INQUIRY BASED LEARNING OF NEW RESEARCH FINDINGS IN SCIENCE AND IDENTIFICATION OF GIFTED STUDENTS

Mojca Čepič
University of Ljubljana, Faculty of Education, Ljubljana, Slovenia

The paper theoretically considers a possibility to use contemporary research findings in science introduced into the science classroom using inquiry based learning approach, for identification of gifted students. Giftedness in science is not yet considered as a specific talent, science teachers and educators are aware of actions typical for gifted students. Those are: good recognition of patterns in a given data, drawing conclusions, forming explanations, testing explanations and a proper choice of evidence for confirmation or rejection of tentative explanations.

Although several instruments for identification of gifted are well known and are widely used, evidences provided by those instruments are very often affected by students’ social and intellectual background. Students with lesser intellectual skills like literacy and math, which are in deprivileged social circumstances more often, do not excel in those tests even if they are gifted. New, contemporary scientific research topics in education provide a milieu, in which students’ preliminary knowledge and experience is equalized, that is, very low or even non-existent. In such circumstances students from deprivileged background are equal to their more privileged peers and may excel.

The paper gives a short overview of identification of giftedness and discusses its effectiveness with respect to the student’s background, explains the idea of using new research topics taught by inquiry based learning approach and provides an example related to screen and printer colours.

Keywords: Science Education, Inquiry-oriented learning, Equity

INTRODUCTION

Although research has shown that giftedness or higher abilities are not hereditary, nevertheless is the share of identified gifted students from social and intellectual privileged families much larger than from families with a deprivileged background (Ford 1998). As the students are identified through various channels, reasons for that vary (Kornmann 2015). Every gifted individual that remains unidentified can be regarded as lost capital for the modern society of knowledge, and therefore the identification is extremely important.

Inquiry based learning is a relatively new approach in science education (McDermot 2000, Harlen 2009) that is derived from the scientific method. When approaching new problems, students acquire new knowledge in a similar way as scientists: they observe phenomena, measure various quantities, find patterns in acquired data, form tentative explanations and construct experiments for their verification. Based on evidence of proposed experiments, they either confirm the validity of explanation or they reject it and search for new ones. Inquiry based learning is an approach, where gifted students are able to excel (Eysink 2015). Because inquiry based learning does not require specific intellectual skills such as reading or mathematical skills, it is suitable for students from all social groups, including deprivileged ones.

Giftedness in science is only one manifestation of general giftedness of an individual; however, it is expressed and can thus be recognised under specific conditions. Carefully designed experimental activities for inquiry based learning of science followed by a relevant protocol, could allow for identification of gifted students, even those, who might have remained unidentified by other instruments of identification.

In this contribution we discuss a theoretical framework for identification of gifted through inquiry based
learning of new research topics in physics. New research topics are characteristic in absence of preliminary knowledge. Students from different social backgrounds have an equal, almost non-existent preliminary experience and knowledge (Pavlin 2013). Because initial conditions are thus independent of students' background, teachers may rely on actions of students that are related to acquiring entirely new knowledge.

NEW TOPICS IN SCIENCE EDUCATION AND GIFTEDNESS

Gifted students or individuals have been identified already for centuries. Systematic identifications and development of approaches for their promotion, however, is discussed more extensively only in the last few decades. Giftedness is not defined unequivocally (Gardner 2006). Even the research community focusing on giftedness and other related phenomena has not yet reach an agreement on basic definitions of giftedness and even the question whether giftedness is innate or not and how it could be reproducibly measured is still discussed (Ericsson 2007). One of the most problematic issues is the lack of researchers' objectivity. In this regard, one might highlight the unclear differentiation between giftedness and skills that may in certain circumstances mimic giftedness; uncertain equivalence of identification of the same individual as gifted by different means and different assessors; inconsistency in changing criteria of giftedness through time; the role of deliberate practicing and so on.

Inquiry based learning of new topics in science establishes circumstances that are not influenced by preliminary experience. Students meet new phenomena, they observe them, measure some quantities they find important and are asked to discover patterns in the measured data. They form possible explanations and test them with purposely designed experiments. From experimental results students conclude if the tentative explanation survived the test and is possible as an explanation or it should be rejected. The whole process systematically establishes the circumstances researchers are faced with while investigating the unknown phenomena. Students' approaches in inquiry based learning that recreates such circumstances can thus be used for identification of giftedness, regardless of students' personal, social, intellectual and economic background.

A SIMPLE EXAMPLE OF UNIT: ADDITIVE COLOUR MIXING

Here we present example of an active, relatively simple inquiry based learning unit on liquid crystals display colours, which may be used for initial tentative identification of gifted.

The detailed explanation of the liquid crystal display function is presented in Chapter 3 (Čepič, 2014), here the structure is only briefly discussed. Each pixel usually consists of three units\(^1\): the red, the green and the blue. The screen consists of pixels with three units with emitting red, green or blue light with controllable intensity. The brightness of each colour is defined by a number between 0 (dark) and 255 (completely transparent, bright). By changing this number, the brightness of considered part of the pixel (red, green or blue) changes and the colour that appears on the screen changes as well. The colour on the screen is defined by three principal numbers from 0 to 255.

The activity aims for students to learn that three elementary colours of different brightness form any colour on the screen, recognize rules of additive colour mixing and are able to predict the colour from the palette numbers. The activity was tested by students in the last years of study at the university, by in-service teachers and at the workshop with gifted students during the ICIE event (Čepič, 2016).

The unit consists of four activities in which students
Activity 1: Learn to use a digital microscope (learn skills).

\(^1\) Pixels in more recent displays often have more units than three. Additional white unit of the pixel is added for increased brightness. Such displays can still be used for the activity.
Activity 2: Observe colours on the screen using a digital microscope (gaining experience with structures of colours, colour math rules).

Activity 3: Relate colours to numerical values (forming association of numbers with colours, deduction, prediction)

Activity 4: Recognize magnified parts of the original screen picture (relate “macro” and “micro” colour).

Each activity allows for several indications for possible giftedness of the student. In addition, activities do require good observation, inference and forming prediction ability, but extensive reading of instructions is not needed.

CONCLUSIONS

The paper discusses problems related to identification of gifted students and is focused on detection of students from deprivileged background. The consideration of modern research topics in education for identification of giftedness is discussed theoretically. In modern scientific topics, especially if they are taught by inquiry based learning approach, students are equal with respect to preliminary knowledge and experience, and the lack of “intellectual skills” like literacy does not obscure actions of students as regular schoolwork at standard topics. Therefore, students with the lack of intellectual skills typical for students with deprivileged background, may express themselves and excel in activities. An observant teacher can focus her/his attention on students’ actions, questions and suggestions indicated for each activity. An example of inquiry based learning unit with the emphasis on activities that can be used for identification of the gifted is briefly presented.

ACKNOWLEDGEMENT

The financial support of ARRS is acknowledged.

REFERENCES


