Identification of gifted students with underprivileged background by doing experiments

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Abstract

A new approach for identification of the gifted coming from underprivileged background having weaker reading, writing, math and artistic skills. An example of the activity on screen colours incorporated into the regular classroom setting that provides hints on abilities of such students as well as the others. The methodology for developing such units is briefly discussed.

Introduction

Students that come from underprivileged social or intellectual home background, very often do not read and write well, have a weak vocabulary, and are weak in math and drawing. This is a natural consequence of home environment, where reading is not common, everyday communication uses a very limited vocabulary, and school chores are not valued. The set of skills, that is, reading, writing, elementary math and drawing/sketching, we call intellectual skills, because they are crucial for acquiring the new knowledge and an implementation of this knowledge in new circumstances in regular classroom settings (Borland, 1994; 2004).

However, as it is well known that talents are not limited to students with good and supportive circumstances at home, it is also well known that talents of such students are identified earlier, are supported in development of talents and, in general, achieve more during the lifetime (Subotnik 2012; Freeman 2013). Even widely used tests for identification of the gifts and talents yield lower results for students with weak intellectual skills (Borland, 1994, 2004). Therefore, even students that are gifted, cannot express their giftedness because they are hindered or even destimulated by the effort needed for understand the tasks (Endelpohls-Ulpe, 2005; Kornman, 2015).

In this contribution we present a new approach for identification of the gifted, adapted to students with “quick” brain but with weak intellectual skills. The approach is based on identification of characteristics of giftedness, which are well expressed in science such as recognition of patterns, predicting consequences of newly observed phenomena in new circumstances, and drawing conclusions based on evidences. Those characteristic are identified through accompaniment of students during special activities and their answers on purposely designed questions. Activities are developed for introduction of new scientific results, because they are mostly unknown and students from privileged and underprivileged background have the same preliminary, actually non-existent knowledge on the topic.

The paper is organised as follows. After the Introduction, a unit on colours is presented to provide the reader the experience with the implementation of the new approach. Next, the implementation of such unit for a teacher, a few other potentially interesting topics and a methodology for development of such units is discussed. The value of a new approach for identification is discussed in Conclusions.

An example of a unit: Screen colours

The first unit we developed considers the construction of colours on a computer screen and it could be extended to colours of printers. To present the idea of the approach, we discuss the first part, the screen colours only.

The material, that is needed for the unit are computers with installed digital microscopes, and tablets or computer screens with the elementary structure of pixels. The structure of pixels has to be verified in advance. The pixel has to consist of three colours only. Some modern screens have an additional white element in the pixel. If so, the mode that switches off the white element of the pixel has to be used. If such mode does not exist, an alternative such as a tablet or even a mobile phone screen could be used. The unit could be implemented with a single computer screen for observation of the magnified parts of the same screen, but it requires a little more effort. The teacher prepares two images, like the one in Fig.1, which contains several different colours on the screen, the best is if the photo includes the rainbow, and the colour Table, Fig.2. The colour Table includes in the first row pure colours given by numbers in red, green and blue components. For example, red should be expressed in RGB as (255,0,0), and similarly green and blue. The next row presents colours with two pure components yellow, cyan and magenta, magenta in RB for example is (255,0,255). The final row gives grey, orange and brown. The choice of colours beside the grey is optional, however, the last two colours have to include RGB components in different intensities. We found orange and brown very instructive, as one is present in the rainbow and the other is not a part of it, but they differ in intensity of components only.

Figure 1. A photo containing the whole spectrum in the rainbow and a variety of other colours. Courtesy Ana Gostinčar Blagotinšek.

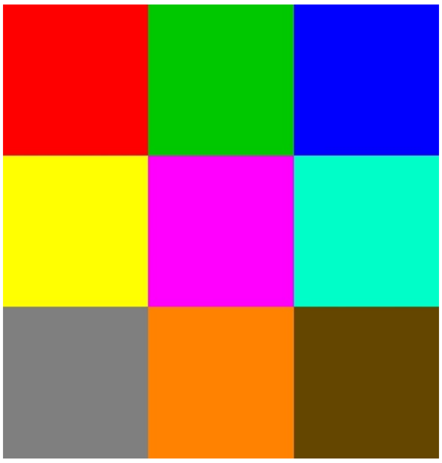


Figure 2. The table of colours. First row – one component colours. Second row – two component colours. Third row – general colours.

Tablets do not have a direct numerical determination of the background colours, but several free Apps exist that allow for it, for example ColorAppLite available for iPads and iPhones.

