GRADE 8 AND 11 STUDENTS’ SCIENCE AND SCIENCE-RELATED CAREER PROFILES

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Abstract
This research is based on a concern that students don’t associate their further studies or careers with their school science learning. It seeks to provide a profile indicating, how students themselves, describe their future science and science-related careers. Using a validated instrument, data is collected from grade 8 (N=218) (14-15 years old) and grade 11 (N=95) (17-18 years old) students and by undertaking inductive content analysis is used to develop students’ career profiles. The results show that, in both grade 8 and grade 11, less than 10% of students’ preferences are towards science careers. Noting a potential future shortfall in science and science-related career professionals, the results indicate that more emphasis is needed to develop students’ career awareness in both middle and secondary school science studies. Furthermore, it is proposed that it is important to rethink how science content is presented to students, especially in developing ways how to link science content with socio-scientific awareness.

Keywords: Career preferences, Career profiles, Inductive content analysis, Science Education, Qualitative research.

1 INTRODUCTION
Today’s society faces a number of problems such as persistent poverty, lack of energy, global climate change and environmental degradation [1]. Solving these problems requires an investment in science learning and the involvement of competent people in science and science-related careers. In this context, there is a need to develop the ability to respond flexibly to complex problems, communicate effectively, work in a dynamic team to create solutions that make efficient use of an increasingly, developing technology and new knowledge [2]. In fact, technological developments have made profound changes in both the operation of 21st century endeavours as well as in everyday life [3]. Yet, most education systems operate similarly to those in the early 20th century [1].

Increasingly around the world, different endeavours are using new technologies and demand workers operate as a team to create new ideas, products, and services [2]. More and more politicians and intellectuals, from different fields and backgrounds, are coming to a common view and recognising that students need to possess a range of competences to be successful in today’s world.

Such views are also reasons causing gaps between student/society needs and school science teaching, leading to a potential drop in student interest in science learning and a decreasing percentage of students choosing science-related careers [3].

As previous research confirms that science subjects are unpopular among students [4;5;6;7;8], students tend not to be interested in science and increasingly high school graduates, especially girls, don’t choose further studies in science fields [9]. Furthermore, different studies have indicated the relationship between students’ attitudes towards science and career preferences [9;10]. Students, who have a more positive attitude towards science, are more likely to relate their future career with science or science-related careers compared with other fields [11].

It is thus detected that, in Europe and America, science careers are increasingly unpopular among students [2]. As research over the decades (e.g. PISA, 2015) indicates, decreasing number of students choosing science careers and students’ lack of interest and knowledge of science and science-related careers is a matter of concern [2;10]. Therefore, it is important to rethink how science is presented to students and investigate why so few students want to take up science-related careers [11;12]. This suggests it is important to create ways to make science subjects more attractive and thereby change the teaching to become more efficient in promoting important competences.

Competence-based education is an approach that may help to ensure students graduate with a set of competences (knowledge, skills, attitudes, and values) necessary for their future careers. This places
the curriculum emphasis on competences acquisition and how to develop these for students through science education. One competence-related approach is to link taught subjects with real-life situations thereby seeking to raise student's interest to study science [13] and more strongly interlink science education with both science and science-related careers.

Based on the PISA 2015 (OECD, 2016) study, 25% of 15-year old students see science-related careers (e.g. health, ICT) as important for them, while at the same time, only 8% are interested in more specific, science careers (e.g. within the fields of chemistry, physics, and biology) [10]. The above suggests that it is important to give students a vision of modern science professions and the work involved in different careers, and to prepare and develop an interest in students to participate in the future science-related workforce. As the growth in jobs tends to require Science, Technology, Engineering and Math (STEM) competences, according to the National Science Foundation (2015), to prepare the future science workforce, acquired competences are needed as well as support and motivate students in their future career search [14;15].

The aim of this research is to explore students career preferences and to create career profiles both in science and science-related careers. This is particularly relevant in science education, helping students to understand career preferences and to determine the level of awareness students hold related to their chosen careers. Investigating students career preferences in grades 8 and 11 is appropriate as it can give an overview about how well students know different science and science-related careers while in either middle or secondary school and allows determination of the degree of change in career preferences.

The following research questions are put forward:

RQ1: What are grade 8 and 11 students’ career preferences and how do they compare?

RQ2: What grade 8 and 11 students’ career profiles can be identified, based on science and science-related career models?

2 METHODOLOGY

A purposeful sample of 313 students (146 boys and 167 girls) participated in this research from all grade 8 (N=218) 14-15 years old and grade 11 (N=95) 17-18 years old students obtained from 5 different Estonian schools. Grade 8 and 11 students were selected, so as to investigate how middle and secondary school students’ career preferences differ.

This research used a paper and pencil instrument (questionnaire) consisted of 3 open-ended questions about student career preferences. For this purpose, the following questions were compiled:

- Which career(s) do you wish to have in the future?
- Describe your future career(s)? What kind of knowledge and skills are perceived to be needed in those career(s)?
- What is the main reason why you choose this/these career(s)?

