What Contributes to Vocational Excellence?

A study of the characteristics of WorldSkills UK participants for WorldSkills Sao Paulo 2015

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January 2016

Preface

The *Developing and Understanding Vocational Excellence* (DuVE) suite of research projects focuses on WorldSkills competitions (WSC). This research is timely because the current vocational education system in the United Kingdom is struggling to meet the demands of the workforce and the needs of many young people. While problems with vocational education have been widely noted in research, few studies have focused on understanding vocational excellence. Gaining this understanding is the primary aim of the DuVE projects.

WorldSkills competitions are held every two years and are organised by WorldSkills International (WSI) as part of their mission to 'raise the profile and recognition of skilled people, and show how important skills are in achieving economic growth and personal success' (WSI, 2015). Approximately 1200 competitors from 59 countries participated in WorldSkills *São Paulo* 2015 in Brazil.

The UK started to compete in WSC in 1953 and hosted competitions in Glasgow in 1965, in Birmingham in 1989 and in London in 2011. In 1990, UK Skills was established as an independent charity to organise and support UK participation in WSC. Renamed WorldSkills UK in 2011, it is now part of Find a Future, a new organisation which brings together skills and careers initiatives from across the UK.

The WSC is recognised by many as the pinnacle of excellence in vocational education and training (VET). The Centre on Skills, Knowledge and Organisational Performance (SKOPE) has been researching WSC since 2007 to understand better how vocational excellence is developed through competition and to inform the development of Squad and Team UK. Between 2007 and 2009, two small projects investigated the individual characteristics of the competitors and their workplace learning environments and covered the competition cycles of WSC 2009 and 2011. The overarching questions addressed were:

- What are the characteristics of individuals who excel?
- What kinds of support enable the development of high-level vocational skills?
- How can vocational education be structured to aim not simply for adequate standards of achievement but for high achievement that reflects world class standards?
- Can broader societal benefits to developing vocational excellence be identified?

Following on from these two initial studies, the first phase of DuVE consisted of three projects conducted between 2011 and 2013, incorporating the competition cycle leading up to WorldSkills Leipzig 2013:

- Project 1: What Contributes to Vocational Excellence? A study of the characteristics of WorldSkills UK participants for WorldSkills Leipzig 2013
- Project 2: Learning Environments to Develop Vocational Excellence
- Project 3: Benefits of Developing Vocational Excellence

Find a Future then funded Phase 2, consisting of three follow-on projects and three new DuVE projects. The six projects are:

- Project 1: Modelling the Characteristics of Vocational Excellence
- Project 2: Learning Environments to Develop Vocational Excellence

- Project 3: Benefits of Developing Vocational Excellence
- Project 4: Further Education College Participation in WorldSkills and other Skills Competitions
- Project 5: WorldSkills UK Competitors and Entrepreneurship
- Project 6: Training Managers: Benefits from and Barriers to WorldSkills UK Participation

Taken together, this suite of six DuVE projects forms one of the five legacy projects (funded by the National Apprenticeship Service and now Find a Future), which are intended to use evidence-based research to further develop high quality WorldSkills practice.

Reports from the previous projects can be found on the DuVE website: http://vocationalexcellence.education.ox.ac.uk/publications/reports/.

A range of reports, publications and reviews resulting from research and development into skills competitions can be found on the WorldSkills UK website: http://worldskillsuk.org/research-and-development.

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Summary

As a developer of vocational talent, Find a Future is interested in factors that contribute to vocational excellence. This research relies on a multidimensional model of vocational excellence comprising three main explanatory factors: natural abilities; intrinsic characteristics (such as motivation); and external conditions (such as support of family and trainers). These are measured through self-report surveys of young people who are participating in training to compete at national and world levels. Survey results are compared to competition results to identify associations between individual attributes and characteristics and vocational performance.

This study was carried out in the run up to WorldSkills Sao Paulo 2015 and includes survey data from 87 squad members, selected by WorldSkills UK to further train and compete for places on Team UK. It also includes data from 81 young people who participated in some competitions but were not selected for the squad. Using statistical methods suited to small sample sizes, the research compares survey results for four groups: male versus female squad members; squad members versus team members; and medal winners versus non-medal winners at WSC Sao Paulo and squad versus non-squad members. The research is limited in its reliance on self-report data and on small samples sizes, which make it more difficult to identify statistically significant relationships.

As with our prior studies involving WorldSkills UK participants for WSC London 2011 and WSC Leipzig 2013, the analysis did not reveal many significant findings. Some patterns emerge across the three studies. Squad members consistently rated three natural abilities as being most important: body-kinaesthetic (handiness), mathematical-logical and spatial. In 2015, interpersonal intelligence (getting along with other people) was negatively related to medal winning. Ethical sensitivity was high for all groups across all three studies, and for 2015 was a little higher for non-competitors. Factors related to talent development (domain- and non-domain-specific conditions and intrinsic and extrinsic motivation) were highly rated across the three studies. Motivational factors, such as interest in the field, were consistently associated with medal winning. Medal winners in 2013 and 2015 were also motivated by the desire to avoid demonstration of incompetence (performance-avoidance goal orientation). Self-reported abilities needed for WorldSkills training (social, cognitive, entrepreneurial) were unrelated to medal winning. We found no significant differences in characteristics between those selected for the squad and those not selected, which suggests that the selection process plays the most crucial role in determining who should advance to the squad.

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Introduction

Find a Future (FAF) supports the development of vocational talent in the United Kingdom by selecting and training young people to compete in World Skills Competitions (WSC). It also organises The Skills Show, the UK's largest skills and careers event, held annually. Skills competitions, like those at WSC and The Skills Show, are seen as an important strategy for raising the attractiveness of vocational education and training (VET) in Europe, as evidenced by research and policy directives, such as the Bruges Communiqué. The UK has participated in the WSC since 1953. Under FAF's guidance, the hands-on skills competitions and related experiential careers events aim to develop young people's understanding of and engagement with further education, apprenticeships and skills.

Because competitions are carried out under world-class standards, they provide both a benchmark for high-performance and an objective way to assess vocational excellence. They also provide an opportunity to better understand the factors that contribute to the development of vocational skills to a high standard. This research project, supported by FAF, was carried out as competitors prepped for the 2015 WSC in Sao Paulo. The research addressed two key questions:

- What are the natural abilities, individual characteristics, and external conditions that contribute to the development of vocational excellence?
- Which abilities, characteristics or conditions are most associated with top-level competitive performance?

The project follows on from two prior studies of the WorldSkills UK squad who trained in preparation for WSC London 2011 and WSC Leipzig 2013 (Nokelainen, Stasz and James, 2013; 2014).

Theoretical Framework and Approach

This study builds on research carried out at the Research Centre for Vocational Education (RCVE), University of Tampere, Finland. It adopts a theoretical model and approach first used to explore the acquisition of vocational expertise among Skills Finland[1] competitors (Nokelainen 2012, 2015; Nokelainen and Ruohotie 2002, 2009; Pylväs, Nokelainen and Roisko, 2015). The theoretical model draws on research into individual attributes and characteristics and the dimensions of intelligence, including Barry Zimmerman's research on self-regulation (Zimmerman 1998, 2000, 2002), Francois Gagné's research on development of talent (Gagné 2004, 2010) and Howard Gardner's research on multiple intelligences (Gardner 1983, 1999). The model maps the development of vocational competence in terms of natural abilities, intrinsic characteristics, and extrinsic conditions (see Figure 1):

[1] Skills Finland is the Finnish equivalent of WorldSkills UK. For more information see http://www.skillsfinland.fi

- Natural abilities include intellectual, affective abilities and body-kinaesthetic abilities (expressed as Multiple Intelligences domains)
- Intrinsic characteristics include volition (perseverance, time management), motivation (intrinsic and extrinsic factors) and self-reflection (attributions of performance to effort or ability)
- Extrinsic conditions include the influence of home and family, as well as trainer and teachers, work experiences and peers.

The major proposition derived from this theoretical framework is that there is a relationship between key attributes and characteristics and vocational performance. In the case of the WorldSkills Competition, performance is measured by competition results, and comparisons can be made between medal winners and other competitors in terms of their abilities, characteristics and external conditions.