Next, one needs a print of the printscreen in Fig. 3 (a) without marked positions or a similar printscreen containing one and two component colours, and a colourfull background. One also needs a corresponding set of magnifications of parts of the screen, Fig. 3(b-f). The printscreen available in printed version should not be available on computers used by students. The worksheet for accompaniment of the activity that includes the printscreen is available in Appendix.

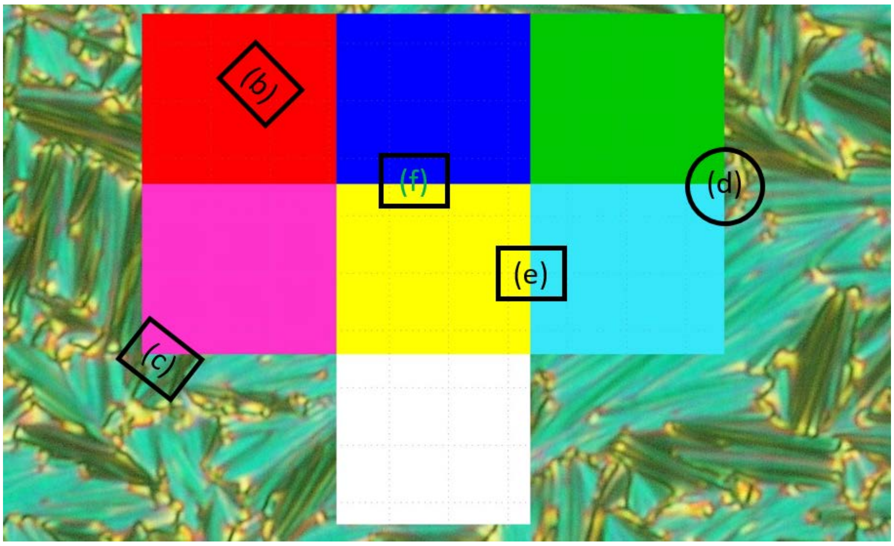
The teacher should provide also a few interesting examples of coloured objects, like LEGO bricks of different colours and pieces of coloured paper.

The activity has the following steps.

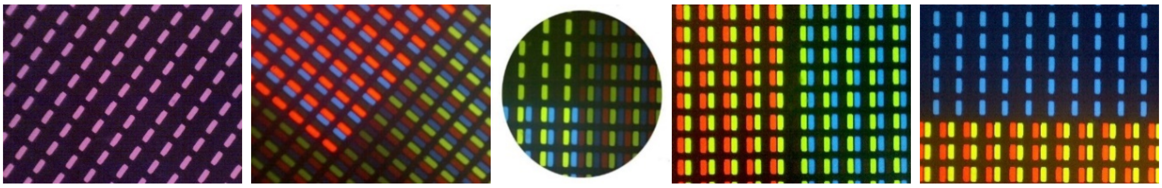
a) Getting acquainted with the microscope

Students are instructed how to use the microscope and are asked to observe the objects provided and other objects by their choice. They are asked to find two magnifications, where the image on the screen is clear, the smaller and the larger.

Teacher observes the students and notifies observed objects. This part of the activity is not yet crucial for identification, but it is interesting to observe, which objects students find interesting enough to observe.



(a)



(a) (b) (c) (d) (e)

Figure 3. (a) The printscreen with marked positions of magnifications (b-f).

b) Observing the magnification of the screen.

Students are provided by the image like the one in Fig. 1 on another computer or on the tablet. They observe magnified parts of the screen by a digital microscope. Students use the larger magnification. If they do not apply it by themselves, they are stimulated to find a larger magnification by the teacher.

At this point teacher accompanies the accuracy of observation, however she does not stimulate drawing conclusions on observations at this point. Students that are good observers find the following

- All colours on the screen consist of three colours only, the red, the green and the blue.
- Various colours on the screen are achieved by variation of the intensity of components.

- In addition, rotating the microscope along the long axis rotates the image on the screen.

c) The rules of forming colours

In the next step students get the Table of colours and are asked to mark the components for each colour in the Table in give the semi-quantitative measure of components' intensity (low, medium, high). Students should recognize that red, green and blue are one-component colours, yellow, cyan and magenta are two components colours and the white around the table has all three components equally bright. The grey shows that the intensity of components is lower, but the same as for white. The role of other two colours was already discussed.

At this point, students are asked to answer two questions, which give hints on student's potentials.

How to change the intensity of colours in the pixel to achieve the pink from the red?

How to change the intensity of colours in the pixel to achieve the dark red?

As students' experiences are mainly based on painting during art lectures, they usually know that adding several colours together ends in something dark, which is typical for subtractive mixing of colours. However, in additive colour mixing applied in screens it is exactly the opposite. Adding the green and the blue to the red makes it pink, and simply lowering the intensity of red, makes the red dark.

