support for basic research in the social sciences** suggests that it would be foolish for the social science community to ignore such complaints. In the present paper, we examine the use of social science basic research in education.

*We use the terms basic and fundamental research interchangeably, and by social sciences we include what are sometimes called the behavioral sciences, *e.g.*, psychology. Some appropriate definitions are provided at a later point in the paper.

**For example, despite the large-scale use of social scientists during World War II, the National Science Foundation (USA) was established without programs for the social sciences. This omission was not formally remedied until 1961. Similarly, the National Academy of Sciences (USA), whose charter states that "... the Academy shall, whenever called upon by any department of the government, investigate, examine, experiment and report upon any subject of science..." (Act of Incorporation: National Academy of Sciences, 1863) did not establish sections in "economic", "political" or "social science" until 1974. (Some areas of psychology and anthropology, however, were represented from the turn of the century.)

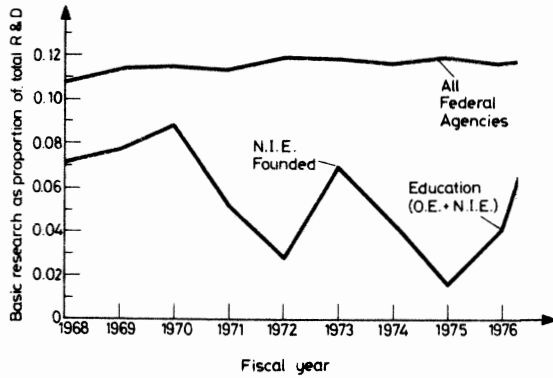


Fig. 1. Proportion of federal research and development funds allocated to basic research by all agencies and by the two major education agencies: Office of Education (OE) and National Institute of Education (NIE). Figure represents actual obligations not estimates for each fiscal year. *Source:* National Science Foundation, Survey of Science Resources Series, NSF-77-317, Appendices C and D; special tabulations for OE and NIE were provided by NSF staff.

Education is a particularly appropriate area for study, since most formal education is supported from public funds and it is largely conducted under the auspices of public agencies. Research which is useful in such an enterprise, should, it seems, have a clear entitlement to public support.

Education, however, is an area in which basic research has received relatively little emphasis. A recent review of funding for educational research by a committee of the National Academy of Sciences (USA) concluded that:

[Although] federal policy to build the scientific foundation of education through fundamental research is established in law, precedent, and concept . . . basic research on the processes of education is assigned very low priority in federal agencies charged with the management of educational research and development. (Ref.¹ p. 77)

Indeed, as Fig. 1. shows, the proportion of funds spent on basic research by the Office of Education and the National Institute of Education is substantially below that prevailing in other federal agencies supporting research and development programs.* Moreover, the proportional share of education Research and Development (R&D) funds spent on basic research showed an overall decline between 1968 and 1976. This erosion occurred despite the fact that a new agency, the National Institute of Education, was created in 1973 to foster basic research, with explicit Congressional recognition that:

*Other independently derived estimates of this proportion yield similar conclusions about the relative magnitude of funding for basic research. (Ref.¹, Chapter 4.)

To achieve quality will require far more detailed knowledge about the process of learning and education than now exists or can be expected from present research and experimentation . . . the federal government has a clear responsibility to provide leadership in the conduct and support of scientific inquiry into the educational process (General Education Provision Act - 1972).

The Use of Research: An Analysis of Citation Patterns

Critics of the low priority given to basic research by education agencies assume that fundamental research in the social sciences provides a key to understanding and ultimately improving education.^{1,2,3} Traditionally, they have pointed out examples of important utilizations of basic research, e.g., the use of research on the nature of human skills in the development of standardized testing. On the other hand, critics of basic research retort with catalogues of research projects that produced no practical benefit.

Argument by example has many unfortunate characteristics in this instance. In particular, it provides no summary assessment of the interrelationship among basic research in the social sciences, applied research in education, and educational practice. For this reason we have approached this issue from a rather different perspective. We have attempted to study a corollary of the proposition that basic research in the social sciences has a substantial impact upon education. Specifically, we have investigated the proposition that the basic research literature of the behavioral and social sciences has a considerable impact upon the writings of educational researchers and practitioners. This corollary rests on an assumption that scholarly publication of research findings is the most frequent and tangible product of research.

