Experimental Comparison of Inquiry and Direct Instruction in Science[1]

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ABSTRACT: There are continuing educational and political debates about ‘inquiry’ versus ‘direct’ teaching of science. Traditional science instruction has been largely direct, but recent national science education standards advocate inquiry throughout K-12 education. While inquiry-based instruction has the advantage of reflecting the nature of real science, there is little unconfounded comparative research into the effectiveness and efficiency of the two modes for developing science conceptual understanding. This research undertook a controlled experimental study comparing the efficacy of carefully designed inquiry instruction and equally carefully designed direct instruction in realistic science classroom situations at the middle school grades. The research design addressed common threats to validity. We report on the nature of the instructional units in each mode, research design, methods, classroom implementations, monitoring, assessments, analysis and project findings

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For many decades there have been both educational and political policy debates over the merits of “inquiry-based” and “direct” approaches to teaching science, with strong opinions on both sides. In broad practice the pendulum has been mostly on the direct side, but in recent years, with the formulation of national and state science education standards, inquiry has become the *sine qua non* for science instruction (National Research Council, 2000b; American Association for the Advancement of Science, 1990; Alberts, 2008). By inquiry-based teaching of science we mean instruction that reflects the investigative approach, empirical techniques, and reliance on evidence that scientists use in making discoveries and constructing new knowledge. A related idea is that of “Scientific Teaching” described by Handelsman et.al. (2004), an aspect of which is that “the teaching of science should be faithful to the true nature of science by capturing the process of discovery in the classroom.” Many educators feel that inquiry teaching rather than direct is most in keeping with the widely accepted constructivist theory of how people learn; but note that constructivism is a theory of learning, not of instruction. Students must construct their own understanding regardless of the resources, be they laboratory activities, lectures, discussion, or text.

Convincing comparative evidence for the superiority of either direct or inquiry science instruction is hard to come by, though it is evident that ‘experientially-based’ instruction and ‘active student engagement’ are advantageous for effective science learning. However, these “hands-on” and “minds-on” (National Research Council, 2000a) aspects can occur in both inquiry and direct science instruction. Thus, the pertinent question we seek to address is not whether active, experiential learning of science is more effective than passive, non-experiential learning. Our research question is whether an inquiry approach or a direct approach to experientially-based instruction is more effective for science concept development, when both approaches are expertly designed and well executed.

Inquiry Science Teaching. Inquiry teaching of science aims to reflect the nature of scientific inquiry in the classroom, and it can be approached in many ways, as noted by Alberts (2008). He lists several goals of science education: to know, use, and interpret scientific explanations of the natural world; to generate and evaluate scientific evidence and explanations; to understand the nature and development of scientific knowledge; and to participate productively in scientific practices and discourse (Alberts, 2009). Brady (2008, p. 607) notes that most science educators claim that we “know how to teach science,” meaning of course to teach science by inquiry, and that the only question remaining appears to be “when will we do it?” Handelsman et. al (2004) state that “to the extent that the authors include a pedagogy of inquiry there is a clear claim here that such a pedagogy has been soundly tested and found effective.” However, proponents of both inquiry-based and direct instruction are convinced of their respective positions regarding pedagogical efficacy. But are these claims justified by evidence? Advocacy of either approach, inquiry or direct, needs support from comparative efficacy studies.

A recent meta-analysis conducted by the Educational Development Center (2007) of research studies into inquiry instruction does not find them to yield sufficiently unconfounded inferences to adequately address the central issue. Indeed, the EDC reports that research rigor had in fact declined from 1984 to 2002. Various confounding threats to the validity of inquiry research since the 1960s include:

- Comparative controlled studies, pitting inquiry against worthy alternative instruction, are few. Controls are often absent or represented by poor or nebulous “traditional” teaching.
- Few studies use randomized assignment of subjects to treatment groups or quasi-experimental efforts to control for differences between subject groups.

- Evaluations not independent of the developers and researchers can be problematic
- Replication may not be feasible due to insufficiently detailed specification of treatments.
- Rarely is implementation compared to the intended instruction, so that tacit assumptions of fidelity may be unwarranted.