If a student is able to make these predictions based on the limited experience she/he obtained during the two activities (b and c), the teacher might consider observing student's regular work more closely.

d) Magnified parts

Students receive the printed image of the screen as given in Fig. 3a, without marked areas, of course. They are told they should consider this image as if it is on the screen. The teacher first shows the students Fig. 3b as an illustration of the magnified red square on the screen. Next, they are asked to find, which part of the picture is magnified in Fig. 3c. The most focused and able students identify the position and the orientation. If there is no answer after a few minutes, students get Fig. 3d. Fig. 3d has a circular frame to emphasize that one should consider an orientation as well. If also this is not successfully solved, students get every few minutes an additional picture of magnified parts, Fig. 3e and f. Usually students solve easier examples and then they can identify more complicated examples. The ablest students identify the most complicated magnification Fig. 3c at the very beginning, and this identification could be considered as a hint for a student's ability.

Students usually like the activity, so the teacher can prepare more magnifications for quicker students.

Sometimes students try to verify the magnification of the red square part shown by the teacher using a microscope on the print and they are surprised that the magnification is not the same. This could be used as a motivation for further activities with the printer colours, which are not discussed here.

Units for identification of able students with weak intellectual skills

The activity presented in the previous section is appropriate for any student and can be used when teaching about additive colour mixing. However, the activity, as it is formed, does not require any preliminary knowledge. The additive colour mixing and how it is implemented in screens is explained in several sources, but nevertheless students usually do not have preliminary knowledge on it. According to our experience, in spite of implementing the activity with a few hundreds of students, we met less than ten that have already seen the magnification of the screen, but also them have not been able to explore the magnifications personally before the activity. Therefore, we believe that the topic is new for any student and students with privileged and students with underprivileged circumstances have the same starting point. None of them got the preliminary information.

Next, almost no reading, no complex writing, no calculation and similar is required during the activity. Therefore, also with this respect, a student with underprivileged circumstances, who is often weak in reading and math, has the same starting point as his more privileged peers that receive additional information through informal channels as well. Finally, we are left with testing the ability of quick digestion of new information and making almost instant prediction using the new knowledge. To test this, such activity is accompanied by a few, two to four questions, called identification questions. The questions are constructed with the aim of testing the application of a newly absorbed knowledge in a simple, and verifiable, predictions. For example, a prediction that adding the blue and the green of the same intensity to the red, will make the red pink, is very easy to verify. The answers to these identification questions are also a new knowledge for other students, so they are a part of a regular curriculum. The only difference is that one expects quick answers of some students and for them they are a hint of potential. The teacher uses those answers for discussion and leads the whole classroom toward the same conclusion and the reasons for it.

We identified several topics related to relatively novel scientific results, which may be developed to activities included in teaching modules with a small set of identification questions. Such topics are experiments with anisotropic materials and polarizers (Pečar, 2015), with microwaves (Ziherl, 2013, 2018), hydrogels and liquid crystals (Pavlin, 2013; Čepič, 2014). There are several others, however we focused on development of units on the indicated topics, as we did on them research previously.

Conclusions

Some students that have weak reading, writing, math and/or artistic skills, as their circumstances at home do not value them, have to struggle for even minor achievement in a regular school process, as the lack of those skills present a serious hindrance on absorbing a new knowledge or on demonstrating it. Those circumstances can suppress the demonstration of abilities, and therefore the achievers, that is, student that well developed their potentials, who come from the social background that values the school chores are much more common. Nevertheless, to miss the able individuals during the education process, and not providing them opportunities for development of their potentials is a loss for those individuals as well for a society as a whole as it does not include the all the potentials to its intellectual pool.

The presented example and the idea of the new approach to identification of the gifted but, let us say, unlucky individuals, during the regular process is an alternative to existing methods for identification.

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Appendix

Worksheet for accompaniment of activites. It should be combined with PPT having Fig. 1 and Fig. 2 on separate slides. For the second task, print the magnifications given in Fig. 3 b-f. The Fig. 3d should be cut in a circular shape as indicated by the form. Students get one magnification by one every few minutes until they find the part in the Fig. 3a that is magnified. After they find one, they should be encouraged to try again and search for magnified parts for other yet unsolved examples.

Worksheet: Screen colours

Observe the magnification of the screen with the picture of the first slide. How do magnified coloured areas on the screen differ from the same areas observed by naked eye?

Magnify the squares in the second slide. Observe the structure of colours. Fill in the table.

Square's colour	Intensity of red	Intensity of green	Intensity of blue
Red			
Green			
Blue			
Magenta			
Yellow			
Cyan			
Light grey			
Orange			
Brown			
White			

A few magnifications of different areas on the screen printed below were captured. Mark them directly on the picture.