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AUTHOR	Kim, Young-soo; Germann, Paul J.; Patton, Martha
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ABSTRACT

This paper reports on the analyses of concept maps on the nature of science constructed by preservice secondary science teachers (N=17) during a semester-long reflective process. Analysis of their electronic journals also provides hierarchical evidence. The research questions explored in this study pertain to determining the views of preservice secondary science teachers about the nature of science, documenting their use of concept mapping and electronic journal writing in exploring concepts related to the nature of science, and finding the kinds of evidence that the preservice science teachers used to support their arguments in the electronic journal writing. Results suggest that students rely frequently on solving a problem for themselves rather than look for evidence from research, theory, or authority. Also, students generally provide low levels of support for their ideas while carrying on their electronic discussions. Contains 19 references. (DDR)

STUDY OF CONCEPT MAPS REGARDING THE NATURE OF SCIENCE BY PRESERVICE SECONDARY SCIENCE TEACHERS

Young-soo Kim, Paul J. Germann & Martha Patton

108 Townsend Hall, University of Missouri-Columbia

Columbia, Missouri 65211

E-mail: Kim<c677329@showme.missouri.edu>

E-mail: Germann<cipjg@showme.missouri.edu>

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ABSTRACTS

An important objective of science education is an adequate understanding of the nature of science. Teachers of science have been charged with the responsibility for achieving this objective. However, the training and experience of many teachers has been dominated by the product of science, scientific explanations and terminology, and they have had little direct experience with scientific methods, values, and assumptions. One of the objectives of methods courses in teaching science is to provide prospective teachers with an understanding of the nature of science so that they are able to help their students appreciate what science is and how it accomplishes its goals. This paper reports on the analyses concept maps of the nature of science constructed by 17 preservice secondary science teachers during a semester-long reflective process. Also, hierarchical evidence was provided from their electronic journals analysis. Results inform our understanding of preparing teachers of science.

INTRODUCTION

An important objective of science education is an adequate understanding of the nature of science (Lederman, 1992; Hazen & Trefil, 1991; Rutherford & Ahlgren, 1990; American Association for the Advancement of Science, 1989). A common view of the nature of science is that it consists of certain methods, values, and assumptions that are inherent in the construction of scientific knowledge (Lederman & Zeidler, 1987). Teachers of science have been charged with the responsibility for achieving this objective. Many teachers, however, lack a sufficient understanding that would enable them to help students construct their own understandings. Their training and experience has been dominated by the product of science, scientific explanations and terminology, and they have had little direct experience with scientific methods, values and assumptions. One objective of methods courses in teaching science is to provide prospective teachers with an understanding of the nature of science so they are prepared to help students appreciate what science is and how it achieves its goals.

THEORETICAL FOUNDATIONS

Constructivism

Learners construct their own meaning concerning a reality that exists independent of human activity. Science students have the task of constructing meaning that correspond to explanations constructed by scientists. The meanings constructed by both students and scientists are socially negotiated. In some cases, that negotiation is a process of give and take, compromise, and consensus building (e.g., science related social issues). The negotiations of scientists, however, are guided by data, interpretations of those data, and a progressive discourse among scientists to advance scientific knowledge. In yet another sense, teachers assist students in negotiating the difficulties, pitfalls, or obstructions that are obstacles to student construction of appropriate meanings (Prawat & Floden, 1994; Bereiter, 1994)

Reflection

Donald Schon (1983) describes expert practice as an artful inquiry into situations of uncertainty. Professionals engage in "reflective conversation" with the uncertain situation, taking stances, experimenting, and learning from the "back-talk" of the situation. Current reform efforts in teacher education are guided by such models of reflective practice. Theoretical underpinnings in cognitive psychology, as well as other forces, are pushing education and especially professional education toward learning through problem solving, authentic projects, apprenticeships and field experiences, and toward learners who act as reflective practitioners. Concept mapping provides science education students with opportunities to participate in "reflective conversation" with teachers, peers, field-based mentors, and students.

Concept Mapping

During concept mapping, each student uses his or her own knowledge structures to map the relationships between concepts using propositional links (Ault, 1985; Novak, 1981; Stewart, 1978). These individual representations of relationships among a set of concepts that exist in the learner's mind are useful to both the student and teacher in assessing the depth of understanding regarding a particular topic.

Concept maps can be an effective metacognitive tool in facilitating one's construction of knowledge. Increasingly, concepts maps are being used in a variety of instructional settings as both learning and research tools (Novak, Gowin, & Johansen, 1983; Cliburn, 1990), especially regarding their use to promote meaningful learning. For example, concept mapping has been found to be an effective strategy in helping undergraduate elementary science methods students practice and monitor knowledge construction (Wallace & Mintzes, 1990). Jay (1994) examined a concept mapping strategy as a metacognitive reflection tool in a secondary science methods course.

Nature of Science

Scientific inquiry is understood to be driven by four major epistemological concerns: scientific assumptions, knowledge, processes, and values. The work of scientists is predicated on the assumptions that there is an underlying order to natural phenomena in the universe, this order is caused by rules that are not capricious, and the rules are knowable and understandable (Trowbridge & Bybee, 1990). They use their present knowledge, in the form of concepts, principles, theories, and laws, to guide them in their search for patterns and regularities in natural objects and events (Rutherford & Ahlgren, 1990). New understandings of those patterns, relationships, and basic rules result. Scientists value logic. They have a reverence for data and evidence. The scientific community demands that results be replicable so that they can be verified and their interpretation discussed and negotiated. The meanings constructed in this way are considered to be tentative and open to revision as new data causes the previous body of facts to be reinterpreted. Despite their tentativeness, scientific knowledge is relatively stable.

RESEARCH QUESTIONS

An understanding of the nature of science is required if teachers are to help their students construct their own appropriate views of science. An instructional strategy emphasizing reflection in a number of contexts, including concept mapping, were used with undergraduate secondary science education students. Two research questions were formulated to evaluate the role of concept maps in facilitating students' conceptual development and change regarding the nature of science.

- What are the preservice secondary science teachers' views of the nature of science in a teaching secondary science methods course?
- How did preservice secondary science teachers use concept mapping and electronic journaling in exploring the concepts related to the nature of

science?

- What kinds of evidence did preservice secondary science teachers used to support their arguments in the electronic journaling?

METHODS AND PROCEDURES

Subjects

During the 16-week Fall semester of 1996, 17 students were enrolled in a 5-credit (6 contact hours) course concerning teaching science in secondary school. The course included both general teaching methodologies as well as those specifically related to teaching science. Students took this course toward the end of their academic preparation for teaching. Student teaching experience occurred during one of the following two semesters. Eleven students were female; six were male. Fourteen were undergraduates pursuing a bachelor's degree in science education. Three were enrolled as post baccalaureate students to take courses required to teach science at the secondary level.