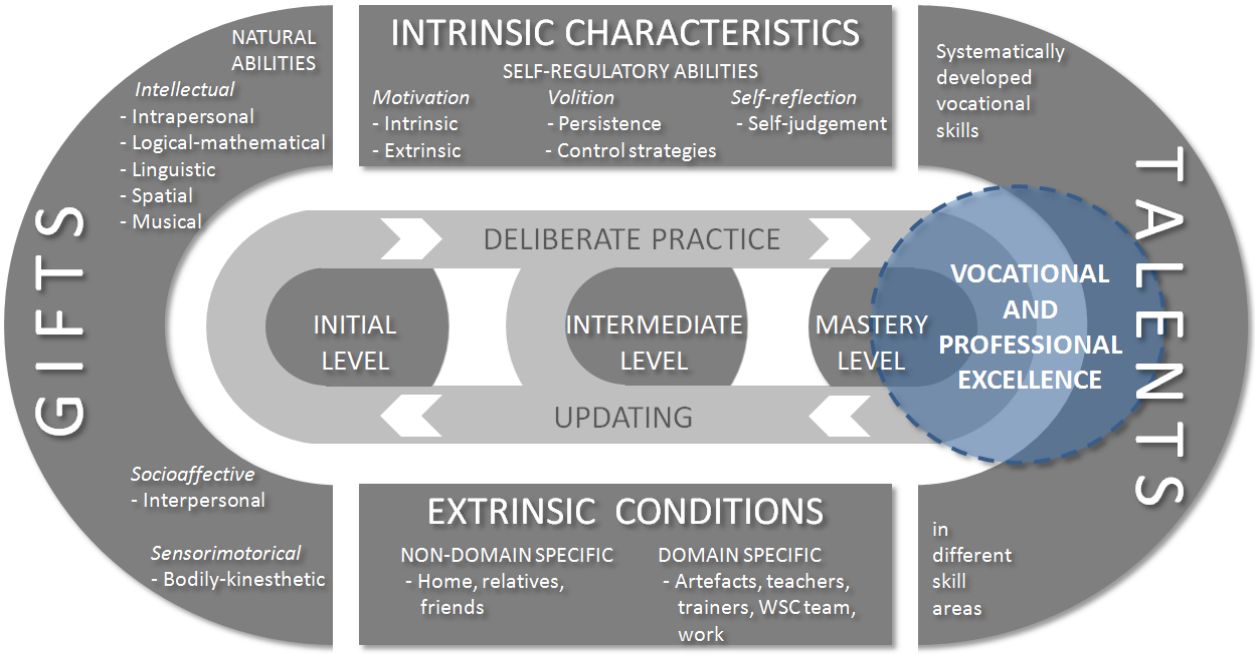


Figure 1: Developmental model of vocational talent (Nokelainen, 2015).

With its focus on understanding the factors that promote development of high-quality vocational skills, this research departs from the 'deficit' view of vocational education in the UK as being a course of study for individuals who are less academically able or have a more 'practical' approach to learning. Rather, it seeks to learn what contributes to high performance among an elite group of young people who are striving to excel in their chosen skill area.

Method

Participants and Procedure

The participants in this study were young people vying for a place in the WorldSkills UK squad 2015 (see Figure 2). The squad consisted of 87 young people who had undergone a selection process that began with numerous regional and national skill competitions held throughout the UK. Competitors for these UK-based competitions may be Further Education college students or apprentices or employees at enterprises that recognise the benefits of skills competitions. Competitors are also identified through the National Apprenticeship Awards, Awarding Bodies, City & Guilds Awards of Excellence, Sector and Industry Awards and through Sector Skills Councils. These events helped identify candidates for a shortlist of potential squad members, and most candidates also attended an interview and submitted recommendations from third parties. The short-listed candidates attended a residential induction programme where three to four events may be held over a few months. Advancement from the shortlist to the squad involves a 'pressure test'. Candidates receive two weeks training, followed by a pressure test benchmarked to the WorldSkills International standards for facilities, test projects (often it is the test project from a previous WSI competition), marking schemes and rigour. After participating in a training programme over approximately six months (including further competitions) Team UK was selected from the squad members (n=39) in May 2015. Team selection was a four-day competition event replicating as much as possible the conditions of a WorldSkills Competition.

During the squad selection process in February 2014, the research team administered a paper and pencil survey to squad members. The survey (described in more detail below) consisted of two sections: demographics and background (37 items) and self-evaluation of characteristics (92 items). Average survey completion time was 30 minutes. Eighty-seven squad members completed the survey, for a response rate of 98% per cent. The sample consisted of 68 (78.2%) male and 19 (21.8%) female respondents. Their ages ranged from 17 to 25 years (M=19.4, SD=1.316). Of the sample (n=87) 39 (44.8%) were selected for the team (30 males and 9 females, 79.6% and 23.1% respectively). Their ages ranged from 17 to 25 years (M=19.5, SD=1.502). Forty-eight (55.2%) were in the non-competitor group – squad members who were not selected for the team – and consisted of 38 males (79.2%) and 10 females (20.8%). Their ages ranged from 17 to 22 years (M=19.3, SD=1.148).

The survey was also administered to 81 young people who did not make the squad. This group consisted of 62 (76.5%) male and 19 (23.5%) female respondents. Their ages ranged from 16 to 23 years (M=19.3, SD=1.169).

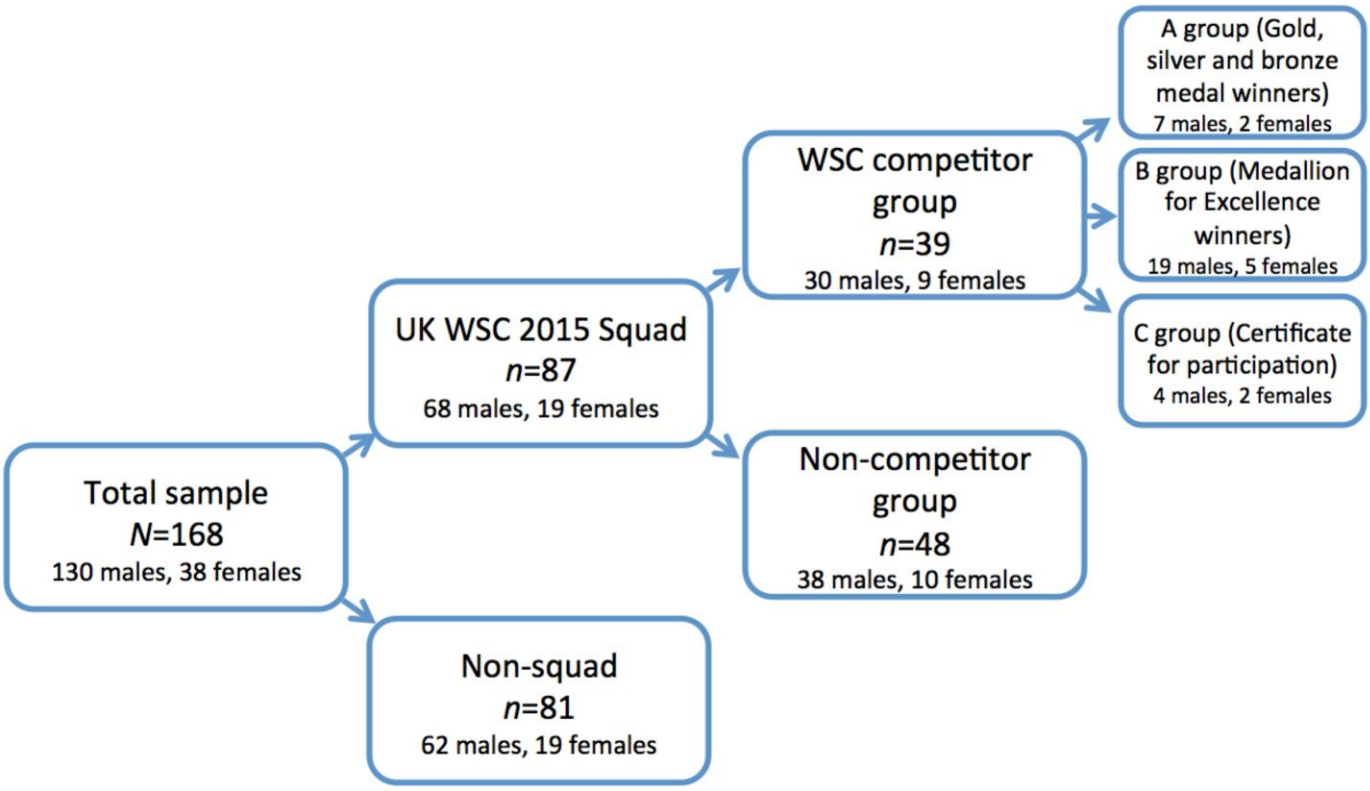


Figure 2: Participants of the study.

