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4. Stick diagram of diamond

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RESEARCH AND RESEARCHERS IN SCIENCE EDUCATION

There are important topics and issues concerning research in science education. It is known that an appropriate level of research improves methods and tools of the teaching and learning process. There are however, different opinions and some confusion in using the concept of "research" in educational practice in different countries.

It is possible to find various publications where the theme of teachers and students as researchers is discussed (Goodwin, 2005). The usual way in which research in science education is undertaken is when the "normal researcher" (the University teacher, researcher from the Institute or laboratory etc.) is responsible for the investigation. Of course, most university science teachers focus their research on science rather than on science education. The same situation exists in the secondary (high) school where teachers generally are not expected to undertake educational research. There are many examples of school teachers presenting very interesting results about their educational experiences and these publications can have the same interest and value as a conventional educational research. Also, some of school teacher take part in "normal" research work together with their university colleagues.

It seems clear that one way of enhancing the quality of teaching and of students' learning is the policy of increasing the number of teachers taking part in research in science education both at university and at school levels. This way increases the amount of information about issues in science education and the effectiveness of active methods of teaching and learning. Even more importantly it engages the teachers' critical interest in their curriculum. Of course these results must be valued and used actively by corresponding systems of preparation of pre-service teachers and by the system set up for the continuing professional development of in-service teachers. We wrote earlier that this last system unfortunately does not exist in many countries (Orlik 2004).

One further problem exists with using the concept "research" in universities in some countries. When educational authorities classify the research work for students into different types such as "formative", "inductive" and "other investigations", it is important to realise that all these activities are only the initial and preliminary stages and really are not true 'research'. The other aspect of this issue is the student-teachers as researchers. It is usual for all kinds of preliminary and normal investigational activities to be done by students in pre-service science teacher programs on the bachelor and post-graduate level of university education. These are very important for developing specialists of good quality. However, there are also situations in secondary (high) schools in some countries when students can engage in science research. This depends on the existence of joint projects between school and universities or research institutes. Some members of Societies of Young Researchers can take part in laboratory experimental work, research seminars and be participants of corresponding scientific projects and publications (Orlik 2002, Parra, Reguero, 2000). There are examples of such activities in Russia, Belarus, when young students published their results from small scale, but real investigations (Young Researcher, 1992). Some scientific societies, such as ACS, Hungarian Society of Chemistry also have considerable experience in this direction (Watson, Wood-Robinson, 1998). These activities may be linked with Science Olympiads at national and international levels. Gold medal-winners demonstrate adequate levels of knowledge and ability for science research work and for this reason they often gain corresponding scholarships for further university studies. This is why the other levels of Science Olympiads – school, city, regional levels - are so important, because two main and very important objectives are fulfilled: (a) the popularization of science in relatively big groups of students and (b) identifying young talent for research work.

There are particular problems in using the word "research" in Latin American countries in the secondary (high) school context. Sometimes this word is used there in a colloquial and incorrect manner. Almost any educational activity of pupils is "an investigation" or "research". For example, it is possible to hear teachers say "You must research this topic (the name of topic follows) in the library" or "You should investigate this chemical reaction in your home experiment" and so on. In spite of existence some language norms that formally permit using this kind of expressions it is necessary to avoid them in the teaching practice from the scientific point of view, because this situation produces not only confusions but the incorrect use and understanding of the nature of science in students and in student's families. The school science teacher is and must be the representative of Science and he/she is responsible for correct use of science concepts and terminology and this responsibility is very high. The best alternative to the use of the word 'research' is "preliminary or initial investigational activities".

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