Treatment

To promote conceptual development and change with respect to the nature of science, students engaged in several activities that spanned 14 weeks of the semester: a reading, an initial exploration activity, electronic journaling, concept mapping, a portion of a final reflection paper, and an exit interview. Similar activities were also conducted for four other topics: science literacy; goals of science education; structure of the discipline; and theories, principles, and practices for the teaching of science. The purpose of the preliminary **reading** (Trowbridge & Bybee, 1990, pp. 47-58) was to orient students to the topic. Based upon their understanding of this reading, each student then obtained a journal article that related to the nature of science. The **initial exploration activity**, *The Card Exchange* (Cobern, 1991), allowed student to interact with one another to begin clarify their present views concerning the nature of science and to appreciate the range of views held by their classmates. This activity was followed by the class discussion. Over the next two weeks, students engaged in **electronic journaling**. During this period, they were to make six contributions to a discussion held on a class listserve. Following this exchange of views, each student created a **concept map** that showed his or her understanding of the nature of science. These concept maps were to be reviewed and updated every two weeks over the rest of the semester. Students constructed their concept maps electronically using the software PIViT (Brade, Krajcik, Blumenfeld, Soloway, & Marx, 1995). Students submitted a **final reflection paper** that addressed the nature of science and the four other topics listed above. These papers went through a peer review and a revision before submission to the instructor. This paper focuses on the students' concept maps of the nature of science and the comparison of two students' concept maps with the nature of science portion of their final reflection papers.

Data Collection and Analysis

Three concept maps regarding the nature of science were collected from each student over a six week period of time. Maps were analyzed by evaluating concepts, linking words, links, and levels of hierarchy using the scoring system provide by Novak and Gowin (1984). Hierarchical evidence was collected from students' electronic journals.

RESULTS AND DISCUSSION

Even though they had engaged in addition learning activities, most students did not change their concept maps. Exit interviews revealed that some students did not feel their views had changed, so modifying their concept maps were not needed. Others admitted that in the press for time, they simply turned in their unrevised concept maps. Some students also acknowledged that they needed to be forced to reflect and reconsider their views.

Total number of concepts varied from 19 to 54 (Table 1). The average number of concepts regarding the nature of science was 35. One student (S14) did not use any linking words in the map. Students S1, S2 and S10 used only a few linking words between concepts. Most students constructed appropriate number of vertical links between or among concepts. S3, S7, S10, S13 and S14 made horizontal link(s) from one branch to another branch. Especially, S7 drew a horizontal link between different levels of hierarchy on two different branches. No missing links existed in their concept maps. Students constructed three to nine hierarchical levels in their concept maps. The average number of levels of hierarchy was six. Only S1 and S17 elaborated on more than half of the concepts they used in their maps.

Students were reasonably proficient at providing concepts and links in a hierarchy. At this stage of the course, students S1, S2, S10 and S14 did not provide linking words consistently. Students need to develop skills making horizontal links and collecting supporting notes in elaborations.

Insert Table 1 about here.

There were a very small number of concepts related to the nature of science that were used by a majority (8) of students. A list of all the concepts used by students and an evaluation of their appropriate use within the concept map is provided in Table 2. Students' concept maps were evaluated on a five point Likert scale as to the degree of agreement the researchers had regarding their use by the student. It was also noted whether the concept was differentiated (d), or not (n).

Insert Table 2 about here.

Two tiers of concepts were identified (Table 3) based on their frequencies in student concept maps. The first are those concepts that appeared in about half (8) of students' concept: science (17), tentative/change (11), experimental (11), values/attitudes (11), observing (10), scientific methods and processes (9), scientific knowledge (8), and discovering (8). The second tier included concepts used by at least five (30%) students: ways of knowing (7), inquires (methods) (7), technology (uses) (7), religious views (7), problem solving (6), open to interpretation (5), historic (cumulative) (5), exploration (5) and critical thinking (5).

Insert Table 3 about here.

Table 4 summarizes the results for the two tiers of concepts. The percentage of agreement between the investigators and the students was 96% for tier 1 and 81% for tier 2. Tier 1 concepts were differentiated 67% of the time and 44% for tier 2.

Most students used the concepts in their maps appropriately. Inappropriate concepts include the following examples.

- Regarding the tentative of changing the nature of science, student S10 had the following chain of propositions: science is ever-changing; ever-changing meaning subject to interpretation; subject to interpretation of values; and values involve certain vs. evolution. The researchers interpreted this to mean that the accuracy and stability of scientific knowledge in subject to indicated interpretation based on a person's set of values, such as religious values in the creation vs. evolution controversy.
- The researchers were unsure of student S14's understanding of technology. This was, in part, due to the lack of linking words in her map. She made connections between technology and the natural world, physical world, phenomenon, and changing.
- Student S4 formed the following propositions regarding the interpretation of science: science has many interpretations depending upon religious beliefs, morals and ethics, science background, and cultural background; morals and ethics such as scientific morals (including not

falsifying data or results) and sociological morals (not utilizing scientific knowledge for disruption or harm to others). Again, this student appears to view science as arbitrary depending on an inductive beliefs, ethics and background.

In a similar fashion, the researchers disagreed with a few students understanding of some concepts: ways of knowing (S2 and S14), religious views (S5, S6, S8, S9 and S17) and open to interpretation (S15).

Most students well developed the attributes of the concepts 'science', 'scientific values/attitudes' and 'ways of knowing.' On another hand, the concepts of 'discovering,' 'problem solving,' 'open to interpretation' and 'critical thinking' need to be developed more attributes. These concepts did not described well enough to now what students meant by them.

Students were not of one mind regarding the concepts that chose to represent the nature of science. Each student constructed different meaning depending upon the cognitive conceptual structures they brought to the leaning activities and the degree to which they engaged in them. A majority chose second level concepts [scientific knowledge (5), scientific methods (9), and scientific values/attitudes (11)] consistent of the researches view, leaving out the attributes of assumptions of science. Many concepts were not differentiated. Student either assumed these concepts were self explanatory or lacked understanding to provide their attributes. Two extreme examples were 'problem solving' and 'open to interpretation.'

Insert Table 4 about here.

Table 5 summarizes the levels of evidence used by each student while presenting their views during electronic journaling of 167 journal entries, 77 (46%) were opinion statements, 54 (20%) used peers to support their arguments, 40 (24%) provided evidence from examples or anecdotes, very few cited instructors (3%), authority (6%), reasoned argument (0), theory (0) and research (1: 0.6%).

Insert Table 5 about here.

Students generally provide low levels of support while carrying on their electronic journaling discussions despite several reminders that such support was necessary. The researchers had the impression that many students failed to understand the importance of supporting their opinions with evidence. For most students, their own experiences and opinions, and those of their peers were adequate. On the one hand, this is distorting. On the other, the electronic journal was an opportunity to informally explore their ideas, understandings and misconceptions.

Insert Table 6 about here.

The difference between electronic journaling and concept mapping can be illustrated by looking at the frequency of concepts in both. Thirty concepts appeared more than three times in 17 students' concept maps, and more than 11 times in 167 electronic journal entries were analyzed.

In coconut maps, major concepts regarding the nature of science which were 'ways of knowing,' 'scientific knowledge,' 'scientific methods/processes,' and 'scientific values/attitudes' were mentioned with attributes of the concepts by students. In electronic journals, however, these concepts except scientific methods/processes were appeared without describing the attributes of the concepts. There were many concepts involving values, and teaching and learning in the electronic journal entries. The concepts about assumptions of science were not showed yet in both of concept maps and electronic journals.