To test the proposition, we have charted the flow of information among three categories of periodicals: (1) basic research journals in the social sciences, (2) educational research journals, and (3) educational magazines written for practitioners. To measure the flow of information we counted the frequency with which a sample of journals in each category cited journals in the same and other categories. While this technique* admits to certain limitations, aggregate data of this kind provide important evidence about the validity of the central proposition. For example, if such an investigation were to show that basic research findings are almost never discussed in the educational literature, we would have to reconsider the fundamental argument that basic research in the social sciences has a substantial impact upon education.

*Further discussion of the technique of citation analysis can be found in the writings of *Margolis*,⁴ *Garfield*⁵ and *Gilbert & Woolgar*.⁶ Applications of these techniques to areas related to the present study have been reported by *Brittain*,⁷ *Barron & Narin*⁸ and *Narin & Garside*.⁹

Method of Study

The citations made in 136 periodicals were analyzed. In selecting these "source periodicals" we attempted to include all publications indexed* in the *Current Index of Journals in Education (CIJE)*. We found that seventy-percent of these education periodicals were also classified as education or education research periodicals in the shorter list compiled by the *Social Science Citation Index*. To this sample of education journals we added a selection of 33 basic research journals in psychology, sociology, economics, anthropology and political science.** When possible, we employed past rating surveys^{10,11,12} to select the "top-ranked" journals in each of these disciplines, and when surveys were not available we relied on the opinions of scientists in the relevant fields and our own judgements. A complete list of the periodicals used in our study is available elsewhere (Ref.¹, p. 101-106); examples of these periodicals are presented in the following section.

Since arbitrariness in the selection of periodicals included in our study has the potential of biasing the results, we have attempted to measure the sensitivity of our conclusions to such selection biases. These results are summarized later in this article.

Citation indexing. In coding data, every citation in an article was identified as being made to one of the following: a source periodical, other periodical, book, newspaper, law case, or unpublished manuscript. In coding citations to periodicals not among our source periodicals, we adopted the following rule. When a periodical was cited more than ten times by any two source periodicals it was assigned

*That is, fully indexed in the 1975 edition of *CIJE*.

**Of this set of possible "source periodicals", 56 were eliminated from our study. All of those periodicals eliminated were from the group derived from *CIJE*.

Ten periodicals were eliminated because they contained no formal citations; 23 other periodicals were eliminated because they contained fewer than 250 citations in 1974-1976. Finally, 23 periodicals were eliminated for other reasons, primarily unavailability of 1975 issues in the Library of Congress or other Washington libraries or sporadic publication of issues. Since these journals might have been appropriate for study if obtainable, we will explicitly name them: *American Indian Culture and Research Journal*, *Bilingual Review*, *California Journal of Teacher Education*, *College of Education Record*, *Communication Education*, *Communication: Journalism Education Today*, *Education Broadcasting International*, *Elements: Translating Theory Into Practice*, *German Quarterly*, *International Review of Applied Linguistics in Language Teaching*, *Italica*, *Journal of Education Measurement*, *Journal of Industrial Teacher Education*, *Journal of Outdoor Education*, *Marquette University Education Review*, *Monographs for the Society of Research in Child Development*, *New Campus*, *NOLPE School Law Journal*, *NSPI Research Quarterly*, *Quarterly Journal of Speech*, *Social Science Record*, *System*, and *Teacher Education*.

It should be noted that *Monographs of the Society for Research in Child Development* was eliminated because we did not consider it to be a periodical by our definition; *German Quarterly* and *Italica* were eliminated because we did not consider them to be education periodicals.

a unique code number, all citations to it were counted, and the periodical itself was subsequently classified as a basic research journal, education journal, education magazine, newspaper, or news magazine.

*Periodical categories.** The categories employed in this study were defined as follows:

Basic Research Journals: Publications consisting primarily of disciplined inquiries designed to increase theoretical or empirical understanding or knowledge in some branch of science or philosophy (not education). For example: *American Journal of Sociology*, *Journal of Experimental Psychology*, *American Anthropologist*, *Journal of Political Economy*, *American Political Science Review*.

Education Journals: Publications consisting primarily of disciplined inquiries designed to increase knowledge or understanding of some branch of science or philosophy as it relates to education (e.g., *American Sociological Review* and *Psychological Review* were classified as "basic research journals" while *Sociology of Education* and *Journal of Educational Psychology* were considered "education journals"). Journals which report attempts to apply scientific findings to educational problems or the development of educational materials were included in this category if the work consisted of systematic studies rather than anecdotal accounts. Examples of such periodicals include: *American Educational Research Journal*, *Educational and Psychological Measurement*, *International Review of Education*, *Programmed Learning and Education Technology*.⁴

Education Magazines: Publications concerned with education whose content is not primarily focused upon increasing knowledge or understanding in a branch of science or philosophy. Typically, such publications communicate with teachers and school personnel concerning practical matters relevant to education, e.g., *Art Education*, *AAUP Bulletin*, *School Counselor*, *Educational Leadership*.

