Identification of gifted less intellectually skilled students by doing experiments

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Less intellectually skilled (LIS) students

- Intelectual skills: literacy, math, and art skills

- Why can a student be less intellectually skilled?
  - Underprivileged
  - Minorities, migrants and refugees
  - Twice exceptional
  - Neglected
  - Any other?
Underprivileged vs. privileged children

Identification of their gifts and talents

Learning science
Outline 1

• What is giftedness? How is it identified?
• Obstacles for identification
• TIMSS and PISA? Do they provide hints?

• Current research results in physics education
• What do they enable?

• Gifted students and inquiry based learning of new topics
• Instrument and protocol appropriate for finding a „good brain“
Outline 2

• The first example: LCD Colours

• The history of development

• Preliminary knowledge

• The activity

• Methodology of testing

• Pilot study results
Gifts and talents

Symbolic system
- Mathematics and logic
- Music
- Languages

Sensomotorial skills -
- Dance
- Painting
- Sports

Teacher’s giftedness/talents
- Music
- Sports
- Dance
- Painting
- Mathematics and logic
- Languages
Important indications

• IQ > 130 or within the 2% of population
• Motivation and persistence
• Self-concept
• Creativity

• Literacy and vocabulary
• Spatial-visual conceptions
Identification in general

Do they tend to come up with lots of ideas in response to verbal or visual cues? Are their ideas different, quirky, 'outside the square'?
Do they look at things from different perspectives (e.g. draw an object from above rather than giving a side elevation)?
Do they suggest solutions to problems that surprise you because they are different or unusual?
Do they express themselves metaphorically or abstractly in play situations or in use of language and storytelling (e.g. "I'm a laser force that's knocking you over")?
Do they find it easy to elaborate on the ideas of others (e.g. can progress shared oral storytelling in unusual directions)?
Do they show an attention to fine detail in drawing and language?
Giftedness

Student Information

Student’s Name (or Assigned Code No.):

Date of Rating _____ / _____ / _____
Y E A R  M O N T H  D A Y

Date of Birth _____ / _____ / _____
Y E A R  M O N T H  D A Y

Age in Years _______

Grade ❑ K ❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5 ❑ 6
❑ 7 ❑ 8 ❑ 9 ❑ 10 ❑ 11 ❑ 12

Rater’s Name: _______________________________________

Relationship to Student: ________________________________

Examiner’s Name: ____________________________________

School Name: ________________________________________

Summary of Scores

I Learning Characteristics
II Creativity Characteristics
III Motivation Characteristics
IV Leadership Characteristics
V Artistic Characteristics
VI Musical Characteristics
VII Dramatics Characteristics
VIII Communication Characteristics (Precision)
IX Communication Characteristics (Expressiveness)
X Planning Characteristics
XI Mathematics Characteristics
XII Reading Characteristics
XIII Technology Characteristics
XIV Science Characteristics

Renzulli scales
### COMMUNICATION CHARACTERISTICS (PRECISION)

<table>
<thead>
<tr>
<th>The student . . .</th>
<th>Never</th>
<th>Very Rarely</th>
<th>Rarely</th>
<th>Occasionally</th>
<th>Frequently</th>
<th>Always</th>
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<tbody>
<tr>
<td>1. speaks and writes directly and to the point.</td>
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<td>2. modifies and adjusts expression of ideas for maximum reception.</td>
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<td>3. is able to revise and edit in a way that is concise, yet retains essential ideas.</td>
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<td>4. explains things precisely and clearly.</td>
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<td>5. uses descriptive words to add color, emotion, and beauty.</td>
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<td>6. expresses thoughts and needs clearly and concisely.</td>
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<td>7. can find various ways of expressing ideas so others will understand.</td>
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<td>8. can describe things in a few very appropriate words.</td>
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<td>9. is able to express fine shades of meaning by using a large stock of synonyms.</td>
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<td>10. is able to express ideas in a variety of alternate ways.</td>
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<td>11. knows and can use many words closely related in meaning.</td>
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Science/physics

Think about few words that describe a gifted student in physics?

Can these indicators be measured?
In physics

• Recognition of patterns in data
• Reasoning, why such patterns – forming explanations
• Design testing experiments
• Drawing conclusions – rejection, support
• Reporting
• Argumentation of ideas

Scientific method
• A - Recognize patterns in given sets of data;
• B - Recognize possible relations among variables;
• C - Form tentative explanations for the observed phenomenon using their knowledge;
• D - Suggest an experiment to test the reasoning;
• E - Use the experimental data to reject the reasoning;
• F - Form a new explanation if the initial idea is rejected;
• G - Consider effectively indirect cause and effect relations;
• H - Consider effects of various variables on the same phenomenon;
• I - Distinguish among more and less important influences of variables;
• J - Describe phenomena symbolically and use those descriptions for support of explanations;
• K - Generalize the conclusions based on studied examples.
Giftedness in science

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<tr>
<td>1.</td>
<td>demonstrates curiosity about scientific processes.</td>
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<td>2.</td>
<td>demonstrates creative thinking about scientific debates or issues.</td>
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<td>3.</td>
<td>demonstrates enthusiasm in discussion of scientific topics.</td>
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<td>4.</td>
<td>is curious about why things are as they are.</td>
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<td>5.</td>
<td>reads about science-related topics in his or her free time.</td>
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<td>6.</td>
<td>expresses interest in science projects or research.</td>
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<td>7.</td>
<td>clearly articulates data interpretation.</td>
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Renzulli scales
Ways of identification

IQ measurements

Visual – Spatial Intelligence

Creativity
How to identify the gifted among underprivileged/LIS?