In summary, while students understanding of the nature of science improved a great deal over the three months period time, this marks only a part of their journey. They appear to rely more on figuring it out for themselves that seeking views that can be supported from research, theory, or authority. Two useful tools that serve different purposes in their inquiry are electronic journaling that support reflection, social discourse and negotiation of meaning, and concept mapping that support the organization of knowledge.

In addition to this study, two case studies consisted of three concept maps, a portion of a final paper, and a concept map of the final paper constructed by the investigators can be found in Kim, Germann and Patton (1998).

Table 1

Total Numbers of Components of Student Constructed Concept Maps Regarding The Nature of Science (N=17)

Student	Concepts	Linking Words	Vertical Links	Horizontal Links	Missing Links	Levels of Hierarchy	Elaborations
S1	23	3	22	0	0	3	18
S2	24	6	26	0	0	6	3
S3	48	12	43	1(1st)	0	9	11
S4	37	12	41	0	0	6	13
S5	38	10	37	0	0	3	9
S6	39	27	38	0	0	4	10
S7	29	12	36	3(1st), 1(2nd)	0	4	9
S8	21	11	28	0	0	6	6
S9	27	17	27	0	0	4	11
S10	19	7	21	1(1st)	0	5	9
S11	35	19	34	0	0	4	5
S12	54	10	55	0	0	6	0
S13	40	11	45	1(1st)	0	9	8
S14	31	0	35	0	0	8	2
S15	49	28	48	0	0	7	0
S16	28	17	27	0	0	4	0
S17	48	42	53	3(1st)	0	5	27

* Note. The fist horizontal links were cross links between two branches over two levels of hierarchy.

** Note. The second horizontal links were cross links between two branches over three levels of hierarchy.

*** Note. The Elaboration column indicated the number of descriptive or explanatory notes about the concepts in the students' concept maps.

Table 2

Identification and Evaluation of Concepts Used in Student Concept Maps (N=17)

Concepts From Student Concept Maps	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	Frequency
Ways of Knowing		SD/d					SA/d					SA/d	SA/d	SD/d	SA/n	SA/d		7
Science	SA/d	SA/d	SA/d	SA/d	SA/d	SA/d	SA/d	SA/d	A/d	SA/d	SA/d	SA/d	SA/d	SA/d	SA/d	SA/d	SA/d	17
Scientific Knowledge	SA/d	SD/n			SA/d						SA/d	SA/d	SA/d	SA/d	SA/d			8
natural world								SA/d				SA/n		SA				3
explanation				SA/d		SA/d				SA/n								3
theory							SA/n		SA/n			SA/n				SA/n		4
law												SA/n				SA/d		2
hypotheses																		0
concepts				SA/n		SA/n												
fact			SA/n		SA/n		SA/n									SA/n		4
tentative, change	SA/n			A/d	SA/n	SA/n	SA/d		SA/n	NS/d		SA/d	A/d	A			SA/n	11
stable; reliable	SA/n				SA/n							SA/d					SA/n	4
public	SA/n																SA/n	2
empirical	SA/n																SA/n	2
replicable	SA/n											SA/n					SA/n	3
historic(cumulative)	SA/n											SA/d	SA/d			SA/n	SA/n	5
organized					SA/n							SA/d			SA/n			3
technology (used to create)										NS/n		SA/n			A			3
equations							SA/n											1
social/political													SD/n			SA/n		2
open to interpretation				NS	SA/n					SA/n			A/n		SD/n			5
modify rather than reject																	SA/n	1
natural phenomena				SA		SA/n												2
world around us							SA/n											2
technology			SD/n			NS/d										NS/d	SD/d	4
adapting																	NS/d	1
control																	D/n	1
eventually fail																	D/n	1
unintentional effects																	SD/n	1
inattentive students																	SD/n	1
change						SA/d												1
complex						SA/n												1
introduction						SD/d												1
methodical												SA/n						1
biased												SA/n						1
contents																		1
methods (deals with)					A/n													1
attitudes				A/n														1
level				NS/n														1
depth				NS/n														1
increases cognition													NS/d					1
increases understanding						SA/n							SA/n					2
reconstruction of ideas												SA/d	SA/d					2
sharing of beliefs													SA/n					1
interdisciplinary												A/d						1
correlated w/all aspects of life/knowledge												D/n						1

Table 2 Continued

Concepts From Student Concept Maps	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	Frequency
evolution	.	.	.	.	.	.	.	.	SA/n	D/n	.	.	.	.	.	.	.	2
creationism	.	.	.	.	.	.	.	.	SA/n	D/n	.	.	.	.	.	.	.	2
philosophy	.	.	.	.	.	.	.	.	.	.	.	.	.	SA/d	.	.	.	1
numbers	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	D/n	.	1
vocabulary	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	D/n	.	1
Scientific Methods/Processes	SA/d	.	SA/n	SA/d	SA/d	.	SA/d	.	.	.	SA/d	SA/d	SA/d	.	.	.	SA/d	9
Skills	.	.	SA/n	.	SA/n	.	.	.	.	.	.	SA/d	.	.	.	.	.	3
Questioning	.	.	.	SA/n	.	.	.	.	.	.	.	.	SA/n	SA/n	.	.	.	3
curiosity	.	.	.	.	.	.	.	.	.	.	.	SA/n	.	.	.	.	.	1
Basic	.	.	.	.	.	.	.	.	SA/n	.	.	.	.	.	.	.	.	1
Observing	SA/n	SA/n	SA/n	.	.	.	SA/n	SA/d	.	.	SA/d	SA/n	SA/d	.	.	SA/d	SA/n	10
Classifying; Categorization	.	.	.	SA/n	.	.	.	.	.	.	.	.	SA/d	.	.	.	SA/n	3
systems	.	.	.	.	.	.	.	.	.	.	.	.	SA/n	.	.	.	.	1
Inferring	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	SA/n	1
Integrated	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
Hypothesis	.	.	.	.	.	.	.	.	.	.	.	SA/n	.	.	.	.	SA/n	2
Predicting	.	.	.	.	.	.	SA/n	.	.	.	.	.	.	.	.	.	.	1
Designing Experiments	.	.	.	.	.	.	.	.	.	.	.	SA/n	.	.	.	.	.	1
Identifying Variables	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
Operationally Defining	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
collect data	.	.	.	.	.	.	.	.	.	.	.	.	SA/d	SA/d	.	.	.	2
Interpreting Data	SA/n	.	.	.	.	.	.	.	.	.	.	SA/n	SA/n	.	.	.	.	3
Evaluating Hypotheses	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
Conclusions	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
Evidence	.	.	.	.	.	.	.	.	.	.	.	.	SA/d	.	.	.	.	1
Inquiries, Methods, Investigations	.	SA/d	.	.	.	.	.	SA/n	.	SA/d	.	SA/d	SA/d	SA/d	SA/n	.	.	7
Scientific Method(s)	SA/n	.	SA/n	.	.	.	.	SA/n	SA/n	.	.	.	.	.	.	.	.	4
Descriptive	.	SA/n	.	SA/n	.	.	.	.	.	.	.	.	.	.	.	SA/n	.	3
Comparative	.	SA/n	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Correlational	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
Analysis	.	SA/n	.	.	.	.	SA/n	.	.	.	.	.	.	.	.	.	.	2
Synthesis	.	SA/n	.	.	.	.	.	.	.	.	.	.	.	.	.	SA/n	.	1
qualitative	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	SA/n	.	1
quantitative	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	SA/n	.	1
Experimental	SA/n	SA/d	SA/n	.	SA/n	SA/n	SA/n	SA/d	.	.	SA/n	.	SA/d	SA/d	.	SA/d	.	11
Cause/Effect	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
Controlled	.	SA/n	SA/n	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Modeling	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	SA/n	1
Trial and Error	SA/n	.	.	.	.	.	.	.	.	.	.	.	.	SA/n	.	.	.	2
Accidental Discoveries	.	.	A/n	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Discovering	SA/n	.	.	.	SA/d	.	.	SA/d	.	SA/n	SA/d	SA/n	SA/n	.	SA/n	.	.	8
Exploration	.	.	.	A	.	.	SA/n	SA/d	SA/n	.	SA/d	.	.	.	.	.	.	5
Technology (uses for Scientific Methods/Processes)	.	SA/n	.	.	.	.	SA/d	SA/d	.	.	SA/d	.	SA/n	NS/n	SA/n	.	.	7
Instruments (tools)	.	.	.	.	.	.	.	.	.	.	SA/d	.	SA/n	.	.	.	.	2
basic information	.	.	.	.	.	.	.	.	.	.	SA/n	.	.	.	.	.	.	1
new information	.	.	.	.	.	.	.	.	.	.	SA/n	.	.	.	.	.	.	1
measuring devices	.	.	.	.	.	.	.	.	.	.	.	.	SA/n	.	.	.	.	1
Thought Processes (skills)	.	.	SA/d	.	.	.	.	.	SA/d	.	.	SA/d	.	.	.	.	.	3
analyzing	.	.	SA/n	SA/n	.	.	.	.	SA/n	.	.	SA/n	.	.	.	.	.	4