We elaborate later on these threats to validity, but turn first to the issue of using a significant control, or in our case, alternative treatment. The fair test opponent in our research is a specified model of good direct instruction.

Direct Instruction. Science education specialists invariably talk about moving teachers away from direct instruction toward inquiry. This commitment is understandable and laudable for anyone who loves both science and the teaching of science. A less commendable argument for inquiry, however, is to contrast it with straw man caricatures of alternative modes of instruction, in particular, direct instruction cast as exposition, memorization, and cookbook laboratory work. David Ausubel (1961) addressed such misrepresentation more than 40 years ago. He argued that the true issue was rote learning vis-à-vis meaningful learning, and that neither inquiry instruction nor direct instruction *automatically* lead to meaningful learning.

Since considerable educational and political support exists for various forms of direct instruction, countering the move toward inquiry in the standards, the question remains: is some expert form of direct instruction more effective than inquiry instruction? David Klahr (2002) thinks so, claiming his research findings “challenge predictions derived from the presumed superiority of discovery approaches for deeper, longer lasting, and ‘more authentic’ understanding of scientific reasoning processes…” Such views are not isolated; in 2006 Kirschner, Sweller and Clark published a paper entitled “Why Minimal Guidance During Instruction Does Not Work,” with Sweller furthering the critique in 2009. However, upon inspection, one notes that Klahr’s research comparing teaching approaches involves open “discovery,” the most unstructured form of inquiry, rather than the guided approach advocated by the NRC and AAAS, and his “direct” mode arguably involves aspects of guided inquiry. Moreover, the study is about acquiring science process skills like the control of variables strategy, rather than about science content learning. Thus, on neither count do Klahr’s findings speak to the core question regarding inquiry instruction for concept development.

Nevertheless, Klahr and Sweller draw attention to the precarious evidentiary support for inquiry instruction. Convincing evidence is similarly lacking for direct instruction, which has simply had the advantage of acceptance as the status quo. Hence, inquiry instruction vis-à-vis direct instruction has not been subjected to experimental controlled studies comparable to that of Klahr or the work referred to by Sweller.

Research Framework. Given the widespread advocacy of inquiry instruction by many educators, and of direct instruction by other stakeholders, together with the problematic evidentiary foundation, we conducted a controlled experimental study to compare experientially-based inquiry instruction and experientially-based direct instruction for science conceptual development at 8^{th} grade level. To minimize threats to validity, we built four features onto our research: Specificity, Fidelity, Objectivity, and Transparency.

Specificity. Rather than rely on single-word descriptors like ‘direct’, ‘inquiry’, ‘traditional’ ‘hands-on’ etc, we specify exactly what we mean by each mode of instruction, by characterizing them operationally with explicit *models*. These include unit structure, components, sequencing and approach, making clear what is different and what is common between modes. Our Guided Inquiry instruction model is based on the Karplus Learning Cycle (Lawson et. al., 1989), designed to reflect important features of scientific inquiry. It involves three main phases, Exploration, Concept Formation, and Application. The Karplus cycle is also at the heart of the BSCS '5E' learning cycle (Bybee et. al., 2006). The exploration and concept formation activities help students toward "inventing" the relevant scientific concepts and "discovering" the relationships and laws, guided or scaffolded by the instructor. By contrast, in our direct instruction model the teacher presents and explains the concepts, relationships and laws directly to the students, as finished products to be learned and understood. We call our direct model "direct active" since it includes hands-on practical work, though of a confirmatory nature and with prescribed steps. The direct-active cycle also has phases, namely Presentation, Explanation, Confirmation, and Application.

For our instructional units we chose two science topics with substantial conceptual demand and known to give difficulties. The units are:

- *It's Dynamic!* – The concepts of force, motion and mass, and their interrelationship in Newton's first and second laws of motion.
- *It's Illuminating!* – A foundation of basic science (light energy dependence on angle, distance and time), followed by application to temperatures on Earth, viz. variation by location (latitude) and time of year (seasons), treated from ground- and space-based perspectives.