The Survey

The demographic section of the survey consisted of 37 questions and gathered information on: participants' age, gender (1=Male, 2=Female), prior study success in general subjects (Mathematics, English, Science, Sports grades from 1=A+ to 6=E, F) and past vocational skills competition success (1=Gold, 2=Silver or bronze, 3=Other).[2] Participants would have taken part in the national skills competitions organised by WorldSkills UK and might have also participated in international competitions as well. It should be noted that the WorldSkills competition is considered more demanding than national or other international competitions.

The self-evaluation section (Nokelainen, 2015) measured participants' characteristics with 92 questions (see Appendix) along a five-point Likert scale (1=totally disagree, 5=totally agree). These questions were related to the dimensions outlined in the theoretical framework and measured by 31 factors on six scales:

1) *Natural abilities:* Linguistic, Mathematical, Spatial, Bodily-kinaesthetic, Musical, Interpersonal, Intrapersonal, Spiritual, Environmental;

[2] The survey used in the Finnish study was first translated into English, and then adapted for use with a UK sample. Only minor adaptations were required (e.g. terminology, background questions pertaining to school subjects).

2) *Ethical sensitivities*: Reading and expressing emotions, Taking the perspectives of others, Caring by connecting to others, Working with interpersonal and group differences, Generating interpretations and options, Identifying the consequences of actions and options;

3) *Influential factors to vocational talent development*: Non-domain specific extrinsic conditions, Domain specific extrinsic conditions, Domain specific intrinsic motivation, Domain specific extrinsic motivation;

4) *Skills needed in WorldSkills training*: Social abilities, Cognitive abilities, Entrepreneurial abilities;

5) *Patterns of adaptive learning*: Mastery Goal Orientation, Performance-Approach Goal Orientation, Performance-Avoidance Goal Orientation; and

6) *Learning motivation*: Intrinsic goal orientation, Extrinsic goal orientation, Meaningfulness of studies, Control beliefs, Efficacy beliefs, Test anxiety.

WorldSkills Sao Paulo competitors' (*N*=39) rank (Gold, Silver, Bronze, Medallion for Excellence, Certificate of Participation) was added to the survey data. Due to the small number of Team UK competitors in WorldSkills Sao Paulo, we used only rank information in the analysis. The categorical "WS_success" dependent variable contained the following three classes: 1) Gold, silver or bronze medal, 2) Medallion for Excellence ≥500 points, 3) Certificate of Participation <500 points).

Research Questions

Following from the two key research questions outlined in the Introduction, and based on the theoretical framework, we formulated six operational research questions:

What are vocational skills competitors' 1) natural abilities, 2) ethical sensitivities, 3) influential factors to vocational talent development, 4) abilities needed in WorldSkills training, 5) patterns of adaptive learning, and 6) learning motivation? We then compared results for: (a) squad members who were and those who were not selected for Team UK and (b) the most and least successful WS competitors (based on actual performance in the competition).

Statistical Analyses

The design of the current study permits the investigation of naïve causality (the assumption that latent causes are absent), as the research evidence is based on multiple data sources collected over time: the characteristics of UK squad members were assessed during the training period (self-evaluation) prior to the WorldSkills competition, and their competition success index was compiled later on the basis of their performance in an international world championship skills competition, WorldSkills Sao Paulo 2015.

Due to small sample sizes, statistical analyses were performed with non-parametric methods (e.g., Spearman rank order correlations, Mann-Whitney *U*-test and Kruskal-Wallis *H*-test). Some research questions were further investigated with non-parametric non-frequentistic Bayesian Classification Modeling (BCM, see Myllymäki et al., 2002), a method for analysing statistical dependencies between discrete observed indicators. BCM resembles Linear Discriminant Analysis, but instead of using frequentistic probability interpretation and mechanistic predictor variable selection methods (e.g., forward, backward), it is based on the concept of so called 'subjective probability' and uses genetic algorithms for variable selection. This data mining approach derives the most probable set of predictor (or independent) variables for a given class variable (gender, WSC Team Membership and WSC success) and visualises the result in a form of a Bayesian Network (BN). The classification accuracy of the model is provided and compared to the baseline classification accuracy (i.e., classifying the cases without the BN). The advantage of using BCM is that it allows linear and non-linear statistical analysis of discrete variables without technical limitations related to sample size or normality assumptions (for a more detailed discussion, see Gill, 2002; Nokelainen, Silander, Ruohotie, & Tirri, 2007; Nokelainen, 2008).

Each research question was investigated in two stages. First, we calculated location and dispersion descriptive statistics (M= mean, SD=standard deviation) for the whole sample (N=168). Second, we made three comparisons of group differences based on participants (squad and team members) 1) gender (n=87, Mann-Whitney U test); 2) selection to the WSC team (n=87, Mann-Whitney U test); and 3) success in the WSC (n=39 Kruskal-Wallis H test). The third comparison was made between the following groups of WSC competitors: "A" group (n=9) consists of WSC gold, silver or bronze medal winners, "B" group (n=24) consists of Medallion for Excellence winners who scored 500 points or more, and the third "C" group (n=6) consists of WSC competitors who scored less than 500 points (certificate of participation). We also examined differences between squad members and those who attempted but failed to make the squad.

Study Limitations

Some limitations to the research should be noted. First, the study relies on self-report data that is not independently verified. For example, we accept respondents' reports about prior competition experience, school grades or evaluations of their own abilities as factual, but acknowledge that such reports may be affected by positive bias (respondents may tend to present themselves in a positive light). Although we use statistical methods suited for small sample sizes, the small sample may make it more difficult to detect a true difference where one exists.

Results

Relationships Among Background Variables

Correlational analysis was conducted on the squad member sample to investigate relationships between respondents' self-reported age, school success in general subjects, past vocational competition success and observed WorldSkills Sao Paulo success. Results presented in Table 1 show that Mathematics grade has a strong positive correlation with English, Science and Sports grades [$r_S(82)=.50$, $p<.01$, $r_S(76)=.49$, $p<.01$ and $r_S(40)=.47$, $p<.01$]. English grades are negatively correlated with past competition success. Mathematics and past competition success are negatively, but not significantly related to performance in the WS competition, a result which may be partly due to the small size of the sample.

Table 1: Correlations Between Background Variables and WorldSkills Sao Paulo Performance (*n*=87)

Variables	Mathematics[a]	English[a]	Science[a]	Sports[a]	Past competition success[b]	WorldSkills Sao Paulo success[c]
Age	.06	-.12	.11	-.05	.11	-.31
Mathematics		.50**	.49**	.47**	.02	-.23
English			.43**	.45**	-.39**	.20
Science				.40*	.03	.10
Sports					-.12	.17
Past competition success						-.32

Note. ** = $p \leq .01$. Spearman rank order correlations were calculated.
[a] Self-reported general school subject success: 1=A+, 2=A, 3=B, 4=C, 5=D, 6=E,F.
[b] Self-reported past vocational competition success: 1=Gold, 2=Silver or bronze, 3=Other.
[c] Observed WorldSkills Sao Paulo success (*n*=39): 1=Gold, silver or bronze, 2=Medallion for Excellence (≥500 points), 3= Certificate of Participation (<500 points).