18

19

Table 2 Continued

Concepts From Student Concept Maps	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	Frequency
critical thinking			SA/n	SA/n					SA/n			SA/n		SA/d				5
reasoning			SA/n									SA/n						2
problem solving			SA/n		SA/n				SA/n			SA/n		SA/d		SA/n		6
investigative												SA/n						1
evaluative										D/d		SA/n						2
inquisitive										SA/d		SA/n						2
logical decisions				SA/n														1
asking questions				SA/n														1
Natural Phenomena											SA/n				SA/n		SA/n	3
systematic, methodical				SA/n	SA/n							SA/n		SA/n				4
reliable												A/n						1
facts					SA/n								SA/n		SA/n			2
data									SA/n									1
explaining											SA/d							1
test theories														SA/n				1
replicable (reproducable)													SA/n	SA/n				2
unbiased				A/n	D/n										SA/n			4
research													SA/d					1
senses																SA/n		1
organized				SA/n														1
empirical													SA/d					1
uses prior knowledge														NS/n				1
labs														NS/n				1
invention										SA/n								1
Scientific Values/Attitudes	SA/n	SA/n			A/n	SA/d	SA/d			SA/d	D/d	SA/d	A/n			SA/d	SA/d	11
Knowledge	SA/n										NS/n		SA/d					3
Questioning											NS/n	SA/n	SA/n					3
Inquiry	SA/n							SA/n								SA/n		3
Empirical Assessment (testing)																		0
Data	SA/n																SA/n	2
Verification	SA/n												SA/n				SA/n	3
replicable												A/n						1
Logic	SA/n												SA/n			SA/n	SA/n	4
honesty							SA/n					SA/n						2
skepticism												SA/n				SA/n	SA/n	3
precision												SA/n				SA/n		2
ethics	SA/n			SA/n	A/n									A				4
moral				SA/d	SD/n									A				3
religious views	SA/n			A	SD/d	SD/d		SD/d	SD/d								SD/n	7
interpretation																	SD/n	1
(religion integrated with science)																	SD/n	1
society		NS/n			NS/n		D/d				SA/d							4
technology	SA/n				NS/n													2
scientists		NS/n																1
Curiosity												SA/n			SA/n			2
open to refutation & modification												SA/n						1
truth					D/d										SA/n		SA/n	3
freedom of thought																	SA/n	1
cultural background				A														1

Table 2 Continued

Concepts From Student Concept Maps	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	Frequency
science background	.	.	.	SA/n	.	.	.	.	.	.	.	.	.	.	.	.	.	1
problems & concerns	.	.	.	.	.	.	.	.	.	.	.	.	.	NS/n	.	.	.	1
decisions	.	.	.	.	.	.	.	.	.	.	.	.	NS/n	.	.	.	.	1
shaped	.	.	.	.	.	SA/d	.	.	.	.	.	.	.	.	.	.	.	1
beliefs	.	.	.	.	.	SA/n	.	.	.	.	.	.	.	.	.	.	.	1
reasonings	.	.	.	.	.	SA/n	.	.	.	.	.	.	.	.	.	.	.	1
perception	.	.	.	.	.	SA/n	.	.	.	.	.	.	.	.	.	.	.	1
innovations	.	.	.	.	.	.	NS/n	.	.	.	.	.	.	.	.	.	.	1
fundamentalism	.	.	.	.	.	.	.	SD/n	.	.	.	.	.	.	.	.	.	1
sanctity of life	.	.	.	.	.	.	.	SD/n	.	.	.	.	.	.	.	.	.	1
Common Beliefs/Assumptions	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	SA/d	1
Universe is (has)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
knowable	.	.	.	.	.	.	.	.	.	.	.	SA/d	.	.	.	.	SA/n	2
not capricious (is lawful)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
patterns and regularities	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
order	.	.	.	.	.	.	.	.	.	.	.	SA/n	.	.	.	.	.	1
rules; laws	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	SA/n	1
system	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
method of investigation that explains												A/n	.	.	.	.	.	1
world around us	.	.	.	.	.	.	.	.	.	.	.	A/n	.	.	.	.	.	1
questioning leads to further inquiry	.	.	.	.	.	.	.	.	.	A/n	.	.	.	.	.			
science leads to advancement of knowledge & life	.	.	.	.	.	.	.	.	.	.	.	A/n	.	.	.	.	.	1
put order in an ever-changing world	.	.	.	.	.	.	.	.	.	.	.							
Technology	.	.	SD/d	.	.	.	.	.	.	.	.	SA/d	.	.	.	.	.	2
Problems/Benefits	.	.	SD	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
benefits	.	.	SD/n	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
increased standard of living	.	.	SD/n	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
closely correlated to science	.	.	.	.	.	.	.	.	.	.	.	SA/d	.	.	.	.	.	1
scientific understanding facilitates	.	.	.	.	.	.	.	.	.	.	.	SA/d	.	.	.	.	.	1
technological innovations	.	.	.	.	.	.	.	.	.	.	.	SA/d	.	.	.	.	.	1
social applications of science	.	.	.	.	.	.	.	.	.	.	.	SA/d	.	.	.	.	.	1
improving/changing our lives	.	.	.	.	.	.	.	.	.	.	.	NS/n	.	.	.	.	.	1
necessity is mother of invention	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Etc.															SA/n	.	.	1
philosophy of science	.	.	.	.	.	.	.	.	SA/n	SA/n	.	.	.	.	SA/n	.	.	3
knowledge vs. truth	.	.	.	.	.	.	.	.	.	NS/d	.	.	.	.	.	.	.	1
science is everything	.	.	SD	.	.	SD	.	.	SD	.	.	.	SD	.	SD	.	.	3
teaching science	.	SD/n	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Procedures & Standards	.	SD/n	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
National Science Education Standards	.	SD/n	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
STS	.	SD/n	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Benchmarks	.	SD/n	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
SS&C	.	SD/n	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
community leaders	.	NS/n	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
milieu	.	NS/n	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	