The inquiry and direct versions of each unit were designed in parallel, to ensure equivalence in science content and approximate teaching time while differing in approach. Both include experiential activities but their sequencing and epistemological bases differ. Note that all lessons are composites, comprising a number of sequenced elements, and that no lesson can be 100% inquiry or 100% direct throughout and still remain generally good instruction. Trying to treat each detail inductively would not work, nor would unbroken didactic presentation. What then is the essential aspect distinguishing inquiry and direct modes? We believe it lies in "how students come to the concept." That is, do students develop the ideas and principles from exploration, or are they told? This represents the 'active agent' distinguishing inquiry from direct. Other lesson ingredients can reflect generic features of good instruction generally and thus be common to both modes. The complete units, including learning objectives, lesson materials and assessments are available online at www.wmich.edu/way2go/.

For our assessment, as for curriculum, we aim for specificity as to its nature and rationale. Having the assessment closely aligned with learning objectives and content is critical for the validity of the study. The assessment instruments are sets of 24 conceptual multiple-choice questions, each with four choice options, together with a three-level indicator of confidence. The questions focus on main principles and embody our criterion for conceptual understanding, viz. the ability to *apply* the concept (Anderson & Krathwohl, 2001). They involve application of principles to new situations rather than recall of factual knowledge. The assessment was the same for both instructional modes, and was administered pre-and post-instruction by independent project evaluators. The teachers implementing the lessons were blind to the assessment questions, to minimize the possibility of inadvertent or deliberate "teaching to the test."

Fidelity. One cannot simply assume that lessons are implemented as intended. In classrooms, two important aspects of fidelity are fidelity to mode and fidelity to curriculum. Fidelity to inquiry or direct mode is clearly a critical feature for comparing their relative effects. We used a "prepare and verify" approach, practicing for fidelity during teacher preparation and evaluating it during teaching. Teacher fidelity was monitored in three ways. First, independent observers were provided by the Science and Mathematics Program Improvement group (2009), specializing in evaluating science instruction. Observers were initially "blind" to teacher mode assignments, but because fidelity to mode was reasonably good, they soon identified the direct and inquiry teachers; thus in subsequent trials they had the appropriate teacher notebooks and could score teachers specifically on fidelity to the intended lessons. Second, teachers posted journal notes on each day's teaching, and third, all lessons were videotaped and could be reviewed.

Reasonable fidelity expectations for teachers must take into account the flexibility inherent in good teaching. Hypothetically one could obtain complete "fidelity" by having teachers read scripted lessons in each mode. Apparent fidelity might then be high, but teaching would be wooden and effectiveness low. Good teaching involves interacting with students and shaping things dynamically as the lesson proceeds, with some degree of personalization. The reality is that all classrooms have variability, due to students, teachers and events; this is the "natural classroom variation" that exists in real teaching situations. Our operational interpretation of sufficient fidelity was that experienced independent observers were able to identify instructional type within natural background variation, and assign a fidelity rating of at least 5 on a 7 point scale. Our teacher fidelity-to-mode median rating of 86% is arguably adequate for our research purposes while remaining realistic with respect to inevitable variation in actual science classrooms. Fidelity scores were somewhat higher for direct instruction than inquiry, which is not unexpected since direct is easier to 'execute' than guided inquiry.

Objectivity. Our research design embedded several areas of "blindness" to minimize bias. Teachers were blind to the assessment, and SAMPI coded and analyzed performance data without knowledge of group. Independent observers initially blind to teacher assignments visited two lessons per unit for each teacher and two observers saw each teacher. The observers documented the instruction and then scored fidelity to method. Final evaluation of both instruction and fidelity was arrived at by consensus in observer meetings after the last observations. The 2008 and 2009 observation reports are available online at www.wmich.edu/way2go/.

Transparency. Transparency of research would allow others to know exactly what the project did and thus facilitate attempts to evaluate or replicate it. Yet many research reports give no more than a brief description of various aspects without access to important detail. We have made our research as transparent as possible by placing all critical information on our project web site. This contains the complete sets of unit descriptions, learning objectives, student materials, teacher guides, and assessments. With this accessible, anyone can see how the research attempts to implement theoretical ideas regarding best practices of inquiry and direct pedagogy, and potentially contribute constructive comment.