Natural Abilities

Descriptive Statistics

Natural abilities were measured with an adaptation of Multiple Intelligences Profiling Questionnaire MIPQ IX (Tirri & Nokelainen, 2011) based on Howard Gardner's Theory of Multiple Intelligences (Gardner, 1983, 1993). MIPQ consists of following nine dimensions (example statements from the survey are provided in parenthesis):

1. Linguistic ("Writing is a natural way for me to express myself.")
2. Mathematical-logical ("Mental arithmetic is easy for me.")
3. Spatial ("I can easily imagine how a landscape looks from a birds-eye view.")
4. Bodily-kinaesthetic ("I am handy.")
5. Musical ("I can easily keep the rhythm when drumming a melody.")

6. Interpersonal ("I get along easily with different types of people.")
7. Intrapersonal ("I am able to analyze my own motives and ways of action.")
8. Spiritual ("I often reflect on the meaning of life.")
9. Environmental ("Protecting the environment is important to me.").

As expected, based on research with skills competitors in Finland (Nokelainen & Ruohotie, 2009; Nokelainen, 2015), competitors rated Bodily-kinaesthetic ('handiness') most strongly (*M*=4.5, *SD*=.514, see Table 2). High-average scores in Mathematical-logical abilities, and low-average scores in Linguistic abilities, are also consistent with the research findings from Finland and with the findings reported in the previous section. However, higher self-evaluated Interpersonal ('social') than Intrapersonal ability of UK respondents differs from combined Finnish team results from 2011 London, 2009 Calgary and 2007 Shizuoka WorldSkills competitions where both interpersonal (*M*=3.6, *SD*=.806) and intrapersonal (*M*=3.6, *SD*=.752) abilities were at the same level (Nokelainen, 2012). Table 2 also shows that non-squad results did not differ markedly from the results of UK squad members.

Table 2: Average Self-reported Scores on Measures of Natural Abilities (*N*=168)

	Non-squad (*n*=81)	Squad (*n*=87)
Natural Abilities	*M*(*SD*)	*M*(*SD*)
Linguistic	2.4(.741)	2.3(.754)
Mathematical-logical	3.8(.753)	3.7(.844)
Spatial	3.7(.698)	3.7(.672)
Bodily-kinaesthetic	4.5(.514)	4.4(.639)
Musical	3.2(1.029)	3.4(.923)
Interpersonal	3.5(.856)	3.5(.781)
Intrapersonal	3.2(.645)	3.3(.709)
Spiritual	3.3(.660)	3.3(.766)
Environmental	3.2(.970)	3.3(.792)

Gender

According to Table 3, females' ratings were significantly higher than males' on the linguistic [*Z*(1,87)=-3.840, *p*<.001] dimension. Male respondents estimated their mathematical-logical abilities higher than females did [*Z*(1,87)=-2.380, *p*=.017]. Similar results were found in our previous UK squad study in 2013 (Nokelainen et al, 2014). These findings are also consistent with an earlier study with Finnish WorldSkills competitors (Nokelainen, 2012). These results show small to medium effect sizes according to Cohen (1988). Bayesian analysis confirmed these results, but they should be interpreted with caution, however, as there were three times as many males as females in the sample.

Table 3: Average Self-reported Scores on Measures of Natural Abilities, by Gender (*n*=87)

Natural Abilities	Gender[a]				
	Male *M*(*SD*)	Female *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Linguistic	2.1(.681)	2.9(.718)	-3.840	.000	.41
Mathematical-logical	3.8(.812)	3.3(.855)	-2.380	.017	.26
Spatial	3.8(.701)	3.6(.561)	-1.006	.314	.11
Bodily-kinaesthetic	4.4(.661)	4.3(.563)	-1.034	.301	.11
Musical	3.4(.909)	3.5(.989)	-1.134	.257	.12
Interpersonal	3.4(.804)	3.7(.682)	-1.116	.264	.12
Intrapersonal	3.3(.706)	3.4(.737)	-.725	.469	.08
Spiritual	3.3(.808)	3.4(.614)	-.212	.832	.02
Environmental	3.3(.724)	3.4(1.021)	-.731	.465	.08

[a] Males *n*=68, females *n*=19.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): Small effect size = .10; Medium = .30; Large = .50.

WSC Team Membership

As we can see from the Table 4, the individuals who were selected to represent UK in the WorldSkills Sao Paulo competition (*n*=39) did not significantly differ from the non-selected individuals (*n*=48) in any of the nine multiple intelligence dimensions.

Table 4: Differences in Self-Reported Natural Abilities Between the WSC Competitors and Non-selected Squad Members (*n*=87)

Natural Abilities	Compete in WSC[a]				
	No *M*(*SD*)	Yes *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Linguistic	2.4(.789)	2.2(.704)	-1.202	.229	.11
Mathematical-logical	3.6(.879)	3.9(.784)	-1.505	.132	.14
Spatial	3.7(.741)	3.8(.581)	-.435	.663	.04
Bodily-kinaesthetic	4.4(.535)	4.3(.749)	-.425	.671	.04
Musical	3.5(.868)	3.2(.972)	-1.148	.251	.11
Interpersonal	3.5(.680)	3.4(.895)	-.227	.820	.02
Intrapersonal	3.4(.670)	3.3(.759)	-.598	.550	.06
Spiritual	3.4(.719)	3.3(.822)	-.953	.341	.09
Environmental	3.3(.816)	3.3(.772)	-.271	.786	.03

[a] Non-selected *n*=48, selected *n*=39.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): Small effect size = .10; Medium = .30; Large = .50.

Success in the WSC

According to non-parametric analyses, success in the WorldSkills Sao Paulo competition was not statistically significantly related to competitors' natural abilities (see Table 5). However, we can see a tendency (supported by our previous study with WSC UK Leipzig 2013 competitors) that members of the A group have higher self-assessed mathematical logical intelligence than the members of the B and C groups. This finding should be interpreted with caution, as the competitor sub-sample is quite small (*n*=39) and thus the power to reject null hypothesis when it does not hold is low (sensitive to Type II error).

Table 5: Differences in Average Self-Reported Natural Abilities by WSC Competition Success (*n*=39)

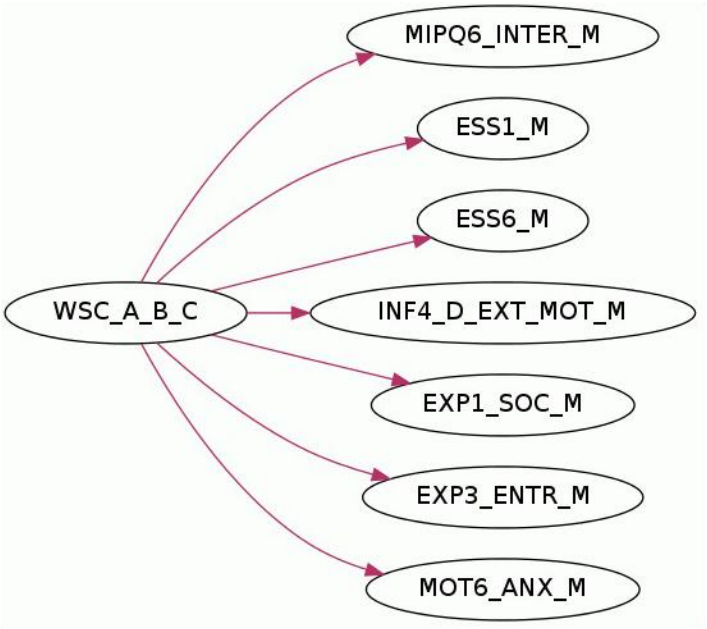
Natural Abilities	Success in WSC[a]					
	A *M*(*SD*)	B *M*(*SD*)	C *M*(*SD*)	χ^{2b}	*p*	η^{2c}
Linguistic	2.0(.423)	2.2(.788)	2.5(.652)	1.964	.375	.02
Mathematical-logical	4.0(.637)	3.8(.818)	3.9(.945)	.241	.887	.00
Spatial	3.8(.622)	3.8(.609)	3.7(.485)	.306	.858	.00
Bodily-kinaesthetic	4.5(.551)	4.3(.819)	4.2(.765)	1.265	.531	.01
Musical	2.8(.781)	3.4(.976)	3.2(1.100)	3.627	.163	.03
Interpersonal	3.1(.936)	3.5(.856)	3.6(1.033)	1.596	.450	.01
Intrapersonal	3.2(.833)	3.2(.771)	3.5(.671)	.885	.642	.01
Spiritual	3.5(.690)	3.1(.878)	3.3(.785)	1.928	.381	.02
Environmental	3.2(.986)	3.3(.690)	3.3(.880)	.145	.930	.00

[a] "A" group (gold, silver and bronze medal winners) *n*=9, "B" group (medallion for excellence winners, score ≥ 500) *n*=24, "C" group (score < 500 points) *n*=6.
[b] Kruskal-Wallis *H* test.
[c] Scale for the effect size indicator ($\eta^2=Z/N$): Small effect size = .01; Medium = .06; Large = .14.