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Table 2 Continued

Concepts From Student Concept Maps	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	Frequency
mindscape		NS/n																1
new motivation			SD															1
new teaching methods			SD															1
exposure			SD															1
equity			SD															1
educational problems-causes			SD															1
educational problems-solutions			SD															1
education, educating						SD												1
church						SD/n												1
teachers						SD/n	SD/n											1
students							SD/n											1
parents						SD/n	SD/n											1
schools							SD/n											1
other nations							SD/n											1
community						SD/n												1
educators									SD/n									1
scientists vs. science teachers									SD/n									1
gender									SD/n									1
values									SD/n									1
types of classes									SD/n									1
activity based									SD/n									1
lecture									SD/n									1
media							SD/n											1
government							SD/n											1
challenging										A/d								1
fun & interesting										A/n								1
definition of science			SD/d	SD/d														1
Various Unrelated Concepts				SD			SD	SD							NS			4

* Note. In each cell, the upper case(s) are indicated the researchers' agreement about the concepts from student concept maps. A five-point Likert scale system was used: SA = Strongly Agree, A = Agree, NS = Not Sure or ambiguous, D = Disagree and SD = Strongly Disagree.

* Note. In each cell, the lower case "n" indicates that the concept was not developed with attributes.

* Note. In each cell, the lower case "d" indicates that the concept had a well-developed attribute description.

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Table 3

Identification and Evaluation of17 Selected Concepts in Student Concept Maps

Concepts From Student Concept Maps	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	Frequency
Science	SA/d	SA/d	SA/d	SA/d	SA/d	SA/d	SA/d	SA/d	A/d	SA/d	SA/d	SA/d	SA/d	SA/d	SA/d	SA/d	SA/d	17
Tentative, Change	SA/n	.	.	A/d	SA/n	SA/n	SA/d	.	SA/n	NS/d	.	SA/d	A/d	A	.	.	SA/n	11
Experimental	SA/n	SA/d	SA/n	.	SA/n	SA/n	SA/n	SA/d	.	.	SA/n	.	SA/d	SA/d	.	SA/d	.	11
Scientific Values/Attitudes	SA/n	SA/n	.	.	A/n	SA/d	SA/d	.	.	SA/d	D/d	SA/d	A/n	.	.	SA/d	SA/d	11
Observing	SA/n	SA/n	SA/n	.	.	.	SA/n	SA/d	.	.	SA/d	SA/n	SA/d	.	.	SA/d	SA/n	10
Scientific Methods/Processes	SA/d	.	SA/n	SA/d	SA/d	.	SA/d	.		.	SA/d	SA/d	SA/d	.	.	.	SA/d	9
Scientific Knowledge	SA/d	SD/n	.	.	SA/d	.	.	.	.		SA/d	SA/d	SA/d	SA/d	SA/d	.	.	8
Discovering	SA/n	.	.	.	SA/d	.	.	SA/d	.	SA/n	SA/d	SA/n	SA/n	.	SA/n	.	.	8
Ways of Knowing	.	SD/d	.	.	.	.	SA/d	.	.	.	.	SA/d	SA/d	SD/d	SA/n	SA/d	.	7
Inquiries, Methods, Investigations	.	SA/d	.	.	.	.	.	SA/n	.	SA/d	.	SA/d	SA/d	SA/d	SA/n	.	.	7
Technology (Uses for Scientific Methods/Processes)	.	SA/n	.	.	.	.	SA/d	SA/d	.	.	SA/d	.	SA/n	NS/n	SA/n	.	.	7
Religious Views	SA/n	.	.	A	SD/d	SD/d	.	SD/d	SD/d	.	.	.	.	.	.	.	SD/n	7
Problem Solving	.	.	SA/n	.	SA/n	.	.	.	SA/n	.	.	SA/n	.	SA/d	.	SA/n	.	6
Historic (Cumulative)	SA/n	.	.	.	.	.	.	.	.	.	.	SA/d	SA/d	.	.	SA/n	SA/n	5
Open to Interpretation	.	.	.	NS	SA/n	.	.	.	.	SA/n	.	.	A/n	.	SD/n	.	.	5
Exploration	.	.	.	A	.	.	SA/n	SA/d	SA/n	.	SA/d	.	.	.	.	.	.	5
Critical Thinking	.	.	SA/n	SA/n	.	.	.	.	SA/n	.	.	SA/n	.	SA/d	.	.	.	5

* Note. In each cell, the upper case(s) are indicated the researchers' agreement about the concepts from student concept maps. A five-point

Likert scale system was used: SA = Strongly Agree, A = Agree, NS = Not Sure or ambiguous, D = Disagree and SD = Strongly Disagree.

* Note. In each cell, the lower case "n" indicates that the concept was not developed with attributes.

* Note. In each cell, the lower case "d" indicates that the concept had a well-developed attribute description.

Table 4

Analysis of Agreement and Attributes of 17 Selected Concepts in Student Concept Maps

Concepts From Student Concept Maps	Frequency	Agreement					Attributes		
		SA	A	NS	D	SD	d	n	No Coding
Science	17	17	.	.	.	.	17	.	.
Tentative, Change	11	7	3	1	.	.	5	5	1
Experimental	11	11	.	.	.	.	5	6	.
Scientific Values/Attitudes	11	8	2	.	.	.	8	2	.
Observing	10	10	.	.	.	.	4	6	.
Scientific Methods/Processes	9	9	.	.	.	.	8	1	.
Scientific Knowledge	8	7	.	.	.	.	7	.	.
Discovering	8	8	.	.	.	.	3	5	.
Ways of Knowing	7	5	.	.	.	2	6	1	.
Inquiries, Methods, Investigations	7	7	.	.	.	.	5	2	.
Technology (Uses for Scientific Methods/Processes)	7	6	.	1	.	.	3	4	.
Religious Views	7	1	1	.	.	5	4	2	1
Problem Solving	6	6	.	.	.	.	1	5	.
Historic (Cumulative)	5	5	.	.	.	.	2	3	.
Open to Interpretation	5	2	1	1	.	1	0	4	1
Exploration	5	4	1	.	.	.	2	2	1
Critical Thinking	5	5	.	.	.	.	1	4	.

* Note. In each cell, the upper case(s) are indicated the researchers' agreement about the concepts from student concept maps. A five-point Likert scale system was used: SA = Strongly Agree, A = Agree, NS = Not Sure or ambiguous, D = Disagree and SD = Strongly Disagree.