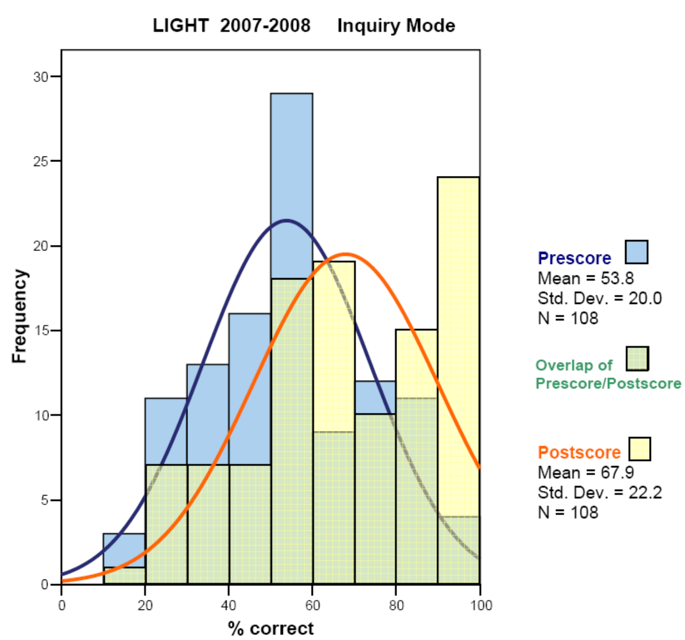
Subjects and Setting. In the 2007 and 2008 summer trials the subjects were 180 incoming 8^{th} grade students from several Midwest school districts, urban, suburban and rural. Over two weeks in June, classes met in the morning for four days a week, covering one lesson of each unit each morning. Districts sent out advance program announcements to parents and hence participation was a family decision. Our instructors were veteran middle school science teachers. Their judgment was that the students were not noticeably different overall from those in their regular school courses. We ran a special summer program to enable random assignment of students to treatment and control groups, which is difficult to do in a regular school setting, and this also enabled us to control time-on-task. A voluntary summer program, however, has limitations. There are no grade incentives, and to include homework or reading assignments would be unrealistic. Learning is thus essentially dependent upon in-class student engagement.

Results and discussion. Student performance data can be analyzed and results compared in a number of ways across various factors. Data were grouped by topic, teacher/classroom, program year and instructional mode. We could thus make various comparisons, and aggregate categories of data if results were similar within statistics. Besides the main research question about inquiry vis-à-vis direct instruction, analyses provided information about randomization, pre-and post-tests, and performance gains, and we summarize these aspects first.

Randomization of students. Student scores on the pre-tests indicate that randomization of students across classrooms was effective, i.e. any variation in pre-scores between classes was consistent with that expected by chance for class sizes of around 20 students.

Pre- and post-tests. Average pre-test scores on the multiple choice assessment instruments were around 50%, with standard deviations around 20%. Individual item prescores varied considerably between items. Items with higher prescores indicated that students already knew something about aspects of these topics, which thus limits possible improvement. For items with low prescores, popular distracter choices reflected the common preconceptions, as expected. The 'pure guessing' rate for items with four choice options would be 25% if students actually chose at random and would also contribute to score spread. However, guessing throughout is rare, and our three–level confidence indicator for each item supports this. Pre- and post-test questions were identical. In every sub-category we analyzed, there were statistically significant though modest gains. Standard deviations on post-tests were similar to those on the pre-tests. Figure 1 shows representative pre- and post-test score data, for the case of the Light/Climate unit in inquiry mode.

Fig. 1. Prescore/Postscore distribution



Performance gains and normalization. Performance gains between pre- and post-tests were expressed as both raw and normalized gain scores, the latter being the ratio of gain to maximum possible gain given the pre-score. To avoid distortions that can occur when a gain is negative, we used the concept of normalized *change* in calculations (Marx & Cummings, 2007). Normalized change is the gain or loss over the maximum possible gain or loss respectively, expressed as a percentage.

Mean normalized gains were of the order of 20% for the Dynamics unit and 30% for the Light unit, for both treatments. The effect sizes (Cohen's d) for raw gain were .69 for the Light unit and .54 for the Dynamics unit. Effect sizes for normalized gain were 0.99 for Dynamics and 1.4 for Light. Raw gains showed consistent (negative) correlation with pretest scores, but normalized gains did not, indicating that normalization was working in this regard.

