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Paper Title: **Enhancing Teacher's Understanding of Student's Science Concepts: The Results from "Misconception" Research on in Service and Preservice Techer Education**
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Abstract: The new Costa Rican science program, with its emphasis on local evironmental content may create additoinal problems for experienced and novice elementary school science student teachers who work hard designing and implementing science lessons that engage their students and teach accurate science concepts. This is especially true for those elementary school student teachers who have a limited knowledge of science. While sdditional study in the sciences is helpful, it is virtually impossible to prepare a general elementary school student teacher for all the science topics they will encounter in Costa Ricas's new elementary school science program.

Three current educational ideas form the foudation of this study: 1.- cognitive research; 2.- research on change and implementing innovations; 3.- and research on student teacher education.

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Enhancing Teacher's Understanding of Student's Science Concepts.

The Results from "Misconception" Research on in Service and Preservice Techer Education.

Paper presented at the Third International Seminar
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The new Costa Rican science program, with its emphasis on local evironmental content may create additoinal problems for experienced and novice elementary school science student teachers who work hard designing and implementing science lessons that engage their students and teach accurate science concepts. This is especially true for those elementary school student teachers who have a limited knowledge of science. While sddditional study in the sciences is helpful, it is virtually impossible to prepare a general elementary school student teacher for all the science topics they will encounter in Costa Ricas's new elementary school science program.

Three current educational ideas form the foudation of this study: 1.- cognitive research; 2.- research on change and implementing innovations; 3.- and research on student teacher education.

COGNITVE RESEARCH.

Cognitive research is revealing that even with what is taken to be good instruction, many students, including acdemically talented ones, understand less

than we think they do, (Rutherford and Ahlgren, 1990, page 185). Examples of cognitve research into children's science concepts and their use for curriculum and instruction has been described by Osborne and Freyberg, (1987) provides extensive examples of work into children's science and mathematics concepts from all over the world.

INERT KNOWLEDGE.

Inert knowledge is knowledge that can usually be recalled when people are explicitly asked to do so but is not used spontaneously in problem solving even though it is relevant.

Piaget (1938) was one of the first to try and elicit children's actual beliefs, what Whitehed might call active knowledge. Piaget's work has been followed and developed by many including Ausubel (1968) and Novak (1990) who expanded the idea that all instruction must start with what the child already know. Recent work has concentrated on children's actual science concepts, not necessarily those used exclusively in school. It is the interaction between school science, children's sciencie and "science" that will help us move school from presenting inert knowledge to active knowledge (Cohen and Ault, 1989; Gilbert and Watts, 1983).

"...reform cannot be imposed on student teachers from the top down or the outside in. If student teachers are not convinced of the merit of proposed changes, they are unlikely to implement them energetically. If they do not understand fully what is called for or have not been sufficiently well prepared to introduce new content and ways of teaching, reform meassures will flounder," and " although creative ideas for reforming education come from meny suources, only student teachers can provide the insight that emerges from intensive, direct experience in the classroom itself,"(Rutherford and Anlgren, 1990, page 185).

RESEARCH ON STUDENT TEACHER EDUCATION.

This project explored how student teachers can learn to design more relevant instruction, to engage students in more appropriate science instruction, and to improve student teacher's understanding of science. Experienced and novice science teachers have a different time designing and implementing science lessons that engage their students and teach accurate science concpets in a manner that is consistent with the nature of scientific thinking (Brickhouse, 1991; Cronnin-Jones, 1991; Dieman-Nenser and Parker, 1991, Hand and Tregust,1991, Kagan and Tippins, 1991).

This is especially true for elementary school student teachers who generally have a limited knowledge of science. While additional study in the science is helpful, it is virtually impossible to prepare a general elementary school student teacher for all the science topics they will encounter in elementary school programs. For the high school student teacher, with a stronger background in science, the problem is one of maintaining a current view of science content and thought. As with the elementary school student teacher, high school student teachers also need help in actively engaging their stuents.

THE RESEARCH PROJECT AND THE THREE EDUCATIONAL TRADITIONS.

This research project is based upon three educational traditions. The first is that instruction must start with what the child already knows (Ausubel, 1968; Novak and others, 1990) . The second is research on children's concepts on the individual interview techniques of Piaget and recently adapted by others for curriculum development and instruction in science (Piaget, 1938; Osborne and Freyberg, 1985). The third is the study of student teacher's abilities to understand their planning and teaching (Brickhouse, 1991; Cronin-Jones, 1991: Dieman-Nemser and Parker, 1991; Hand and Tregust, 1991; Kagan and Tippins, 1991).

THE INDIVIDUAL INTERVIEWS.