Bayesian modeling of the factors related to success in the WSC

Due to the small sample size, we conducted Bayesian Classification Modeling (BCM) in order to learn which factors are related to WSC success. The success in WSC was coded into "WSC_A_B_C" variable for the analysis ("A": gold, silver and bronze medal winners, *n*=9; "B": Medallion for Excellence winners, *n*=24; "C": Certificate for participation, *n*=6). The BCM analysis aimed to find most probable Bayesian Network representing dependencies between the class variable ("WSC_A_B_C") and the 31 predictor variables ("Natural Abilities", 9 variables; "Ethical Sensitivities", 6 variables; "Influential Factors to Talent Development", 4 variables; "Abilities Needed for WorldSkills Training", 3 variables; "Patterns of Adaptive Learning", 3 variables; "Learning Motivation", 6 variables).

Figure 3 presents the most probable model for the WSC success with 76.9% classification accuracy. The model predicts factors related to success quite well, as the baseline model (predicting A, B, and C group membership without survey information) yields 61.5% classification accuracy. The automated variable selection process (data mining) included these seven variables in the model, as they provide useful information to predict WSC success. The other 24 variables were not included in the model, as they did not provide such information.



MIPQ Interpersonal ability

ESS Reading and expressing emotions

ESS Generating interpretations and options

INF Domain specific extrinsic motivation

EXP Expertise – social abilities

EXP Expertise – entrepreneurial abilities

AL MOT Test anxiety

Figure 3: Bayesian Network of Factors Related to WorldSkills Competition Success

Note: "WSC_A_B_C" variable has three classes: A=Gold, silver and bronze medal winners, B=Medallion for Excellence winners with a total score ≥ 500, C=Competitors with a score < 500.

Figure 4 presents the results of BCM regarding the first dimension ("Natural Abilities"). It shows that only one multiple intelligence factor, Interpersonal intelligence ("MIPQ6_INTER_M"), is related to the WorldSkills Sao Paulo success. Further, we can see the probability distribution for this variable if we "know" that a participant belongs to the A, B or C group. For example, the medal winners ("A", second column from the left) have a lower probability to select response option 4 ("agree") or 5 ("totally agree") when self-assessing their interpersonal (32%+11%=43%) intelligence than competitors in the two other groups (summative probabilities range from 64% – 69%).

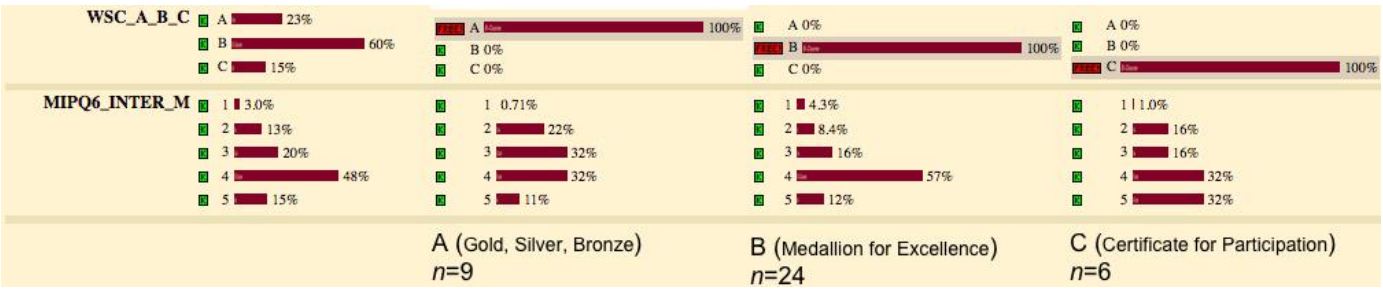


Figure 4: Bayesian Network of Relation Between Interpersonal Intelligence and WorldSkills Competition Success.

WSC Squad vs.Non-squad Group

As we can see from the Table 6, the individuals who were squad members for the WorldSkills Sao Paulo (*n*=87) did not significantly differ from the individuals who did not make the squad (*n*=81) in any of the dimensions.

Table 6: Differences in Self-Reported Natural Abilities Between the WSC Squad (*n*=87) and Non-squad Group Members (*n*=81)

Natural Abilities	Non-squad group [a] *M*(*SD*)	WSC Squad [a] *M*(*SD*)	*Z* [b]	*p*	*r* [c]
Linguistic	2.4(.741)	2.3(.754)	-.626	.532	.05
Mathematical-logical	3.8(.753)	3.7(.844)	-.271	.786	.02
Spatial	3.7(.698)	3.7(.672)	-.628	.530	.05
Bodily-kinaesthetic	4.5(.514)	4.4(.639)	-.526	.599	.04
Musical	3.2(1.029)	3.4(.923)	-1.427	.154	.11
Interpersonal	3.5(.856)	3.5(.781)	-.337	.736	.03
Intrapersonal	3.2(.645)	3.3(.709)	-.498	.619	.04
Spiritual	3.3(.660)	3.3(.766)	-.241	.809	.02
Environmental	3.2(.970)	3.3(.792)	-.118	.906	.01

[a] Non-squad group *n*=81, WSC squad *n*=87.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): Small effect size = .10; Medium = .30; Large = .50.

Ethical Sensitivities

Descriptive Statistics

Ethical sensitivities were measured with an adaptation of the Ethical Sensitivity Scale (ESS, see Tirri & Nokelainen, 2011), which is based on Narvaez's operationalization of ethical sensitivity (1993; Narvaez & Endicott, 2001). Its main purpose is to scale the respondents' orientations on ethical issues. We collected data on the following six dimensions (example statements from the survey in parenthesis):[3]

1. Reading and expressing emotions ("I notice if someone working with me is offended at me.")
2. Taking the perspectives of others ("I think it is good to have close friends and associates who think in different ways.")
3. Caring by connecting to others ("I take charge of how other people are doing.")

[3] Her theory consists of seven dimensions, but in this study we omitted the fifth original dimension (Preventing social bias) due to its problematic psychometric properties (for more discussion, see Tirri & Nokelainen, 2011, p. 64)

4. Working with interpersonal and group differences ("I take other peoples' viewpoints into account before making important decisions in my life.")
5. Generating interpretations and options ("I think about the consequences of my acts when making ethical decisions.")
6. Identifying the consequences of actions and options ("I notice when I am facing a moral issue at school, WSC training or work.").

Table 7 shows that these young vocational skills competitors seem to be able to take other peoples' viewpoints into account before making important decisions. Quite high-value mean scores on all dimensions suggest that most participants are ethically sensitive.