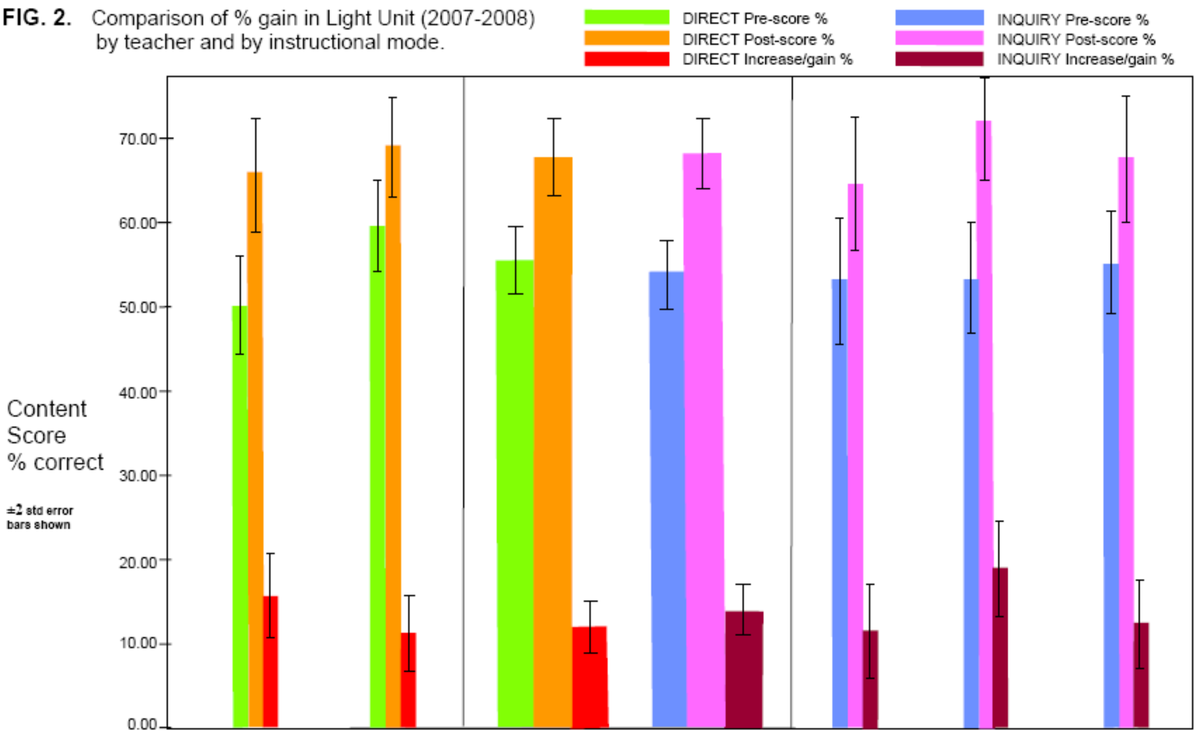
These gains can be put in perspective by noting that in a large survey of courses which used the well-known Force Concept Inventory (FCI) for pre and post testing in mechanics, typical normalized gains varied from ~ 20% for traditional courses to ~ 35% for courses involving more active engagement (Hake, 1998). The normalized gains in our study are of the same order. Note that our assessment items, like those on the FCI, are conceptually demanding, involving *application* of the concepts to cases, not just knowledge recall. Project data shows that students get higher gains on factual knowledge, but that is not the objective here.

If average gain is relatively modest (say less than a standard deviation) then *differences* in such gains between instructional mode will intrinsically be smaller and may not reach statistical significance in this realistic context, given the score spreads obtained and classroom variations observed. We found this to be the case in this summer program field study, for the most part. Gains were modest for reasons that could be identified from the classroom observations, performance data, and unit and test characteristics. Some reasons are intrinsic while others provide insights for refinements to the units, instruction and implementation.