News Magazines: Publications providing general information on current affairs which do not fall into the above categories, e.g., *Time* magazine, *Atlantic Monthly*.

*A *periodical* is a publication issued on a regular basis and typically referenced: "article title", *Journal Name*, volume *N*, pp. 1–2. Also included in this category – because they were ill-suited for any other – were Monograph supplements to journals, and the *Annals* of the New York Academy of Sciences and the American Academy of Political Science. An article for the purposes of this sample may be more easily defined by what it is not. An article includes any piece published in a journal *except* editorials, regular departments of the journal (e.g., reports to membership), and annotated bibliographies. Notes and Communication were sampled as articles when they were research-oriented and referenced in a manner similar to other articles in the periodical. For most journals, then, the rubric "articles included in the survey" implies a signed piece reporting the results of research; for "magazines" it includes similar signed pieces which do not necessarily report research results.

A *book* is a (non-periodical) volume issued by a publishing house; all documents published by the US Government Printing Office were considered books unless they were obviously periodical publications. *Unpublished materials* include all self-described unpublished documents, doctoral dissertations, anything marked "mimeo", and work marked "in press" with no publisher or periodical indicated. Certain miscellaneous publications were also included in this category, e.g., irregularly issued bulletins and all publications whose publisher was an organization.

Sampling procedure. Beginning with the first issue of 1975, we sampled articles in each source periodical. In education periodicals all articles were sampled regardless of their subject matter. For basic research journals, only articles considered relevant to education were sampled. To determine an article's relevance to education, we examined the title for the following words or their equivalent: education, school, learning, teaching, cognition, memory, intelligence, perception, language/linguistics, concept formation, (school-related) achievement, status attainment, knowledge, intellectual development, and in some cases human capital, personality development, and career and occupation, if education was implied. For doubtful articles, we next consulted the abstract, and if the article was not abstracted, the text itself to determine if these concepts were discussed.

Sampling of articles continued until 250 references were obtained.* If the end of the year was reached without a yield of 250 references, the sample was considered complete anyway. For basic research journals, the sample was expanded to two years before being considered complete. Regardless of other criteria, at least ten articles and at least one full issue were always sampled from every periodical.

Results

Table 1 describes the sample we obtained using the procedures described above. In total over 47,000 citations were surveyed and classified. The majority of references (59%) were to books and unpublished manuscripts. The next largest segment (25%) were to the source periodicals indexed and categorized in our survey. A smaller number of citations (19%) were made to unindexed periodicals.

Table 2 lists the 20 journals most frequently cited in educational journals and magazines, exclusive of self-citations.** These 20 journals received over one-half

*Some journals collect articles one topic and place them in special issues, or group them in a special section of each issue, or organize each issue around one topic. In these cases, the entire year was examined and the frequency of special issues ascertained. If more than half of the issues were "special", the first article of each special issue was sampled. If all numbers were special issues, the first article of each issue was sampled, the second article, etc., until 250 journal references were obtained. If special issues comprised less than 50% of the journal, regular issues were sampled until 250 citations were obtained or the end of the year was reached; then the special issue(s) were sampled until a representative proportion of "special issue" citations was obtained.

**"Self-citation" occurs when an article in journal A cites another article published in Journal A. Since self-citation rates are considerably lower (4% vs. 9%) in education periodicals, the exclusion of self-citation in our analyses introduces a modest bias *against* the main proposition of this study.

Table 1
Characteristics of the sample and citations

Item	Basic research journals	Education journals	Educational magazines	Total sample
Number of periodicals surveyed	28	68	40	136
Number of periodicals in Index	54	69	41	164*
Citations:				
To self	1 199 (9%)	1 060 (4%)	377 (4%)	2 636 (6%)
To other indexed periodicals	2 840 (21%)	4 577 (19%)	1 414 (15%)	8 831 (19%)
To unindexed periodicals	2 265 (17%)	4 073 (16%)	1 525 (16%)	7 863 (17%)
To law cases	66 (1%)	164 (1%)	81 (1%)	311 (1%)
To books	4 957 (37%)	9 479 (38%)	3 972 (42%)	18 408 (39%)
To unpublished materials	1 942 (15%)	5 343 (22%)	2 128 (22%)	9 413 (20%)
Total citations	13 269 (100%)	24 696 (100%)	9 497 (100%)	47 462 (100%)

*Note: Three news magazines and all citations to newspapers were also indexed.

of all the citations made to periodicals included in the survey. The table indicates that among the top twenty journals cited in education periodicals, nine were basic research journals.