Table 7: Average Self-reported Scores on Measures of Ethical Sensitivity (*N*=168)

	Non-squad (*n*=81)	Squad (*n*=87)
Ethical Sensitivities	*M*(*SD*)	*M*(*SD*)
Reading and expressing emotions	3.5(.877)	3.6(.769)
Taking the perspectives of others	3.8(.820)	3.8(.822)
Caring by connecting to others	4.2(.736)	4.2(.687)
Working with interpersonal and group differences	3.8(.855)	3.9(.761)
Generating interpretations and options	4.0(.770)	4.0(.833)
Identifying the consequences of actions and options	3.9(.900)	3.9(.836)

Gender

In parallel with earlier studies, Table 8 shows that females tended to rate their ethical skills higher than males did (e.g., Tirri & Nokelainen, 2011, p. 71). Results of Mann-Whitney *U* test show that there are gender-related significant differences in the sample: Females' ratings were significantly higher than males' in the 'Taking the perspectives of others', [*Z* (1,87)=-1.967, *p*=.049] and 'Caring by connecting to others', [*Z*(1,87)=-2.243, *p*=.025] dimensions. However, effect sizes of these results are small to medium.

Table 8: Differences in Self-reported Scores on Measures of Ethical Sensitivity by Gender (*n*=87)

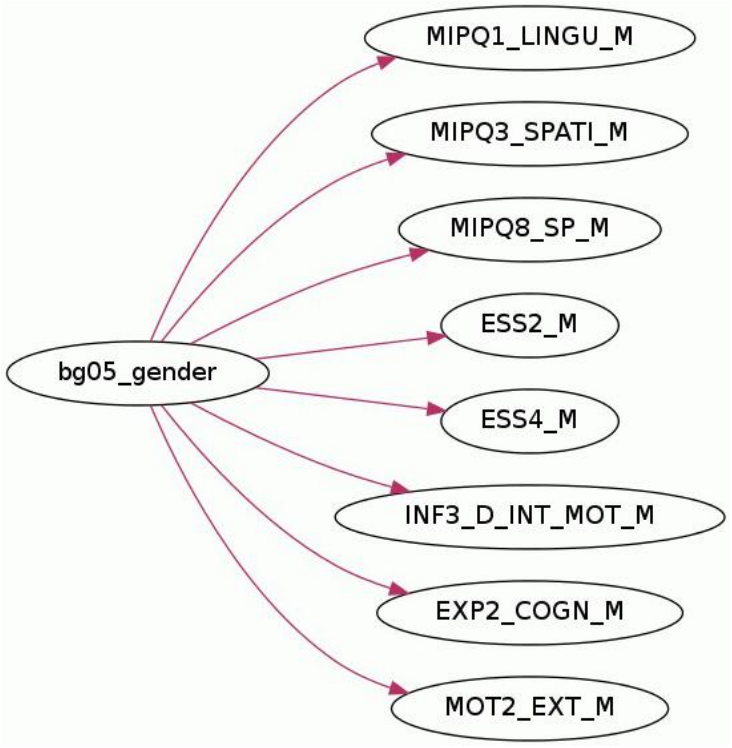
	Gender[a]				
Ethical Sensitivities	Male *M*(*SD*)	Female *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Reading and expressing emotions	3.6(.800)	3.7(.700)	-.921	.357	.10
Taking the perspectives of others	3.7(.850)	4.1(.640)	-1.967	.049	.21
Caring by connecting to others	4.1(.700)	4.5(.540)	-2.243	.025	.24
Working with interpersonal and	3.8(.800)	4.1(.400)	-1.251	.211	.13

group differences					
Generating interpretations and options	3.9(.800)	4.3(.800)	-1.872	.061	.20
Identifying the consequences of actions and options	3.9(.800)	4.2(.800)	-1.565	.118	.17

[a] Males *n*=68, females *n*=19.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): Small effect size = .10; Medium = .30; Large = .50.

Due to the small sample size, we conducted Bayesian Classification Modeling (BCM) in order to learn which factors are related to participants' gender. The gender was coded into "bg05_gender" variable for the analysis ("male"; "female"). The aim of the BCM analysis was to find the most probable Bayesian Network representing dependencies between the class variable ("bg05_gender") and the 31 predictor variables (representing "Natural Abilities", 9 variables; "Ethical Sensitivities", 6 variables; "Influential Factors to Talent Development", 4 variables; "Abilities Needed for WorldSkills Training", 3 variables; "Patterns of Adaptive Learning", 3 variables; "Learning Motivation", 6 variables).

Figure 5 presents the most probable model for the gender related differences with 87.4% classification accuracy. The model predicts factors related to gender quite well, as the baseline model (predicting participants' gender without survey information) yields 78.2% classification accuracy. The baseline classification accuracy is high, as there are more males (*n*=130) than females (*n*=38) in the sample. The automated variable selection process (data mining) included eight variables in the model, as they provide useful information to predict gender. The other 23 variables did not provide relevant classification information.



MIPQ Linguistic intelligence

MIPQ Spatial intelligence

MIPQ Spiritual intelligence

ESS Taking the perspectives of others

ESS Working with interpersonal and group differences

INF Domain specific intrinsic motivation

EXP Expertise – cognitive abilities

AL MOT Extrinsic goal orientation

Figure 5: Bayesian Network of Factors Related to Gender.

As Figure 5 shows, two ethical sensitivity dimensions are valid predictors for gender: '2. Taking the perspectives of others' and '4. Working with interpersonal and group differences'. According to Figure 6, analysis of probability distribution of the second ethical sensitivity factor shows that 87.0 per cent of females (vs. 71.0% of males) are likely to select the "totally agree" or "agree" response options for a question such as "I get along with people who think in different ways." Further, investigation of the fourth ethical sensitivity factor showed that 98.0 per cent of females (vs. 79.0% of males) would select the "totally agree" or "agree" response options for a question such as "I take other peoples' viewpoints into account before making important decisions in my life."

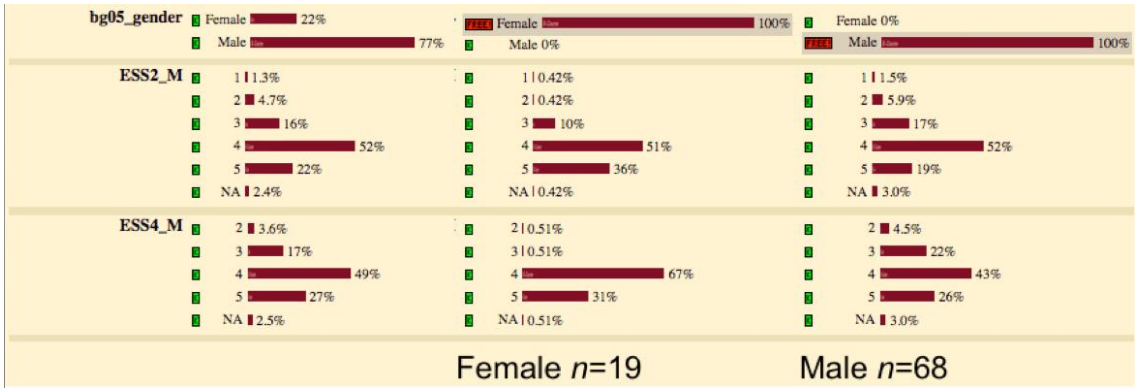


Figure 6: Bayesian Network of Ethical Sensitivity Factors Predicting Gender.

WSC Team Membership

The results in Table 9 show that the non-competing participants self-evaluated the second ('Taking the perspectives of others') and sixth ('Identifying the consequences of actions and options') ethical sensitivity dimensions higher than the competing participants. Results were statistically significant. In contrast to our earlier findings with 2011 and 2013 UK squads, it seems that ethical sensitivity is one of the factors that differentiate between the squad members who were selected to compete at WSC 2015 and those who were not selected. Our earlier studies with WCS London 2011 and WSC Leipzig 2013 UK squad[4] competitors found no significant differences between the WSC competitors and non-selected squad members.

[4] Also a recent study with academically gifted Finnish mathematics Olympians suggested a positive relation between higher order moral judgment, operationalizing the post-conventional level (5th and 6th stages) of Kohlberg's moral theory (1969), and the fifth and sixth dimensions of ethical sensitivity (Tirri & Nokelainen, 2012).