Comparative results. In the sections below we present and discuss results for science content understanding as assessed by the pre- and post-instruction tests, analyzed by topic, program year, teacher and instructional mode.

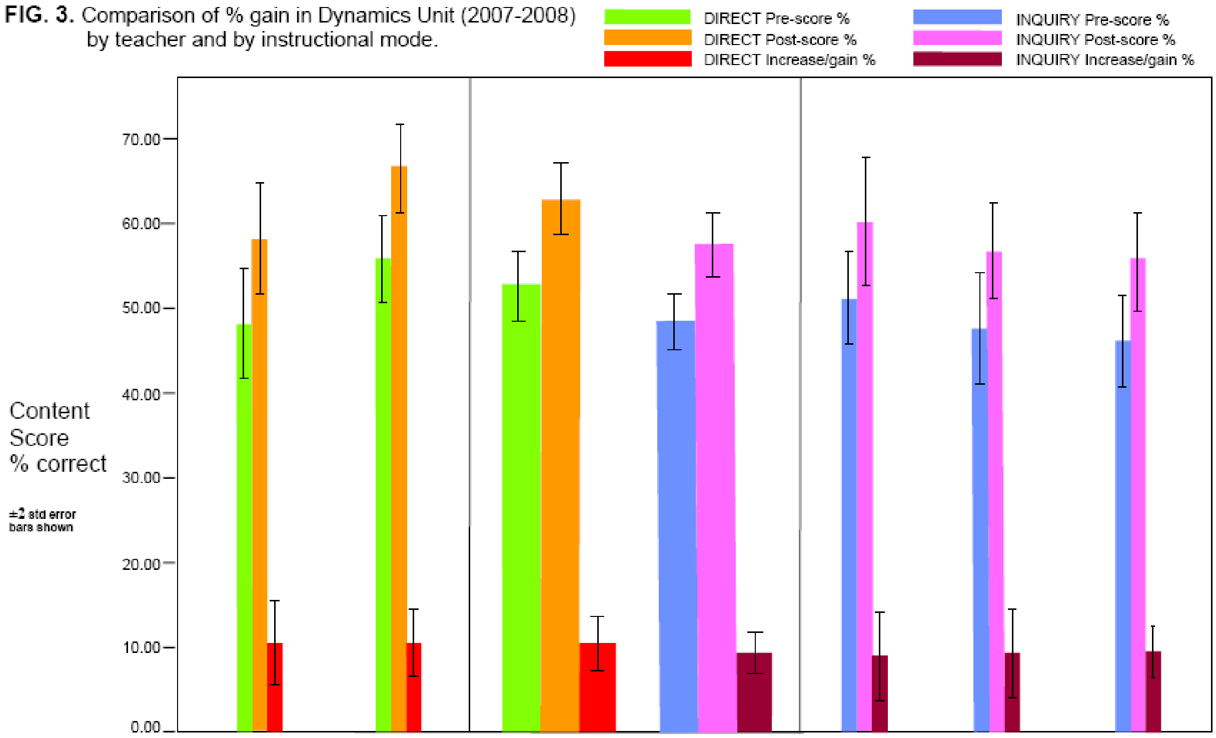
Results for the Light/Climate and Dynamics units are displayed as bar charts in Figures 2 and 3, with standard error bars overlaid, and accompanied by tabulated values for scores, gains, and standard deviations. The two charts display results by topic, teacher, and instructional mode, while aggregating data from two program years.

FIG. 2. Comparison of % gain in Light Unit (2007-2008) by teacher and by instructional mode.



Means (SD)	Joe	Ann	DIRECT	INQUIRY	Sam	Tom	Liz
	(N=32)	(N=40)	(N=72)	(N=108)	(N=37)	(N=35)	(N=36)
Pre-score	50.1 (16.5)	59.4 (17.9)	55.3 (17.8)	53.8 (20.0)	52.9 (22.7)	53.2 (19.3)	55.2 (18.3)
Post-score	65.5 (18.6)	70.5 (16.3)	68.2 (17.4)	67.9 (22.2)	64.5 (23.6)	71.8 (20.5)	67.6 (22.2)
% Increase	15.3 (13.2)	11.0 (13.8)	12.9 (13.6)	14.1 (16.4)	11.5 (16.6)	18.6 (16.8)	12.4 (15.3)
Normalized % change	32.5 (28.3)	29.9 (30.8)	31.1 (29.5)	34.9 (35.9)	31.5 (38.4)	43.6 (32.9)	30.0 (35.4)

FIG. 3. Comparison of % gain in Dynamics Unit (2007-2008) by teacher and by instructional mode.



