Young Kiwi's Motivation to Study Science

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Abstract

As motivation is one of the crucial keys to better education, we explored the motivation of New Zealand students toward studying Science. We used the Science Motivation Questionnaire [1] to measure the motivation score of 648 students from 14 different high schools. To be able to identify and confirm latent components of the Science Motivation Questionnaire which have been discussed [2,3], we also employed factor analysis. We found boys were motivated toward studying science more than girls which was reflected in the different scores of only boys and only girls schools. The students who liked being challenged in Science lessons had the highest motivational scores in contrast to students who liked practicals and nothing. Students who mentioned practical specified things like "blowing stuff up". The students mostly disliked too much writing about their Science lessons, followed by listing specific topics. Perceiving Science as too hard and irrelevant were mentioned less often. Most of the students would consider taking non obligatory Biology lessons if they find them interesting and discover new things during them. This demant was followed by the future career requirements. It seems that in general, young Kiwis are motivated toward studying Science and are more likely to find it relevant and interesting than unconnected to real life and boring.

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1. Introduction

We understand motivation as an internal state which is moving someone to do something [1]. For successful learning, of course, motivation to learn is crucial. Self-efficacy described by Bandura [2] is the part of motivation which closely relates to academic achievement as it influences the goals the students plan to reach [3]. Other parts of motivation (which were also taken into account as underlying factors in the Science Motivational Questionnaire SMQ besides self-efficacy), intrinsic, extrinsic motivation and amotivation were described [4] with extrinsic motivation being divided into more sub constructs. In an educational context, motivation toward a specific activity which is happening and engaging the students at the specific moment is also important [5].

Unlike in most public schools in Europe, the schools in New Zealand are not only coeducated, but also boys only or girls only. The low- and high- performing students are less likely to attend the same school than the OECD average. New Zealand students scored above OECD average in Science in 2018 with 11% of them being able to autonomously find creative solutions to scientific problems [6]. The New Zealand Science curriculum is focused on understanding the Nature of Science and the ability to perform inquiry rather than knowledge [7].

Aim

Our main aim was to explore the motivation of New Zealand high school students to study Science. Our other aim was to analyze some factors which influence this motivation.

2. Methods

In order to explore the motivation towards studying science, we asked year 11 students from 14 high school (37 classes) on the North Island, New Zealand to participate in a survey using SMQ [8], although we are aware of studies suggesting needed changes, but even the second version of SMQ II is not ideal [9-12]. The questionnaire consisted of 30 5-point Likert scale questions and with the total score between 30 and 150 points, the higher the total score, the higher the motivation toward studying