Individual interviews are used as part of many student teachers training programs. Cohen (1970) has used these interviews as part of his science methods course for undergraduates and for student teachers since 1968, and Calvo (1993) has used these interview also as part of his science methods and content course. The techniques are built on the early work of Piaget and the methods are relatively easy to learn. The difficulty for student teachers is usually in conducting the interviews to find out what the children think without trying to teach the children.

OBJECTIVES.

GENERAL OBJECTIVE.

The main goal or objective of this research will be to evaluate the effect of interview studies on Costa Rica student teachers' concepts of teaching, curriculum development, how children learn and sciences.

SPECIFIC OBJECTIVES.

1.- Develop interview techniques for student teachers. Working with the participating student teachers, the research team will develop interviews appropiate for Costa Rican students;

2.- Evaluating the effects of the interview studies on the student teachers. Working with the participating student teachers, the research team will develop an instrument to measure the type and amount of change caused by the interview process and the research project;

3.- The student teachers will conduct pilot interviews, report their findings and changes in their teaching;

4.- Carry out interview studies with their students;

5.- Individually, the student teachers will report on the content of their interviews, and describe how the interview process and the results of the interviews have changed their concepts of teaching, curriculum development, and how cildren learn science.

6.- They will complete the instrument developed for this project, that measures change;

7.- A follow-up seminar for the research team and the student teachers to report and compare findings, to discuss areas of concern, to evaluate the project and to discuss additional research and follow-up project;

8.- The research team will conduct an analysis of the interview data and the effect of the interview on the student teachers. The team will then write the final report, submit it for presentation at professional meetings and for submission to research journals.

PROCESS FOR THE METHODOLOGY.

Population: the research into children's concepts will be carried out with elementary school children. The student teachers involved are students of the two semester courses in Science Methods and Science Content, 1991-1993, at the Escuela de Formación Docente (School for Student Teachers) Universidad de Costa Rica.

For rain and enach of the others topics, the student teachers involved in the research interview at least six of their own students. They can always interview more, and often the children in a class request an interview. The children want to trested like those being interviewed.

FINDING.

The principal finding is related to the new methodology and its implementation at the level of the students at the College, Escuela de Formación Docente at the Universidad de Costa Rica. We find that it is better: 1.- to beguin with an assignment of lecture of a content; 2.- after wards the students interview each other in class. The cours professor give to one of the students one question; the student give the question to the other student, and the first student hase to write all the answers. 3.- starting from the answers, the student who is making the interview obteing new questions, and "so on" new answers and more

questions. At the end a "tree" of questions and answers is formed. 4.- Next is the interchanging of students, to continue with the process described in 1, 2 and 3.