* Note. In each cell, the lower case "n" indicates that the concept was not developed with attributes.

* Note. In each cell, the lower case "d" indicates that the concept had a well-developed description of attributes.

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Table 5

Levels of Evidence Used in Electronic Journal Entries (N=17)

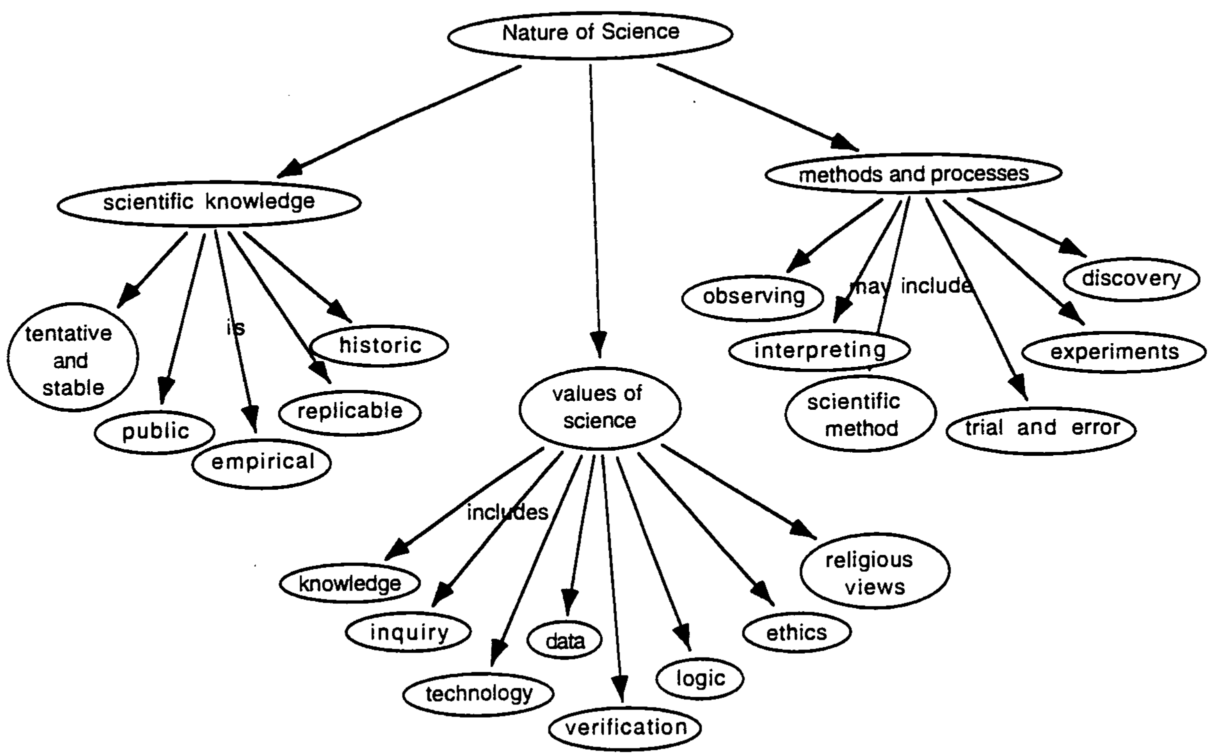
	Categories	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	Frequency
D	Data, Evidence, Research																		
	a use of the actual data	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1
	b explicit reference to the data	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
	c general reference to the data	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
T	Theory																		
	a explicit, specific reference	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
	b general reference	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
R	Reasoned Argument																		
	a postulates, conclusions, formal	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
	b informal	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
A	Authority																		
	a marked attribution to someone with expertise	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	3
	b unmarked attribution to someone with expertise	1	.	.	.	1	.	2	.	.	.	.	.	1	2	.	.	.	7
I	Instructors																		
	a the course instructor	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	b cooperating teacher (field experience)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
	c education instructor	.	.	1	.	1	.	.	.	.	.	.	1	1	.	.	.	.	4
	d science instructor	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
E	Example																		
	a personal anecdote	2	3	.	.	1	.	1	.	1	.	1	4	1	.	1	.	1	16
	b anecdote attributed to individual	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1
	c generally attributed anecdote "as you all have experience..."	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	d illustrative example	2	1	3	2	1	2	.	1	3	2	.	.	2	.	2	.	1	22
P	Peer																		
	a marked attribution to a classmate	.	.	5	3	1	.	1	.	3	1	3	2	.	1	.	1	.	21
	b unmarked attribution to a classmate	1	.	.	.	1	.	.	.	.	1	.	.	.	.	.	.	.	3
	c marked/unmarked attribution to whole class	.	.	1	.	1	.	.	.	.	.	.	1	1	.	2	.	1	7
	d marked/unmarked attribution to other non-authority	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1
	e marked/unmarked attribution to "everyone"	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	2
O	Opinion/Statement																		
	a marked and unqualified assertion "As I said earlier..."	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	3
	b unmarked assertion	5	4	5	4	6	4	4	5	5	4	5	5	5	2	5	1	5	74
	c assertion with a hedge	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0

Table 6

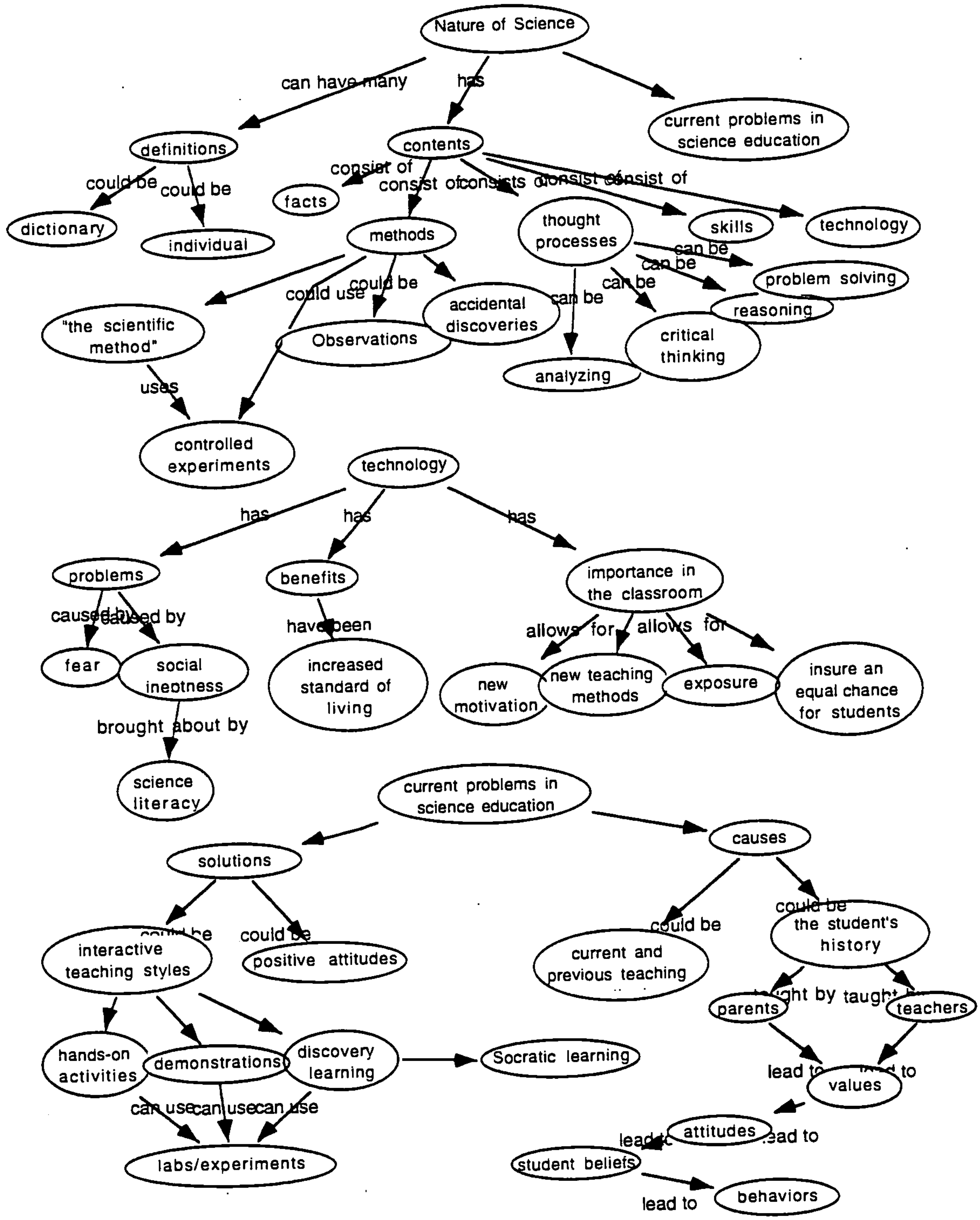
Comparison of Frequencies in Concept Maps and Electronic Journal Entries