While gross citation data can tell us about the citation of available research information by writers in education, they do not adequately assess the relative impact of specific publications. In particular, such data do not control for the number of education articles published in each periodical. This omission distorts any rank order, since other things being equal, we would expect a journal publishing twenty education articles each month to have a greater chance of being cited than one which publishes only ten education-related articles a year. To control for this artifact we have estimated periodical citations relative to the average frequency with which education articles appear in each periodical. These estimates were derived by reweighting the raw citation data by the reciprocal of the number of education articles a periodical published each year. The resulting rank order is presented in Table 3. Here we find, although the ordering is different, that basic research

Table 2
The twenty periodicals receiving the largest number of citations
in Education Journals and Magazines

Periodical type*	Periodical name	Number of citations received
EJ	1. Journal of Educational Psychology	391
EJ	2. Harvard Educational Review	195
B	3. Journal of Personality and Social Psychology	181
B	4. Child Development	168
B	5. American Psychologist**	163
B	6. Psychological Bulletin	155
EJ	7. Review of Educational Research	152
B	8. American Sociological Review	136
EJ	9. Journal of Educational Research	127
EM	10. Foreign Language Annals	121
EJ	11. Journal of Counseling Psychology	121
B	12. Science**	120
EJ	13. Educational and Psychological Measurement	119
EJ	14. Personnel & Guidance Journal	118
EJ	15. American Education Research Journal	104
B	16. Psychometrika	101
B	17. American Journal of Sociology	99
B	18. Psychological Review	99
EJ	19. Reading Research Quarterly	96
EJ	20. Journal of Teacher Education	77

Note: Self-citations are never included in our calculations.

*B: Basic Research Journal; EJ: Educational Research Journal; EM: Education Magazine.

**Periodical was not indexed as a source periodical, and hence it was ineligible for inclusion in the ranking by 'adjusted' citation rates presented in Table 3.

journals in the social sciences comprise ten of the twenty most-cited journals. Moreover, we observe that a full spectrum of disciplines in the behavioral and social sciences is represented.

This analysis supports the idea that writers in education draw on the published basic research literature. Analysis of the overall citation patterns presented in Table 4, corroborates our impression that education journals cite basic research articles as frequently as they cite articles published in other education periodicals. Table 4 also indicates that education magazines, which are read primarily by practitioners, rely heavily upon the education research journals and basic research

Table 3
The twenty periodicals with the highest adjusted rates of citation
by Education Journals and Magazines

Periodical type*	Periodical name	Citations per article from education periodicals (and from all journals)**
EJ	1. Harvard Educational Review	16.3 (18.0)
B	2. Psychological Review	11.9 (33.5)
EJ	3. Review of Educational Research	10.9 (11.4)
B	4. American Journal of Sociology	10.0 (17.6)
B	5. American Sociological Review	9.8 (17.1)
B	6. Journal of Political Economics	7.0 (16.7)
B	7. Psychological Bulletin	6.5 (11.0)
EJ	8. Reading Research Quarterly	6.5 (6.5)
B	9. Review of Economics and Statistics	5.0 (8.0)
EM	10. Foreign Language Annals	4.7 (4.8)
EM	11. AAUP Bulletin	3.9 (4.6)
EJ	12. American Educational Research Journal	3.9 (4.1)
EJ	13. Journal of Educational Psychology	3.8 (4.4)
EJ	14. Journal of Counseling Psychology	3.6 (3.9)
B	15. American Economic Review	2.9 (5.9)
B	16. Psychometrika	2.9 (6.8)
EJ	17. Sociology of Education	2.1 (3.0)
B	18. American Anthropologist	2.1 (9.3)
B	19. American Political Science Review	2.0 (4.9)
EJ	20. School Review	2.0 (2.1)

*see Table 2.

**The total number of citations received was weighted by the reciprocal of the number of education articles which the journal published per year. Self-citations were excluded from the calculations.

journals as (cited) sources of information. Finally, these data indicate that while authors who publish education-related articles in basic research journals most frequently cite other basic research journals, they also cite "problem-oriented" sources, including newspapers and news magazines.