The compiled instrument was validated by 10 science teachers, who participated (October 2017-January 2018) in an in-service teacher training programme, plus 4 scientists from the University of Tartu.

2.1 Data analysis

This study is based on qualitative research. For analysis, the collected student answers were encoded using inductive thematic analysis as a standard content analysis procedure [16], in which the themes identified are strongly related to the data themselves. In this sense, this thematic analysis is data-driven [16]. The classification of careers into science and science-related careers were based on ISCO-08 classification of occupations [17]. The analysis included data reading of students’ open-ended answers about their career preferences, themes identification, coding and finally interpretation of the content of themes.

The validity and reliability of the created instrument and methodology were determined as shown in table 1.
Table 1. Validation and reliability of the created instrument for this research.

<table>
<thead>
<tr>
<th>Instrument/method</th>
<th>Validity/reliability</th>
<th>Used validation/reliability method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students’ career preferences/open-ended questions</td>
<td>Content validity</td>
<td>Initial coding generation, search for themes based on the initial coding and review of the themes</td>
</tr>
<tr>
<td></td>
<td>Construct validity</td>
<td>Themes identification and labelling and report writing</td>
</tr>
<tr>
<td></td>
<td>Inter-coder reliability</td>
<td>The percentage agreement between the two coders was 92%</td>
</tr>
</tbody>
</table>

3 RESULTS

3.1 Grade 8 and 11 students’ career preferences

Student (grade 8 and grade 11; total N=313) career preferences were explored and categorised according to the International Standard Classification of Occupations, 2008 [17]. These were then taken as the basis for creating the following career profiles (figure 1-6).

Figures 1 and 2 shows that half of the respondents chose careers, which are not related with science or science-related careers, as their career preference, both in grade 8 and 11. The results further show that 27% (N=25) of the grade 11 students’ career preferences were science-related careers (e.g. doctor, psychologist etc.), while only 7% (N=6) were for science careers (e.g. physicist, chemist etc.). Lower percentages were obtained with grade 8 students; 12% chose science-related careers and 6% science careers as their future career preference.

![Figure 1. Grade 8 and 11 students’ career preferences.](image)

Figure 2 gives the main reasons for the career preferences selected. Interpretation of the results reveals that students’ career preferences relate to 8 major fields. And that for both grade 8 and 11 students, common reasons for their preference were career attractiveness and their own interest towards the chosen career.

Major reasons for grade 8 and 11 students choosing the careers indicated were related to money, experience, and peer influence. Thus, for example, 13% of grade 8 students indicated that money played a major role, although only 8% of grade 11 students also mentioned this. Experience (15%) played a greater role with grade 11 students’ career preferences than with grade 8 students (7%). A much greater impact for grade 8 students’ career preference compared to grade 11 was peer influence (for grade 8 students 6% and grade 11 1%).

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3.2 Grade 8 and 11 students’ career profiles

Career profiles were developed for both grade 8 and 11 students, based on their responses. Examples of student preferences within the science field were: geographer, biologist, chemist, physicist and for science-related careers: psychologist, doctor, surgeon, physiotherapist, veterinarian, meteorologist. Other careers preferences were given as: lawyer, hairdresser, makeup artist.

Students open-ended answers were analysed and categorised based on inductive thematic analysis, as indicated in the methodology section. The created career profiles indicated in figures 3-6 showed skills, attributes and knowledge that students had considered important in their chosen career. When comparing the career preferences of this sample, science-related careers were more popular than science careers.

Figure 3 illustrates doctor career profile, based on grade 8 and 11 student answers.

<table>
<thead>
<tr>
<th>List of skills and attributes:</th>
</tr>
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<tbody>
<tr>
<td><strong>Grade 11</strong></td>
</tr>
<tr>
<td>Empathy (5)</td>
</tr>
<tr>
<td>Problem solving skills (5)</td>
</tr>
<tr>
<td>Communication skills (4)</td>
</tr>
<tr>
<td>Patience (1)</td>
</tr>
<tr>
<td>Decision making skills (1)</td>
</tr>
<tr>
<td>Hard-working (1)</td>
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<tr>
<td>Diligence (1)</td>
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<tr>
<td><strong>Grade 8</strong></td>
</tr>
<tr>
<td>Critical thinking skills (4)</td>
</tr>
<tr>
<td>Communication skills (3)</td>
</tr>
<tr>
<td>Patience (3)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>List of knowledge:</th>
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</thead>
<tbody>
<tr>
<td><strong>Grade 11</strong></td>
</tr>
<tr>
<td>Knowledge of biology (11)</td>
</tr>
<tr>
<td>Knowledge of medicine (1)</td>
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<tr>
<td>Language knowledge (1)</td>
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<table>
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<tr>
<th><strong>Grade 8</strong></th>
</tr>
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<tbody>
<tr>
<td>Knowledge of biology (6)</td>
</tr>
<tr>
<td>Knowledge of chemistry (2)</td>
</tr>
<tr>
<td>Knowledge of mathematics (2)</td>
</tr>
<tr>
<td>Scientific knowledge (1)</td>
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</tbody>
</table>