Means (SD)	Joe (N=32)	Ann (N=40)	DIRECT (N=72)	INQUIRY (N=108)	Sam (N=37)	Tom (N=36)	Liz (N=35)
Pre-score	48.1 (18.0)	54.6 (14.9)	51.7 (16.6)	48.2 (17.3)	51.2 (16.7)	47.4 (19.3)	46.0 (15.8)
Post-score	58.2 (18.5)	65.5 (16.2)	62.2 (17.5)	57.4 (19.4)	60.1 (23.2)	56.6 (17.4)	55.4 (17.1)
% Increase	10.1 (13.9)	10.8 (13.2)	10.5 (13.4)	9.2 (13.6)	8.9 (15.5)	9.3 (15.5)	9.4 (8.8)
Normalized % change	19.6 (28.8)	24.1 (27.8)	22.1 (28.2)	19.0 (29.2)	21.8 (37.9)	16.3 (27.6)	18.7 (19.1)

This project data allowed us to make comparisons for different program years, teachers, topics and instructional modes. Each of these aspects is discussed below.

Different program years. This particular factor can be viewed as a replication in successive years with different students. Results were similar across the two trials, with small mean differences, which were not statistically significant. Thus this replication data could be aggregated in studying other factors.

Different teachers. Student gains for different teachers within the same instructional mode were compared, and no statistically significant differences in normalized gain were found among either the Inquiry teachers or the Direct teachers. Observationally however, “natural teacher variations” in personal teaching style and practice were clearly evident.

Different topics. There is no a priori reason to expect that different topic units (Dynamics and Light/Climate) should necessarily have the same pre –scores, post scores or gains, except inasmuch as they are at similar conceptual levels. Rather, we are interested in comparing inquiry and direct gains *within* each topic unit. On the other hand one might possibly expect a *correlation* between student gains in two topics taught by the same teacher. We find that raw percent gain does not correlate between the Light and Dynamics unit (Pearson’s, r=.077, *p*=.308), but normalized gain/change shows a statistically significant correlation (Pearson's, r=.238, *p*=.001).

Different instructional modes. Regarding the central research question, i.e. comparing inquiry and direct instruction, the center portions of the bar charts in Figures 2 and 3 represent these results. Findings for the summer program over two years are as follows.

For the Light unit, over two trials, the difference between direct and inquiry groups on normalized gain/change was not statistically significant ($t(178)=.755$, $p=.451$) (mean diff. 3.8, std. error diff. 5.1, effect size Cohen's d=.12). Note that on raw gain there was a small but statistically significant difference between one direct teacher (Ann) and one Inquiry teacher (Tom) ($t(73)=2.132$, $p=.036$), but that upon normalization the difference was not statistically significant ($t(73)=1.857$, $p=.067$). Similarly, for the Dynamics unit, differences between direct and inquiry groups on normalized gain/change were not statistically significant. ($t(178)=.717$, $p=.474$) (mean diff. 3.1, std. error diff. 4.4, effect size Cohen's d=.11).

Thus with teacher data aggregated within each mode and over both years, we find that normalized gain differences between modes of instruction were small and not statistically significant, given standard deviations reflecting the wide range in scores that students obtain in pre-and post-tests.

Note that, given such score spreads, it is clear that both the gains and gain differences would need to be larger than those observed in order to show statistical or practical classroom significance. A single larger-scale study would of course provide larger N size, but at the cost of precision, since practically it becomes more difficult to prepare, control and monitor instructional and classroom situations, thus increasing variation. Following Cronbach (20) a number of separate local studies in various environments would be more informative, to see whether and how the findings generalize to other situations and to refine and study the effect of various parameters.

Time comparison. Overall, direct lessons took about 10 minutes less per nominal 1-hour session than inquiry lessons; although this varied by lesson, and variations between teachers were at least as great as variations between modes.