	Concept Maps		Electronic Journals	
Rank	Concept	Frequency	Concept	Frequency
1	Science	17	Science	225
2	Tentative, Change	11	Student	90
3	Experimental	11	Teach; Teaching	68
4	Scientific Values/Attitudes	11	Values	53
5	Observing	10	Teacher	48
6	Scientific Methods/Processes	9	Scientist	36
7	Scientific Knowledge	8	Knowledge	30
8	Discovering	8	Learn; Learning	29
9	Ways Of Knowing	7	Lecture	27
10	Inquiries, Methods, Investigations	7	Change	25
11	Technology(Uses For Scientific Methods/Processes)	7	Technology	24
12	Religious Views	7	Understand	24
13	Problem Solving	6	Nature (Of Science)	23
14	Historic(Cumulative)	5	Religion; Religious	21
15	Open To Interpretation	5	Class; Classroom	19
16	Exploration	5	Gender	19
17	Critical Thinking	5	Truth	18
18	Theory	4	Belief; Believe	17
19	Fact	4	Interpret; Interpretation	15
20	Stable; Reliable	4	Different	15
21	Technology	4	Interest; Interesting	15
22	Scientific Method(S)	4	People	15
23	Analyzing	4	World	15
24	Systematic, Methodical	4	Hands-On	14
25	Unbiased	4	Explain; Explanation	13
26	Logic	4	Everything	13
27	Ethics	4	Society	13
28	Society	4	Discover; Discovery	12
29	Natural World	3	Apply	11
30	Explanation	3	High School	11