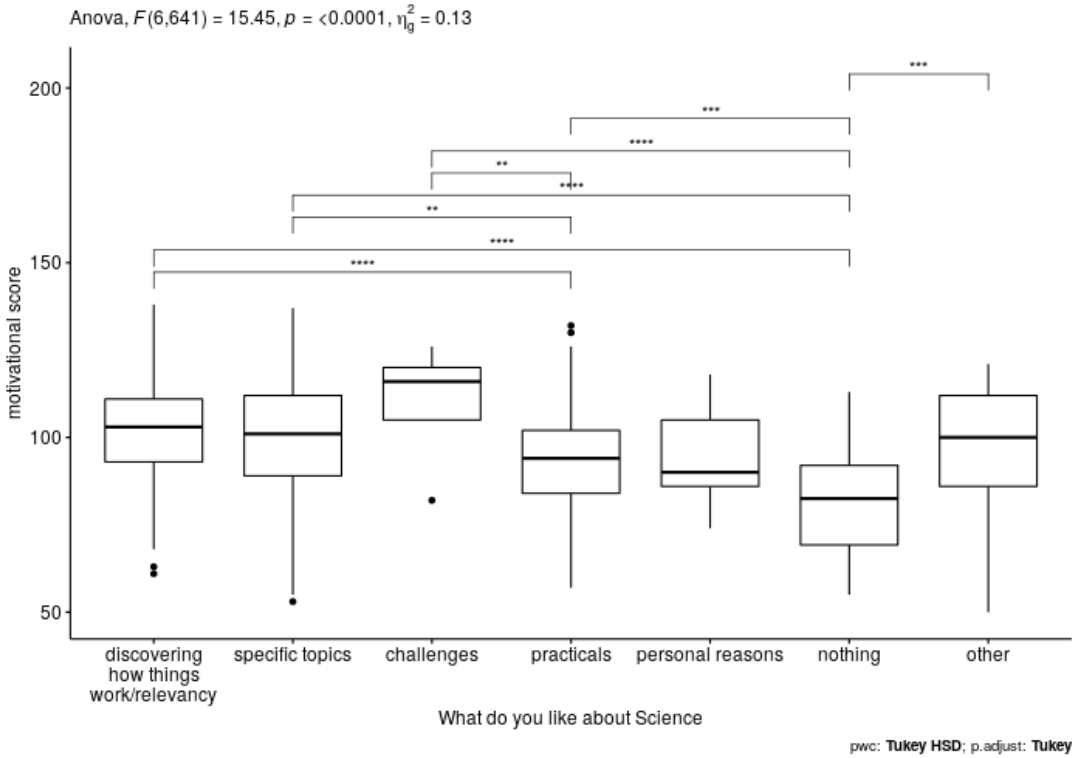
Science. The wording was adapted to the New Zealand school environment and 648 answers were analyzed (339 females, 309 males) using R v.4.0.3. [13]. The favourite subject was categorised as *science* (science, biology, chemistry, physics, physical education which includes anatomy in New Zealand) or *other*; free time activities were categorised as *social*, *sport*, *reading/writing*, *artistic* and *other*; what did the students like about their science lessons was categorised as discovering *how things work/relevancy*, *specific topics*, *challenges*, *practicals*, *personal reasons*, *nothing*, *other*; we also asked what would make the student to take a Biology class next year and categorised the answers as *interest*, *future career requirement*, *personal/easy credits*, *nothing*. The reliability was checked by calculating Cronbach alpha. Factor analysis with Oblimin rotation was used to explore the factors included in the questionnaire. The numbers of the respondents and other assumptions as normality and homogeneity allowed us to use ANOVA for group comparison. Effect sizes were calculated sensu [14] and interpreted as follows: 0.10 small, >.25 moderate and >.40 large effect. The differences were considered statistically significant if $p < .05$.

3. Results

The mean motivational score was 97.5 points. Cronbach alpha of the SMQ was 0.91, showing a great internal consistency. The Parallel analysis suggests to use 5 factors which explain the following proportions of the overall variation PA1 (intrinsic motivation) = 0.22; PA2 (assessment anxiety) = 0.18; PA3 (self-efficacy) = 0.18; PA4 (career motivation) = 0.26; PA5 (self-determination) = 0.15. When compared to the original model [10], self-determination factor consists of the same questions; 3 questions (q2, q19, q11) from personal relevance factor rather belong to career motivation factor; assessment anxiety questions formed a separate factor; factors grade motivation and self-efficacy form one joint factor.

3.1 What influences the motivation toward studying Science

Boys were more motivated towards studying science than girls ($F = 23.77$; $p < 0.0001$; Cohen's $f = 0.19$). The type of free time activities did not influence the motivation score. Those with a favourite science subject (N = 240) had higher motivational scores than students with a favourite non science subject (N = 408; $F = 20.68$, $p < 0.0001$; Cohen's $f = 0.18$). The students who liked being challenged in Science lessons had the highest motivational scores but statistically significantly different only from those who liked *practicals* and *nothing* ($F = 15.45$; $p < 0.0001$; Cohen's $f = 0.38$), Graph 1.