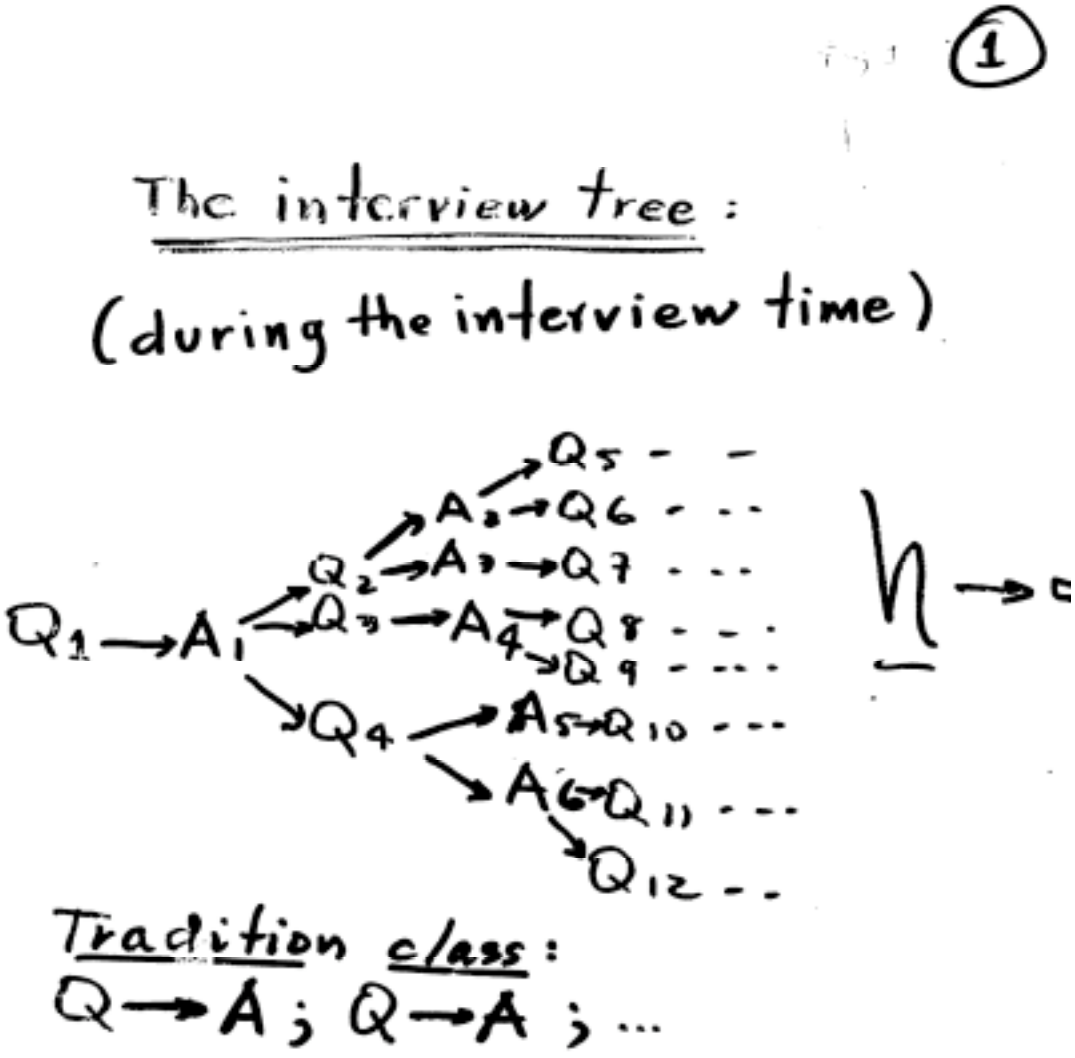

Figure 1. The Interview Tree

The second important finding is using the conceptual maps, we can target the exact misconception, and we can make the exact process to change the misconception into the correct learning. The best way is the inquiry thought. Is the orientation of the student to find the answer using text book, or another

material.