Discussion

Does basic research in the social sciences have an important influence on our understanding and practice of education? To the extent that the education literature is an adequate reflection of the real world, and citations a good measure of influence, this proposition appears to be supported.

Table 4
Overall citation patterns of Indexed Periodicals

Source: Periodical Type		Type of periodicals cited			
		Basic	Education Journals	Education Magazines	Newspaper or News-Magazine
Basic Research Journal	gross %	84.6	8.3	2.3	4.8
	mean %	83.8	10.0	3.5	2.7
Education Journal	gross %	39.9	43.4	9.6	7.0
	mean %	39.8	42.6	9.8	7.7
Education Magazines	gross %	28.1	32.4	32.6	6.9
	mean %	26.4	30.4	35.1	8.1

Note: Self-citations are not included. "Gross %" entries are total number of citations from all indexed periodicals of type A to periodicals of type B multiplied by: $(100 \div \text{total number of citations made by periodicals of type A to all indexed periodicals})$. The citation pattern of a journal contributes to the gross percent entries in direct proportion to the number of citations it makes to indexed journals.

The "Mean %" entries were obtained by first computing the percent distribution of citations for each periodical (i.e., the percent of citations which periodical *i* made to periodicals of type A, B, etc.), and then computing the average of the percents of citations given by periodicals of type A to type B, etc. The citation pattern of all periodicals contribute equally in determining the mean percent entries.

The results we have obtained may be compared to three prototypes of the flow of information.

1. *Isolation*: In its pure form, this type would be characterized by a zero rate of cross-citation, e.g., if articles in basic research journals did not cite articles in education journals and *vice versa*.

2. *Equanimity of influence*: This type of information flow would be characterized by a rate of cross-citation among categories of journals exactly commensurate with the actual quantity of publication in each category. If education journals produced three times as many education articles as basic research journals, for example, we would expect both education-related articles in basic research journals and education periodicals to give three times as many citations to education journals as to basic research journals.

3. *Domination*: This "one-way" influence might occur when one class of journals (e.g., basic research journals) was heavily cited by another class (e.g., education periodicals), while the reverse citing rate was zero. This relationship admits to interesting special cases. For example, we might conceive of a "colonial" relation-

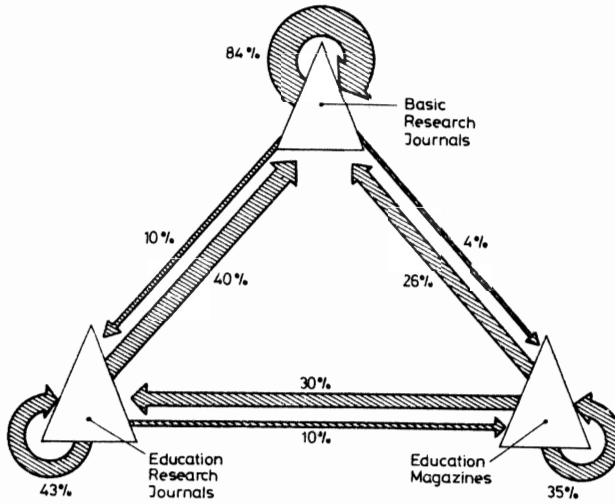


Fig. 2. Pattern of citations in education literature (derived from Table 4). Figures are mean percent of citations given to journals of specified types; figures do not sum to 100% because citations to news magazines are excluded from illustration.

ship in which Class B journals *only* cited Class A journals, while Class A journals cited themselves and journals in other classes, but never Class B.

Fig. 2. illustrates the relationship found in our study. It is clear that none of the three "pure" types of information flow adequately characterizes the relationship between basic research and the educational literature. In particular, there is no case to be made for "isolation"; the basic research literature has a very strong influence on the literature in education. Even ignoring the fact that the basic research literature is smaller and publishes relatively few education-relevant articles, we find that education research journals are equally likely to cite basic research journals as they are to cite work published in other education periodicals. We also find that education-relevant articles in the basic research journals do draw on the education literature, although less frequently than on the basic research literature. Finally, the citation patterns of education magazines suggest that there is some direct translation of basic research findings into the world of the practitioner.