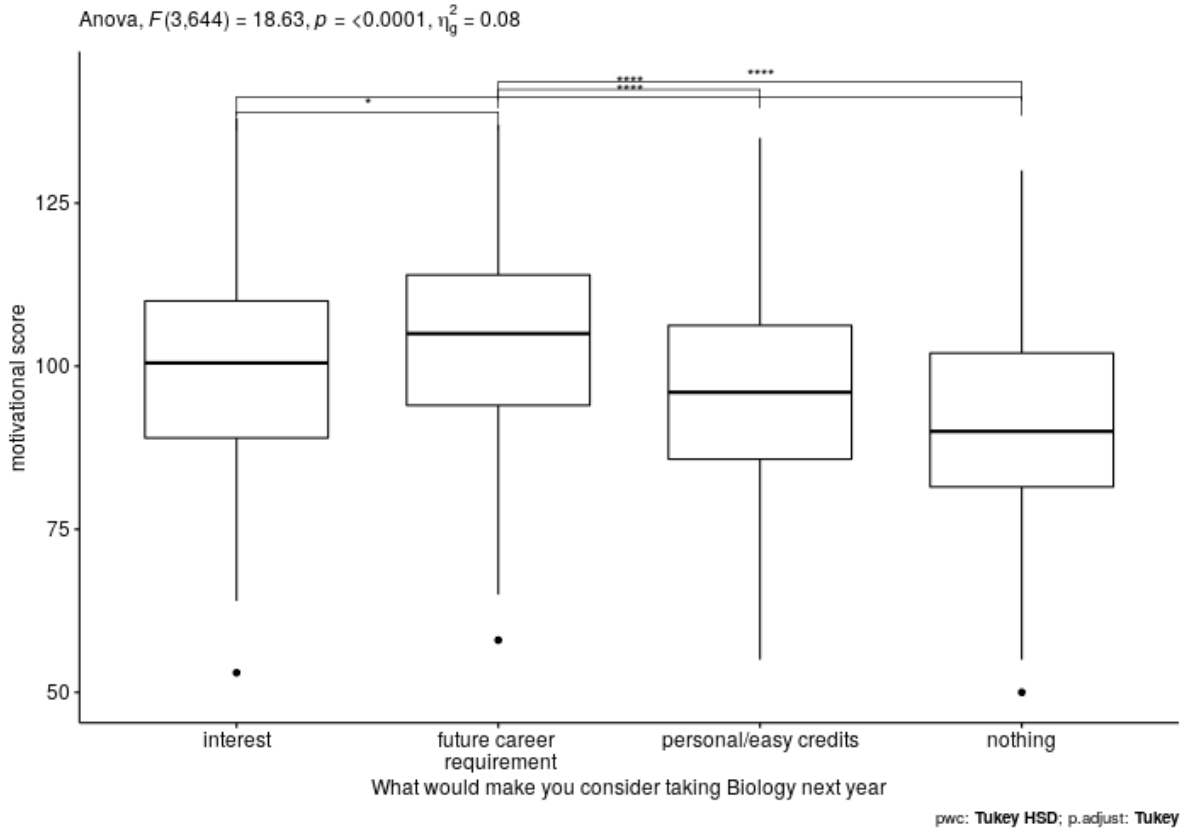
Graph 1. Factors that students like about Science and motivation score toward studying Science.

Statistical significant pairs marked as follows: * p <.05, ** p <.01, *** p < .001, **** p < .0001.

If the students dislike Science, it was mostly because of too much writing and long reports (N = 152) followed by specific topics (N = 135) and the fact they found Science too hard and confusing (N = 86). Other reasons were perceiving Science irrelevant (N = 69) or personal (N = 68).

3.2 Why to consider studying Biology

The students basically had three different motives to take Biology class (which is not obligatory) next year: interest (N = 200), future career requirement (N = 161), or the fact they can gain easy credits and consider Biology easy (N = 120). The rest of the students (N = 167) would not consider taking Biology at all. The students who would consider taking Biology class next year due to future career requirements had statistically significantly higher motivation toward studying Science than students who had other reasons or would not take Biology, Graph 2.



Graph 2. Motivational score of students who would (not) consider taking Biology next year. Statistical significant pairs marked as follows: * p <.05, ** p <.01, *** p < .001, **** p < .0001.

Because students have a joint subject Science until year 11 in New Zealand and can choose individual science disciplines in later years, we asked which part of Science do they identify as Biology. Most of the students (N = 454) mentioned correct parts of Biology, only a few (N = 5) students mentioned parts of Physics or Chemistry; quite a lot of students (N = 189) did not answer or they didn't know.

4. Discussion and Conclusions

As was suggested [9-12], the factors of SMQ did not fully match our results, but our five factors did reflect the original idea with some questions being transferred into different factors. The original factor self-efficacy and assessment anxiety was divided and assessment anxiety left alone and well defined in our model unlike in [11]. Grade motivation and self-efficacy were fused, partly as in [11]. Surprisingly, the students who liked practicals the most were significantly less motivated towards studying science. This seems to contradict the fact that practicals are one of the methods suggested for improving the attitudes toward science [15]. We think the key is provided in the further comments of some students like “blowing stuff up” is fun. This suggests they are not interested in finding how things

work through hands-on practicals but merely in seeing some effective action. The young Kiwi students obviously dislike writing reports which are part of both internal and external assessments in which they typically have to plan, conduct and discuss an experiment [16]. The fact that more students dislike writing in Science more than the feeling Science was too hard and confusing or irrelevant may be good news for the New Zealand Science educators as showing Science as relevant for everybody and everyday life is a crucial part of Science education [17].

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