Insights. In addition to the results, valuable insights were gained during the project into the multiple aspects involved in such an endeavor, including instructional design, assessment, materials, teacher development, classroom implementation, student learning, research design, methodology, etc. These have implications for instruction and suggest issues for further research.

Cognitive and curriculum perspectives. It is perhaps not surprising that students should acquire comparable conceptual understanding of science subject-matter via soundly-designed models of either inquiry or direct instruction, if both involve features of generally good instruction. From a cognitive perspective, learning is not linear but 'hyperlinked'; it involves putting together pieces of both new and existing knowledge. Students need to construct their own conceptual schemata this way regardless of how instruction is organized. Thus, whether students initially 'find out' or 'are told,' the concept elements and connections need to be revisited and re-sorted while making sense of things, during assimilation and accommodation in Piaget's terms. From a curriculum perspective, note that hands-on experiential aspects occur in both modes, albeit differently, and that the presence of an 'application' phase enhances understanding in case-based fashion in both modes, as students *use* the concepts. Thus, for both cognitive and curriculum reasons, any differences in *initial* concept learning via one mode or the other may be evened out considerably thereafter.

Note that affective and epistemological factors also play a role. Interest may be sparked more naturally by inquiry, leading to positive attitudes toward science. Experiencing inquiry-based lessons may promote epistemological changes in students' understanding of the nature of science. Transfer of knowledge to new situations and longer-term retention may also be enhanced if students develop the concepts themselves, under guidance. Note that it will take a while for students to adjust their conceptions of what science is all about, and hence their own learning approaches, in response to the nature of instruction, so differences in learning due to inquiry or direct instruction might not be as evident initially. All the above issues are of course further research questions.

Conclusion. The results from our experimental study comparing specified models of inquiry and direct instruction, implemented in realistic classroom environments in a two-week program, are that inquiry and direct methods led to comparable science conceptual understanding in roughly equal instructional times. Gain differences between instructional modes were not statistically significant within the observed natural variation of students, teachers and classrooms.

Mastery of science content in the alternative modes was our central research question, but the inquiry-versus-direct debate is not just about content: it is also about the nature of science and about efficiency. Most science educators feel that inquiry instruction, by its very nature, provides crucial added value, in having students 'do' science for themselves. This gives a 'feel' for science and a broader appreciation of the nature of science. For direct instruction, given our finding that it does not lead to a better grasp of the basics, it is not as clear what other grounds there might be on which to argue superiority. One may be that direct instruction is easier from the *teaching* point of view, particularly for less experienced teachers or those not confident with the content. Another is that the cut-and-dried structure of direct instruction may be less demanding for weaker students, at least initially. There is also merit to the time argument, but our study shows that the time differential is not as great as usually claimed, if both modes include experiential and application aspects, and if inquiry is focused and well guided. True, direct is certainly more efficient than 'open discovery', but no one is advocating that. On both content and time grounds, therefore, the 'efficiency' of direct instruction is not markedly greater, and any time saving is likely to be outweighed by loss of other benefits. Direct instruction does risk sending the message that science is simply a body of knowledge to be learned.

Returning again to our main research question, and given the composite nature of all lessons, and the realities of implementation in classrooms, we see that some common claims for the superiority of either direct and inquiry instruction in regard to concept acquisition may be viewed as somewhat overstated. Our study shows that good direct and inquiry instruction led to similar understanding of science concepts and principles in comparable times. It may well be that under more tightly controlled and rehearsed conditions one could better distinguish the performance effects of mode of instruction, which would be of significant theoretical interest; but this study gives a practical indication of what is likely to happen in the field. Thus, the promotion of one mode of instruction over the other, where both are based on sound models of expert instruction, should not be based on content acquisition alone.

Inquiry-based instruction clearly offers significant potential advantages for science education, by modeling scientific inquiry during concept learning; these concomitant benefits would need to be studied in research designed for that purpose. However, as far as science concept understanding is concerned, our conclusion is that expertly designed instructional units, sound active-engagement lessons, and good teaching are as important as whether a lesson is cast as inquiry or direct.

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