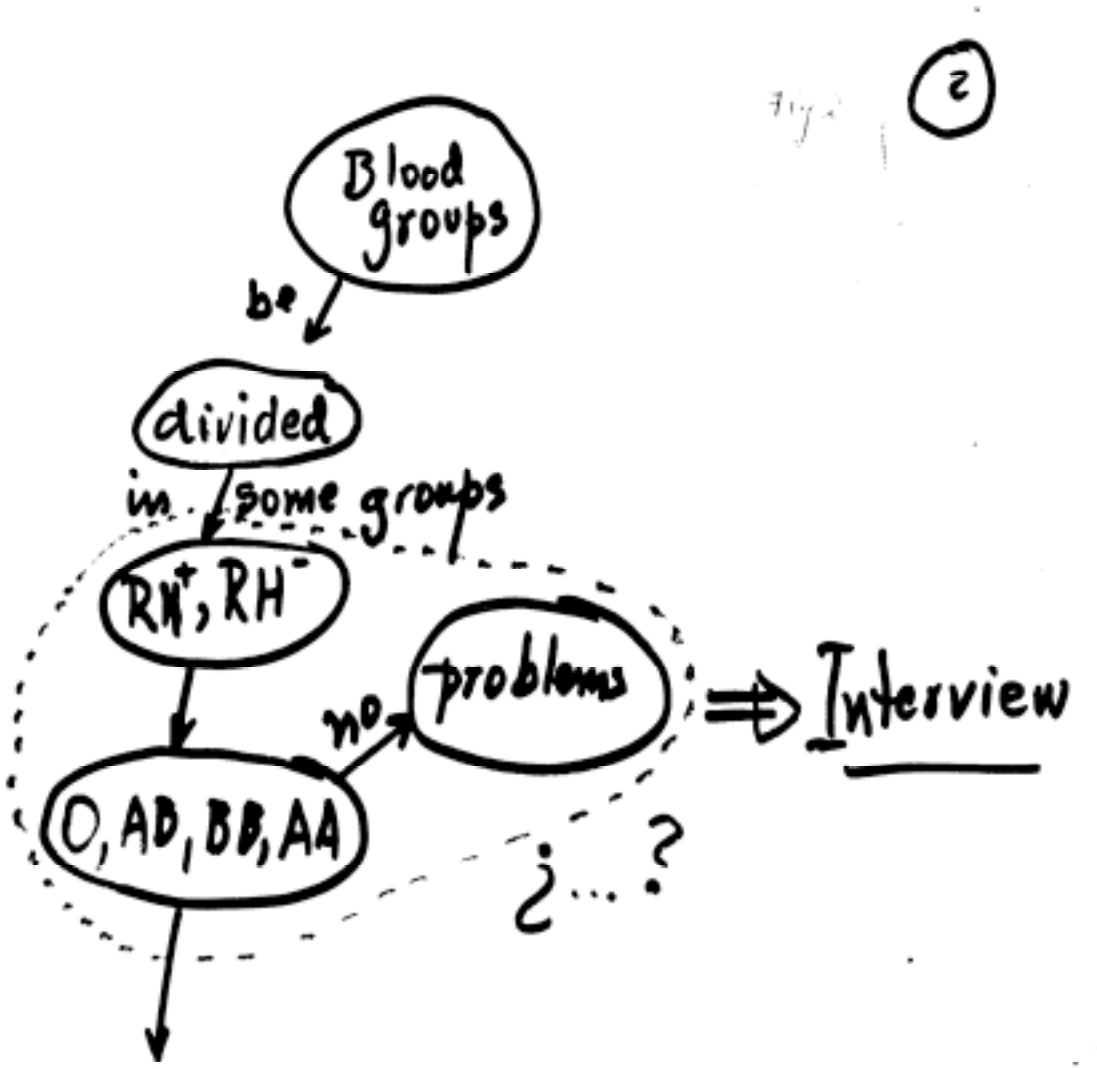

Figure 2. A Concept Map of Blood Groups.

The third important finding is when the interview is produced, the student teacher can understand when and the structure of the knowledge in the thought of the student, through the meaning of the words, and the explanation that is given by the student to the meaning that the student teacher has of the same word or concept, and the same science concept when he is "drawing" the concept

map. When the time to begin the change of the attitude of both the student and the student teacher.

The fourth important finding is the belief of student teachers when they stand up to reality, "their are in front of the most spectacular frigth", and the excuse always is the influence of the state curriculum, or the text curriculum, or the hidde curriculum, and the influence of parents, etc..

Related with the fright of meaning of the learning process, is the opinion of the student teacher after the interview, the panic, the amazment of their own learning-less knowledge about the science content, after the finish of the secondary school education period.

The "break" of the student teachers' beliefs produces great amazment because they are working with children under different realities and situations that will produce different thoughts and different meanings of their own life.

In our work we find in the activity "Why is raining?" with children, real amazing meanings of the facts, always that Costa Rica have a rainy season of 12 months at the north and to the east of the contry, and 9 months at the northwest; central and southern regions. Forty-six percent of the interviews answered because the clouds absorbe the water, and after it is well soaked, it rain. The seven percent of the beliefs is because when two clauds are well soaked, they shock and it rains. Ten percent of the interview beliefs are that it rains because of the hydrolic cycle. Thirty-five percent of the beliefs are thet rain is becaused by evaporation and condensation of the water during the hydrologic cycle;

An important datum; of 144 student teachers, only three believs that rain is becaused by "gravity".

DISCUSSION.

It important to highlight a few general concepts about teaching and learning. In relation to cognitive research it reveals that even with what is taken to be good instruction, depending on the meaning of teaching that every teacher have their own. In our work we have many students, academically talented ones, who

understand less than we think they do, (Rutherford and Ahlgren, 1990, page 185) in relation with those activitis. The ninty percent of the teachers in our work, believe that the cognitive development is the lecture of the content, solely when it take place it's possible the cognitive research.

This work shows the possibility of using the interview technique to development the qualitative research, like an instrument very important to understand why there are misconceptions in the thought of the students when they are in the learning science process.

Inert knowledge is knowledge that can usually be recalled
when people are explicitly asked to do so but is not used spontaneously in problem solving even though it is relevant. When the student teachers interview the children, the inert knowlege
passes to active knowledge, when they work with the conceptual maps and the inner analyses, and understanding the nature of the learning process and knowledge construction.

Through research on change and implementing innovations, it is possible when the same "target teacher" is to be able to understand and to know how and when is taking the process of learning and the process of construction of the knowledge. When it is usful one technique like the interview to beliefs in the meaning of the teaching science process is real, not like a prescription because the same teacher is convinced by ther self, the teacher begin to accept the research on change and possibly to implement innovations. In Costa Rica actually we have the innovations in the new programs for Science in the Curriculum of Elementary and Secondary School, and it is broken because the process of implementation perhaps never take care of the teachers who are the principal actors and actresses of the eternal tale of the education, and only a few "teknitians" who were the team which prepared the curriculum. And the annoyance of the education in development coantries are the polititians and the politics.

The research on student teacher education is really "terrific". After they participated the process of the research they enjoyed process and they began to inquieere about their own process, they are share, what they can do, not because

the professor told them, but because of their own process of discovery and they offer themselves the rich solutions, and "emerging concepts" (Cohen, 1992). Another important aspect would be to look at those concepts that help students learn when they discover which are and where they are.

One possibility is the call for a cross-cultural research (Cohen, !992) on student teacher education, not to be an international curriculum. The more we begin to compare methodologies and techniques to discover how the different populations or communities can learn and structure knowledge, through the teaching process and the inquiry thought, "we believe conversations and interviews with children and teachers about what they are learning have a major place in teacher education programs and future curriculum development plans" (Cohen, 1992).

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