Table 9: Differences in Ethical Sensitivity Between the WSC Competitors and Non-selected Squad Members (*n*=87)

Ethical Sensitivities	Compete in WSC[a]				
	No *M*(*SD*)	Yes *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Reading and expressing emotions	3.7(.800)	3.5(.700)	-1.022	.307	.10
Taking the perspectives of others	4.0(.690)	3.5(.870)	-3.243	.001	.31
Caring by connecting to others	4.3(.620)	4.2(.760)	-.533	.594	.05
Working with interpersonal and group differences	4.0(.700)	3.7(.800)	-1.423	.155	.13
Generating interpretations and options	4.1(.800)	3.9(.900)	-1.084	.278	.10
Identifying the consequences of actions and options	4.1(.700)	3.7(.900)	-2.127	.033	.20

[a] Non-selected *n*=48, selected *n*=39.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): Small effect size = .10; Medium = .30; Large = .50.

Success in the WSC

Results of our previous study with the WSC Leipzig 2013 team indicated that medal winners (A group) were less ethically sensitive than competitors in the other two groups. This finding, also supported by Bayesian analysis, was not replicated in the current study (see Table 10).

Table 10: Differences in Ethical Sensitivity by WSC Competition Success (*n*=39)

Ethical Sensitivities	Success in WSC[a]					
	A *M*(*SD*)	B *M*(*SD*)	C *M*(*SD*)	χ^{2b}	*p*	η^{2c}
Reading and expressing emotions	3.3(.700)	3.6(.700)	3.4(.900)	1.025	.599	.01
Taking the perspectives of others	3.3(.710)	3.6(.720)	3.2(1.510)	.949	.622	.01
Caring by connecting to others	4.3(.750)	4.2(.640)	3.8(1.170)	1.247	.536	.01
Working with interpersonal and group differences	3.7(1.000)	3.8(.700)	3.5(.900)	.429	.807	.00
Generating interpretations and options	3.8(1.000)	3.9(.800)	3.7(1.300)	.012	.994	.00
Identifying the consequences of actions and options	3.9(.900)	3.6(.900)	3.8(1.200)	.500	.779	.00

[a] "A" group (gold, silver and bronze medal winners) *n*=9, "B" group (medallion for excellence winners, score ≥ 500) *n*=24, "C" group (score < 500 points) *n*=6.
[b] Kruskal-Wallis *H* test.
[c] Scale for the effect size indicator ($\eta^2=Z/N$): Small effect size = .01; Medium = .06; Large = .14.

WSC Squad vs. Non-squad Group

As we can see from the Table 11, the individuals who were squad members for the WorldSkills Sao Paulo (*n*=87) did not significantly differ from the individuals who did not make the squad (*n*=81) in any of the dimensions.

Table 11: Differences in Self-Reported Ethical Sensitivities Between the WSC Squad (*n*=87) and Non-squad (*n*=81)

Ethical Sensitivities	Non-squad [a] *M*(*SD*)	WSC Squad [a] *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Reading and expressing emotions	3.5(.900)	3.6(.800)	-.087	.931	.01
Taking the perspectives of others	3.8(.820)	3.8(.820)	-.036	.971	.00
Caring by connecting to others	4.2(.740)	4.2(.690)	-.032	.975	.00
Working with interpersonal and group differences	3.8(.900)	3.9(.800)	-.008	.993	.00
Generating interpretations and options	4.0(.800)	4.0(.800)	-.439	.661	.03
Identifying the consequences of actions and options	3.9(.900)	3.9(.800)	-.405	.686	.03

[a] Non-squad *n*=81, WSC squad *n*=87.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): Small effect size = .10; Medium = .30; Large = .50.

Influential Factors to Talent Development

Descriptive Statistics

The third research question concerns the influence of domain- and non-domain-specific factors on the development of vocational talent. Domain-specific factors are directly related to vocational skill areas, such as welding or hairdressing. Non-domain-specific factors, such as family and friends, may have indirect relationships to vocational talent development. In the survey we asked 12 questions about talent development, drawn from prior research (Campbell, 1996; Nokelainen & Ruohotie, 2008; Nokelainen, in press). These questions operationalized the following four factors (sample items in parenthesis):

1. Non-domain-specific extrinsic conditions (“An encouraging home atmosphere.”)
2. Domain-specific extrinsic conditions (“Stimulating influence of a teacher or trainer.”, “Seeing impressive demonstrations of skill.”)
3. Domain-specific intrinsic motivation (“My own interest in the field.”)
4. Domain-specific extrinsic motivation” (“Interest in competing with others in vocational skills.”)

Table 12 shows that respondents considered all of these four factors to be important for vocational talent development. Consistent with earlier research with UK squads for WSC London 2011 (Nokelainen et al, 2013), WSC

Leipzig 2013 (Nokelainen et al, 2014) and in Finland (Nokelainen, 2015), the least important factor for skills development was related to non-domain-specific extrinsic conditions.

Table 12: Average Self-Reported Scores on Measures of Talent Development (*N*=168)

	Non-squad (*n*=81)	Squad (*n*=87)
Influential Factors	*M*(*SD*)	*M*(*SD*)
Non-domain specific extrinsic conditions	4.1(.834)	4.1(1.009)
Domain specific extrinsic conditions	4.5(.491)	4.5(.578)
Domain specific intrinsic motivation	4.8(.395)	4.9(.305)
Domain specific extrinsic motivation	4.5(.607)	4.5(.691)

Gender

Results of non-parametric Mann-Whitney *U* tests (Table 13) show that there are self-reported gender-related differences in domain- and non-domain-specific extrinsic conditions with regard to vocational talent development: Females evaluated the first two factors significantly higher than males. This finding is consistent with our previous WSC Leipzig 2013 study.

Table 13: Differences in Average Scores on Measures of Talent Development by Gender (*n*=87)

	Gender[a]				
Influential Factors	Male *M*(*SD*)	Female *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Non-domain-specific extrinsic conditions	3.9(1.100)	4.5(.600)	-2.085	.037	.22
Domain-specific extrinsic conditions	4.5(.600)	4.7(.600)	-2.035	.042	.22
Domain specific intrinsic motivation	4.9(.300)	4.9(.300)	-.659	.510	.07
Domain-specific extrinsic motivation	4.5(.700)	4.7(.500)	-.610	.542	.07

[a] Males *n*=68, females *n*=19.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): Small effect size = .10; Medium = .30; Large = .50.

WSC Team Membership

Findings from the previous studies with WSC London 2011 and WSC Leipzig 2013 squads indicated no self-reported differences related to team membership on influential factors to vocational talent development. However, data presented in Table 14 show that non-competing squad members of the Sao Paulo team valued domain specific extrinsic conditions (such as teacher's encouragement) more than competing members, [$Z(1,87)=-2.945$, $p=.003$]. There is a tendency for non-competitors to rate motivational factors as important as well.

Table 14: Differences in Talent Development Between the WSC Competitors and Non-selected Squad Members (*n*=87)

Influential Factors	Compete in WSC[a] No *M*(*SD*)	Compete in WSC[a] Yes *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Non-domain specific extrinsic conditions	4.2(.900)	3.9(1.100)	-1.172	.241	.11
Domain specific extrinsic conditions	4.7(.500)	4.3(.600)	-2.945	.003	.28
Domain specific intrinsic motivation	4.9(.100)	4.8(.400)	-1.854	.064	.18
Domain specific extrinsic motivation	4.6(.800)	4.5(.600)	-1.834	.067	.17

[a] Non-selected *n*=48, selected *n*=39.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): Small effect size = .10; Medium = .30; Large = .50.

Success in the WSC

Data presented in Table 15 show that there were no self-reported differences related to WorldSkills competition success on influential factors to vocational talent development. However, results indicate that medal and medallion winners evaluated their domain-specific intrinsic motivation higher than non-winners (C group). This finding is in parallel with the results of WSC Leipzig 2013 study. However, medal winners at WSC London 2011 had a significantly lower score on domain-specific extrinsic motivation (drive to compete).