*() indicates how many students indicated this in their answers.
Most students (28) mentioned doctor as their future career preference. Grade 11 students described a doctor’s career in a more detailed way, especially in the skills and attributes part, than grade 8 students. Grade 11 students emphasised empathy, whereas grade 8 indicated patience as an important attribute for the success in a doctor’s career. Both grade 8 and 11 students brought out that patience is need for doctors. Grade 11 students also emphasised that empathy is needed for the doctors. The most mentioned common skills, at each grade level, were problem-solving (grade 11) and critical thinking (grade 8). However, in students’ answers, the relation between critical thinking and problem-solving skills was not mentioned. Students in both grades emphasised communication skills.

Students in both grades indicated that essential knowledge doctors should possess was a knowledge of biology. Grade 11 students also indicated knowledge of medicine and languages. Grade 8 indicated knowledge of chemistry and mathematics.

Figure 4 illustrates a psychologist’s career profile, based on grade 8 and 11 students answers.

A further popular career preference for students was a psychologist, which was indicated by 11 students. Students in both grades mentioned communication skills as an important skill. Grade 8 students also emphasised patience as an important attribute. In comparing students’ responses for skills, attributes and knowledge, students gave answers that were vaguer only indicating knowledge of anatomy, language and psychology.

Figure 5 illustrates a biologist career profile, based on grade 8 and grade 11 students' answers of needed skills, attributes, and knowledge.
The most popular science career preference was a biologist, although this was only indicated by 9 students. These students described a biologist’s career as needing different skills and knowledge, but attributes were not mentioned. Grade 11 students mentioned laboratory and planning skills, while grade 8 students emphasised critical thinking, communication and argumentation skills. With respect to the knowledge part, grade 11 students indicated knowledge of physics, chemistry and material science, whereas grade 8 students mentioned knowledge of biology and earth science, scientific knowledge and knowledge of safety requirements.

The science career preference of a physicist was chosen by 7 students. Grade 11 students described a physicist’s career as requiring communication, teaching, and practical skills. They identified self-development, punctuality, and responsibility as important attributes. Both grade 8 and 11 students emphasised knowledge of physics, mathematics and chemistry, as important for a physicist’s career.

The created career profiles (based on students’ open-ended answers) give a good overview of how students themselves imagine their future careers. These career profiles covering three components – attributes, skills, and knowledge, indicate students’ future career importance. These created career
profiles help indicate what students do and do not yet know about their chosen career. These career profiles are seen to be helpful to students, teachers, and educators to understand that students’ chosen careers are very limited (suggesting that many careers are not known to students). In fact, among the very extensive careers options today, students’ career preferences are really narrow.

These findings:

- support those of earlier studies; students lack knowledge of science and science-related careers and this affects students’ interest in both studying and choosing such careers [15]. Since previous research (PISA) is related to middle school, this research goes further and research also secondary school students.
- shows that the same tendency occurs in both middle and secondary school levels [10].
- confirm that students aren’t very aware of science and science-related careers e.g. in the physicist’s career profile, students refer to communication and teaching skills, but don’t include problem-solving skills, which are considered important in today’s society.

4 CONCLUSIONS

This research indicates that it is important to think about how science subjects are taught at school and how to relate these with career awareness. In both grade 8 and 11, findings indicate that most students’ career preferences did not relate to careers in science, or science-related, fields and the percentage for grade 8 students was even lower than that for grade 11.

For both grade 8 and 11 students, the most chosen science-related careers were those of doctor and psychologist and the most chosen science careers were biologist and physicist. Students described their science and science-related careers with different attributes, but most common were empathy and patience and communication and critical thinking were the most mentioned skills. Students also described their chosen science and science-related careers using different knowledge areas, but biological knowledge was frequently cited.

Surprisingly, noting the very extensive careers options today, the different students’ career preferences were really narrow. This suggests the need to enhance science subjects with reference to different science and science-related careers and ensure students gain a greater overview about which competences are needed in these careers.

4.1 Recommendations

In order that science education should be more integrated with real-life situations, more attention should be paid on teaching approaches. Based on these research outcomes and it is important that the content of the teaching material is more closely related to everyday situations - descriptions of science and science-related careers.

It is important to introduce different science and science-related careers to students in both middle and secondary school studies, because students are interested in these, but they need more knowledge about different science and science-related careers, especially which competences are valued in these careers.

4.2 Limitations

This research focused only on grade 8 and grade 11 students and therefore it is not possible to describe, how students’ views changed during their learning over this timespan. Only a paper and pencil instrument was used for data collection and there was no possibility to clarify students’ responses at a later stage (e.g. using interviews).

It was also important to recognise that the sample size for the career profiles was very small. For a more presentative sample, future research in this field is necessary.

REFERENCES