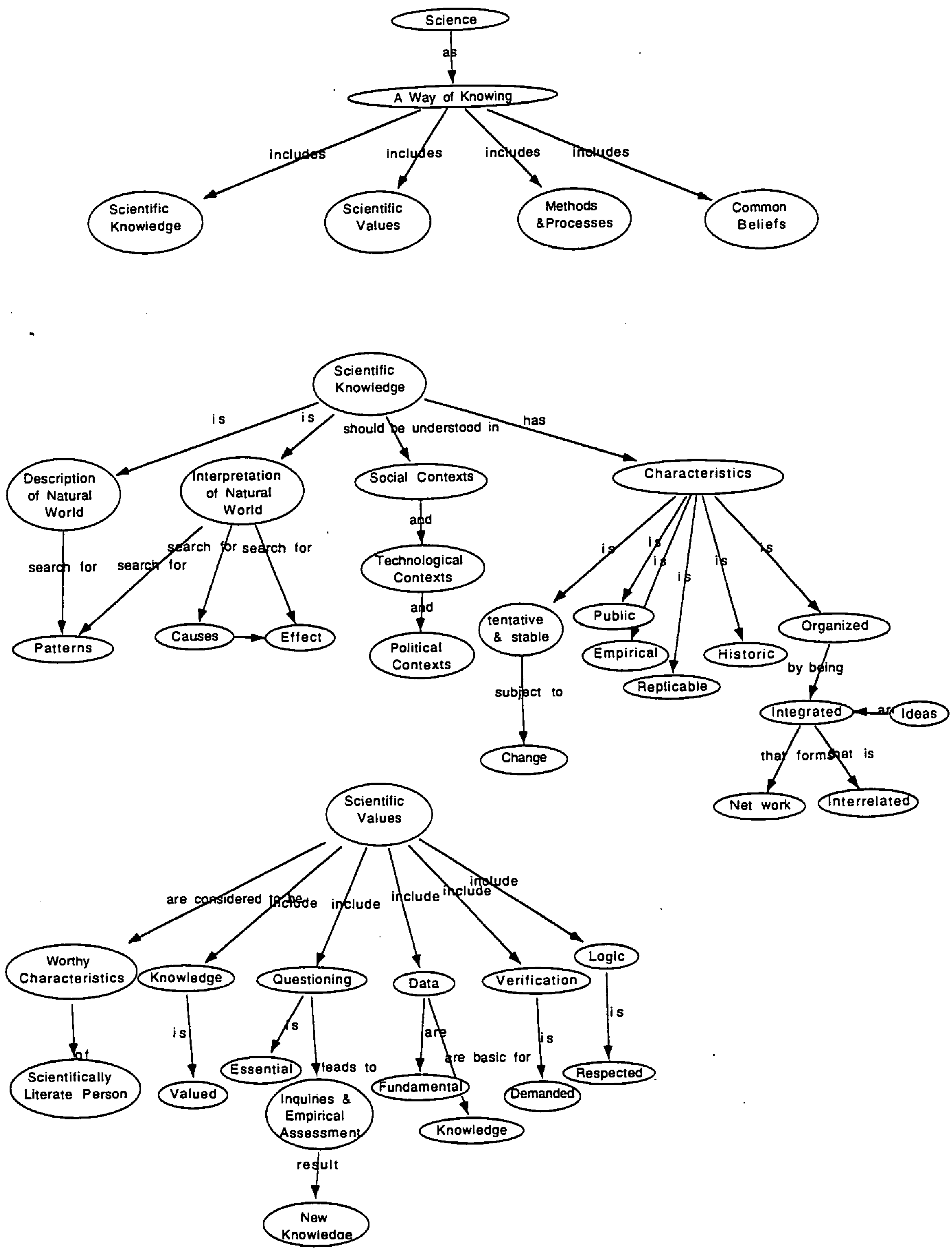
STUDENT CONCEPT MAP EXAMPLE 1



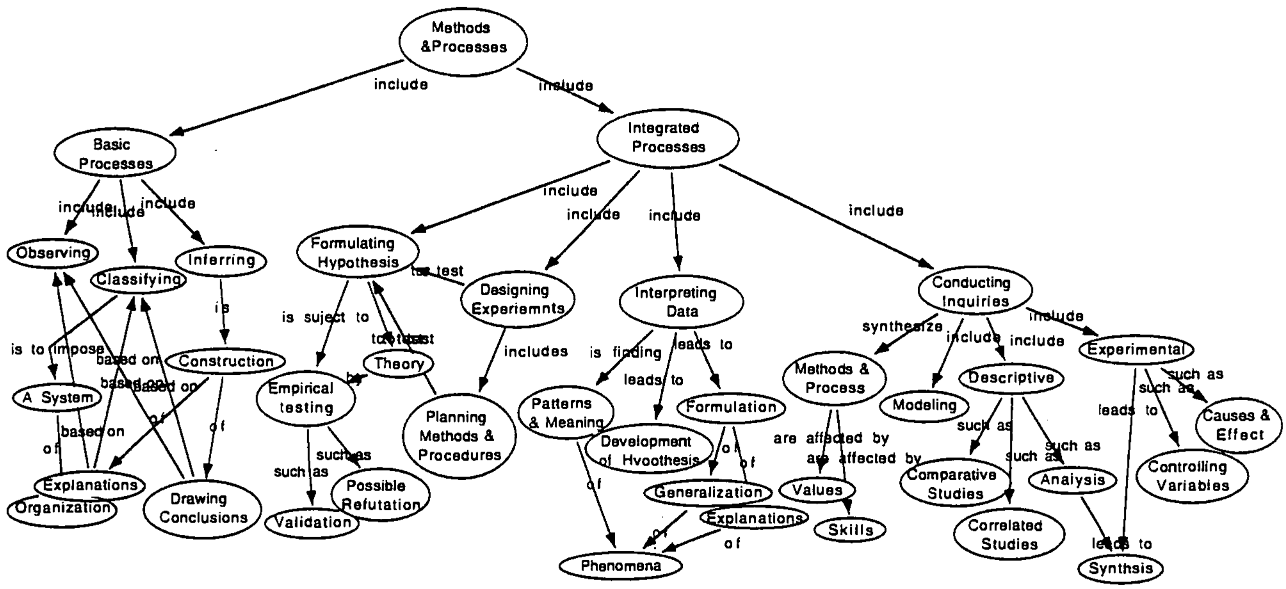
STUDENT CONCEPT MAP EXAMPLE 2

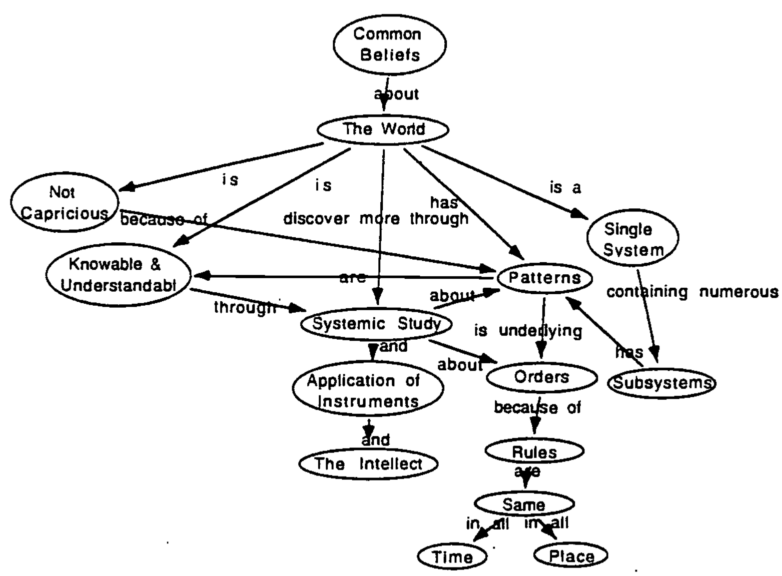


RESEARCHER-CONSTRUCTED MODEL MAP



RESEARCHER-CONSTRUCTED MODEL MAP CONTINUED





REFERENCES

American Association for the Advancement of Science (1989). *Project 2061: Science for all Americans*. Washington, DC: Author.

Ault, R. A. Jr. (1985). Concept mapping as a study strategy in earth science. *Journal of College Science Teaching, 15*(1), 38-44.

Bereiter, C. (1990). Implications of post modernism for science, or, science as progressive discourse. *Educational Psychology, 29*, 3-12.

Brade, K., Krajcik, J., Blumenfeld, P., Soloway, E., & Marx, R. (1995). Project Integration Visualization Tool (PIViT). Regents of the University of Michigan.

Cobern, W.W. (1991). Introducing teachers to the philosophy of science: The card exchange. *Journal of Science Teacher Education, 2*(2), 45-47.

Cliburn, J. W. (1990). Concept maps to promote meaningful learning. *Journal of College Science Teaching, 19*(4), 212-217.

Hazen, R. M., & Trefil, J. (1991). *Science matters*. New York: Doubleday.

Jay, J. A. (1994). *A study of concept mapping in a college-level cell biology course*. Ph. D. dissertation, University of Missouri-Columbia, Columbia.

Kim, Y.S., Germann, P., & Patton, M. (April, 1998). *Preservice secondary science teachers' conceptions of the nature of science: By investigating their concept maps and final reflection paper*. Paper presented at the annual conference of the National Association for Research in Science Teaching, San Diego, CA, April, 1998.

Lederman, N. G. (1992). Students' and teachers' conceptions of the nature of science: A review of the research. *Journal of Research in Science Teaching, 29*, 331-360.

Lederman, N. G., & Zeidler, D. L. (1987). Science teachers' conceptions of the nature of science: Development, use, and sources of change. *Science Education, 74*(2), 225-239.

Novak, J. D. (1981). Applying learning psychology and philosophy of science to biology teaching. *American Biology Teacher, 43*(1), 12-20.

Novak, J. D., & Gowin, D. B. (1984). *Learning how to learn.* New York: Cambridge University Press

Novak, J. D., Gowin, D. B., & Johansen, G. T. (1983). The use of concept mapping and knowledge Vee mapping with junior high school science students. *Science Education, 67*(5), 625-645.

Prawat, R.S., & Floden, R.E. (1994). Philosophical perspectives on constructivist views of learning. *Educational Psychology, 29*, 37-48.

Rutherford, F. J., & Ahlgren, A. (1990). *Science for All Americans.* New York, NY: Oxford University Press.

Stweart, J. (1978). The effects of instructional organization and selected individual difference variables and the meaningful learning high school biology students. *Dissertation Abstracts International, 42*, 1088-A.

Trowbridge, L. W., & Bybee, R. W. (1990). *Becoming a secondary school science teacher (5th Ed.)* Ohio: Merrill Publishing Company.

Wallace, J. D., & Mintzes, J. J. (1990). The concept map as a research tool: exploring conceptual change in biology. *Journal of Research in Science Teaching, 27*(10), 1033-1052.

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