**PROBLEMS**
- Irrelevance of knowledge as regarded by parents
- Absent support for schoolwork at home
- Absence of books, discussion, listening,..
- Internal tensions at home
- Language difficulties
- Inherent teachers’ expectations
- Less possible competition

**CONSEQUENCES**
- Poor reading skills, vocabulary
- Underdeveloped fine motorics relevant for drawing skills
- Weak abstract thinking in general
- Lack of extracurricular knowledge (science, languages, arts,...)
- Difficulties in communication
- Overlooked unexpected results

To create a milieu where also less intellectually skilled students might excell
Does any information on giftedness among LIS/underprivileged already exist?

PISA (Programme for International Student Assessment) K. Šterman Ivančič
– large sample, science, the whole span of high schools, age 15-16

TIMSS (Trends in International Mathematics and Science Study) B. Japelj
– large sample, science, compulsory school, ages 10, 14
Do difficult tasks exist in TIMSS and PISA that are solved independently of student’s background? 
If so, what are their properties?

Between 10 and 20 tasks were found in PISA and TIMSS

Properties: No long text, No open questions
Multiple choice, Single word answers, Graphics

Is it possible to find rules for construction of such tasks?

ONE ALTERNATIVE
Recent research results in physics education

• Examples of introduction of a new topic
  → A theory of introduction of new topics
• New field, where students do not have experiences
  → The frame for studies:
    How students acquire new concepts
• Hands-on experiments in the new field
  → The laboratory for formative and summative assessment of practical work
• For the gifted?? SECOND ALTERNATIVE ??
Could new scientific results provide a milieu for identification of gifted students?

• No preliminary experience for all students in the classroom

• Hands-on experimentation for gaining personal experiences
• Very little instructions in a written form

• Units on new scientific results
  - Quick digestion of new information
  - Ability to use it in new circumstances
  - Appropriate for the whole classroom

Can one find such topics?
New scientific results in the classroom

Existing studies focused on experimental work
- Screen colours (Čepič)
- Liquid crystals (Čepič, PeF group)
- Hydrogels (Pavlin)
- Spreading shadows (Poklinek)
- Microwaves and optics of wood and pasta metamaterials (Ziherl)
- Optics of anisotropic and optically active materials (Pečar)
- Conoscopy (Pečar)
The first example: The screen colours

The unit takes 20-30 minutes.

Tasks:
- Learn how to use a digital microscope.
- Observe magnification of different parts of the screen.
The first example: The screen colours

- Find the rules for formation of colours.

You can intentionally change the intensity of colour components.

What would you do to change the pure red to pink?

Subquestion:
What would you do to change the pure red to dark red?
The first example: The screen colours

The students get a printscreen

Can you find, which part is magnified on this picture?

Subquestion:
Can you find, which part is magnified on this picture?
The testing

• 9 students age 15 that came to the camp for winners of math, astronomy and physics competitions.
• Interview accompanied by active work of a student
• Duration: 20-30 minutes
• Audio and video recorded
• Two observers and note takers
Results

What would you do to change the pure red to pink?
- 2 students answered directly, that one has to add blue and green. They also commented without being asked, that the two colours have to have the same intensity but lower than red.

- 2 students returned after the subquestion (What would you do to change the pure red to dark red?) and answered correctly.
- 1 student needed reflection of painting experience in addition
- 3 students needed more help
- 1 no correct answer
The first example: The screen colours

The students get a printed screen

Can you find, which part is magnified on this picture?

4 students were able to find the part on the screen.
Only one student immediately marked also the orientation of the capture.

Subquestion:
Can you find, which part is magnified on this picture?
For 3 more students the first hint was enough.
1 needed even simpler magnification to come with an idea.
1 student was colourblind and was not able to find anything.
Future plans

- Individual testing of younger gifted (lower secondary)
- Individual testing of other students (lower secondary)
- Individual testing of underprivileged/LIS
- Training of teachers
- Testing in classroom situation

- Creation of new units, testing,...

- Instrument and protocol
Conclusions

• New scientific results in the science classroom appropriate for identification of the gifted LIS students
• Are they appropriate for identification of the gifted LIS students

• New method testing
  • Feasibility
  • Discrimination, accuracy
  • Reliability
  • Prediction
Acknowledgement

• The research grant J7-8278 by Slovenian Research Agency.

THANK YOU