Reliability of the findings. Our analysis is vulnerable to errors of subjective judgement in two areas: (1) in the selection of the set of journals we surveyed, and (2) in the classification of periodicals as basic research journals, education journals, education magazines or news magazines. To some extent, our use of the independent classification schemes of the *Social Science Citation Index* and the *Current Index of Journals in Education* provides some safeguard against subjective bias.

Nonetheless, since we have exercised some discretion in our selection of journals and the classification of "borderline" periodicals, it is important to measure the extent to which such subjectivity might systematically bias our results.

To check the adequacy of our classification, the entire list of periodicals was independently classified by two raters using the definitions described above. Agreement about the classification of basic *vs.* education research journals was reasonably good (95% agreement). The classification of education periodicals as "education journals" *vs.* "education magazines" was much more unreliable (65% agreement). This unreliability arose because periodicals classified as "borderline journals" by one rater were classified as "magazines" by the other.*

To investigate the implications of this unreliability for our results we have recomputed all of the tables using the individual classifications of each rater. In no case would the conclusions of this study be altered if we substituted the judgements of one rater for that of the other.**

To test the sensitivity of our conclusions to fluctuations in the composition of our sample, we took two non-overlapping subsamples, each consisting of 50% of the original journals (randomly selected), and subjected them to similar analyses. The results of this analysis indicate that our conclusions are relatively insensitive to random changes in sample composition.***

Limitations of the study. There are a number of pitfalls in defining the "influence" or "impact" of an article as the number of times it is cited. We know,

*Thirty-four of the 85 periodicals classified as education journals by rater 1 were classified as "education magazines" by rater 2. However, 13 of the 15 periodicals called "education magazines" by rater 1 were given the same classification by rater 2.

We have relied upon the judgement of a third rater — a periodicals librarian in an education library — to arrive at final classifications for "disputed" periodicals.

**For example, in recomputing Table 4, we would obtain the following mean percent entries using the two sets of judgements.

Source	Cited			
	B	EJ	EM	News
Basic	82% vs. 79%	15% vs. 16%	0% vs. 2%	3% vs. 3%
Ed. Journal	41% vs. 41%	44% vs. 40%	7% vs. 13%	8% vs. 7%
Ed. Magazine	28% vs. 23%	56% vs. 30%	5% vs. 37%	10% vs. 10%

***In recomputing Table 4 for the two subsamples, we obtained:

Source	Cited			
	B	EJ	EM	News
Basic	84% vs. 80%	11% vs. 17%	1% vs. 0%	4% vs. 2%
Ed. Journal	42% vs. 41%	44% vs. 45%	5% vs. 8%	9% vs. 6%
Ed. Magazine	35% vs. 18%	48% vs. 67%	3% vs. 8%	14% vs. 6%

for example, that articles which are frequently cited are not necessarily considered "good" or "influential" by those doing the citing. For example, an article which is notorious because of its recognized flaws may be heavily cited as an example of a methodological error. Furthermore, using publications and the citation of publications as the data for study narrowly defines the process of information flow and influence in education. Some of the major outcomes of educational research do not necessarily result in published articles but rather generate new curricula, policies, television programs, and so forth. Finally, there is a substantial community of educational practitioners who do not publish, but who are, however, influenced by publications. The foregoing study provides only indirect evidence of the influences on educational practitioners.

These limitations prompt an obvious *caveat*; since the literature in education is not an end product in itself, our study can only provide incomplete evidence to support the central proposition of this study. Nonetheless, we do find that even practitioner-oriented magazines draw on the results of basic research. More complete evidence of this phenomenon would require careful investigations of the diffusion of *ideas* from basic research into educational practice; this task is well beyond our present resources. We would, however, point out that *Comroe* and *Dripps*¹³ studies of the impact of fundamental research in the biomedical sciences provide persuasive examples of how such work might proceed.

Summary

A central proposition of several recent reports on funding for educational R & D has been that basic research in the social sciences is a crucial factor in advancing our understanding and ultimately improving the practice of education. This study analyzed citation patterns in the education literature to test the corollary proposition that basic research has a substantial impact on the literature in education. The empirical data we have collected on citation patterns in the education literature are entirely consistent with this proposition.

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This research was undertaken while the authors served as staff officers for the National Academy of Sciences' Committee on Fundamental Research Relevant to Education. This committee has established at the request of the National Institute of Education; Sheldon *White* served as chairman. The final report of this committee¹ was published in the Summer of 1977.

The opinions expressed in the present article are the sole responsibility of the authors; they do not reflect the official positions of the National Academy of Sciences, the National Research Council, or the committee.

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