Table 15: Differences in Talent Development by WSC Competition Success (*n*=39)

Influential Factors	Success in WSC[a] A *M*(*SD*)	Success in WSC[a] B *M*(*SD*)	Success in WSC[a] C *M*(*SD*)	χ^{2b}	*p*	η^{2c}
Non-domain-specific extrinsic conditions	4.4(.700)	3.8(1.200)	3.6(1.500)	1.926	.382	.02
Domain-specific extrinsic conditions	4.5(.600)	4.4(.500)	4.0(1.000)	.730	.694	.01
Domain-specific intrinsic motivation	4.9(.300)	4.9(.300)	4.4(.700)	5.145	.076	.05
Domain-specific extrinsic motivation	4.7(.400)	4.5(.600)	4.1(.900)	1.647	.439	.01

[a] "A" group (gold, silver and bronze medal winners) *n*=9, "B" group (medallion for excellence winners, score ≥ 500) *n*=24, "C" group (score < 500 points) *n*=6.
[b] Kruskal-Wallis *H* test.
[c] Scale for the effect size indicator ($\eta^2=Z/N$): Small effect size = .01; Medium = .06; Large = .14.

WSC Squad vs. Non-squad

As we can see from the Table 16, the individuals who were squad members for the WorldSkills Sao Paulo (*n*=87) did not significantly differ from the individuals who did not make the squad (*n*=81) in any of the dimensions.

Table 16: Differences in Self-Reported Talent Development Between the WSC Squad (*n*=87) and Non-squad Members (*n*=81)

Influential Factors	Non-squad [a] *M*(*SD*)	WSC Squad [a] *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Non-domain specific extrinsic conditions	4.1(.800)	4.1(1.000)	-.094	.925	.01
Domain specific extrinsic conditions	4.5(.500)	4.5(.600)	-1.118	.263	.09
Domain specific intrinsic motivation	4.8(.400)	4.9(.300)	-.430	.667	.03
Domain specific extrinsic motivation	4.5(.600)	4.5(.700)	-.542	.588	.04

[a] Non-squad *n*=81, WSC squad *n*=87.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): Small effect size = .10; Medium = .30; Large = .50.

Abilities Needed for WorldSkills Training

Descriptive Statistics

Nokelainen (2015) found that essential abilities to succeed in WorldSkills training could be categorised into three classes (sample statements in parenthesis): 1) Social ("Bounce back from failures or injustices."; "Do team work."; Manage conflict situations."); 2) Cognitive ("Create new work methods."; "Apply new work methods."); and 3) Entrepreneurial ("Take responsibility and controlled risks."; "See problematic work tasks as positive challenges."). The first class represents *skills*, the second *intelligence* and the third *aptitude*. Table 17 shows that all three components were reported to be related to success in training and were considered equally important.

Table 17: Average Self-reported Scores on Measures of Abilities Needed in WorldSkills Training (*N*=168)

	Non-squad (*n*=81)	Squad (*n*=87)
Abilities Needed in WorldSkills Training	*M*(*SD*)	*M*(*SD*)
Social abilities	4.6(.431)	4.5(.528)
Cognitive abilities	4.6(.473)	4.6(.443)
Entrepreneurial abilities	4.6(.498)	4.6(.469)

Gender

Comparison of males to females indicated that both groups estimated the importance of these abilities to be high (mean range from 4.5 – 4.8). Females rated their social and cognitive abilities on the same level as males, and entrepreneurial abilities higher than males did [$Z(1,87)=-2.479$, $p=.013$] (Table 18). Although the last difference is statistically significant, the effect size is not that strong. Females reported higher rating on all three abilities in

2013. In 2011, however, the result was somewhat opposite: males rated their cognitive and entrepreneurial abilities as significantly more important.

Table 18: Differences in Abilities Needed in WorldSkills Training by Gender (*n*=87)

Abilities Needed in WorldSkills Training	Gender[a] Male *M*(*SD*)	Female *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Social abilities	4.5(.600)	4.5(.400)	-.335	.737	.04
Cognitive abilities	4.6(.400)	4.6(.500)	-.536	.592	.06
Entrepreneurial abilities	4.6(.500)	4.8(.400)	-2.479	.013	.27

[a] Males *n*=68, females *n*=19.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): Small effect size = .10; Medium = .30; Large = .50.

WSC Team Membership

Both competing and non-competing WSC groups rated all three abilities highly. Table 19 shows that non-competing group estimated their social abilities, e.g., ability to bounce back from failures or injustices, and their entrepreneurial abilities higher than competitors. None of these abilities was significantly related to team membership in the 2011 or 2013 studies.

Table 19: Differences in Abilities Needed in WorldSkills Training Between the WSC Competitors and Non-selected Squad Members (*n*=87)

Abilities Needed in WorldSkills Training	Compete in WSC[a] No *M*(*SD*)	Yes *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Social abilities	4.6(.400)	4.3(.600)	-2.163	.031	.20
Cognitive abilities	4.6(.400)	4.6(.500)	-.400	.690	.04
Entrepreneurial abilities	4.7(.400)	4.5(.500)	-2.099	.036	.20

[a] Non-selected *n*=48, selected *n*=39.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): Small effect size = .10; Medium = .30; Large = .50.

Success in the WSC

The Kruskal-Wallis *H* test showed that competitors' performance in WSC Sao Paulo was not statistically related to their social, cognitive or entrepreneurial abilities (Table 20). This was also true for WSC London 2011 and WSC Leipzig 2013 competitors.

Table 20: Differences in Abilities Needed in WorldSkills Training by WSC Competition Success (*n*=39)

Abilities Needed in WorldSkills Training	Success in WSC[a] A *M*(*SD*)	B *M*(*SD*)	C *M*(*SD*)	χ^{2b}	*p*	η^{2c}
Social abilities	4.3(.400)	4.3(.700)	4.6(.400)	1.331	.514	.01
Cognitive abilities	4.5(.600)	4.6(.500)	4.5(.500)	.547	.761	.00
Entrepreneurial abilities	4.7(.400)	4.5(.500)	4.4(.800)	.522	.770	.00

[a] "A" group (gold, silver and bronze medal winners) *n*=9, "B" group (medallion for excellence winners, score ≥ 500) *n*=24, "C" group (score < 500 points) *n*=6.
[b] Kruskal-Wallis *H* test.
[c] Scale for the effect size indicator (η^2=*Z*/*N*): Small effect size = .01; Medium = .06; Large = .14.

WSC Squad vs. Non-squad

As we can see from Table 21, the individuals who were squad members for the WSC Sao Paulo (*n*=87) did not significantly differ from the individuals who did not make the squad (*n*=81) in any of the dimensions. However, WSC Squad members rated their social abilities slightly lower than the non-squad group.

Table 21: Differences in Self-Reported Abilities Needed in WorldSkills Training Between the WSC Squad (*n*=87) and Non-squad Group Members (*n*=81)

Abilities Needed in WorldSkills Training	Non-squad[a] *M*(*SD*)	WSC Squad[a] *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Social abilities	4.6(.400)	4.5(.500)	-1.764	.078	.14
Cognitive abilities	4.6(.500)	4.6(.400)	-.003	.997	.00
Entrepreneurial abilities	4.6(.500)	4.6(.500)	-.353	.724	.03

[a] Non-squad *n*=81, WSC squad *n*=87.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator (*r*=*Z*/√*N*): Small effect size = .10; Medium = .30; Large = .50.

Patterns of Adaptive Learning

Descriptive Statistics

Goal orientation theory discriminates between mastery and performance goals, approach and avoidance goals, and task and ego involvement (Ames, 1992; Elliot & Harackiewicz, 1996). *Mastery goal-oriented* competitors enjoy learning new skills because they find them inherently interesting. They seek to develop their competence and to aim at achieving mastery and a deep understanding of their skill area (e.g., "I want to be as good as possible in my own skill area."). Their *task and ego involvement* is directly related to mastery goal orientation, but in this case, the attention focuses on the task (Midgley et al., 2000). Performance goal orientations are linked to approach and avoidance goals, usually labelled *performance-approach* and *performance-avoidance goal orientations*. The former

is related to the demonstration of competence (e.g., "My aim is to show others that I am in the top level in my skill area."), whereas the latter is related to avoidance of the demonstration of incompetence ("I avoid showing others if I am facing difficulties in WSC training exercises.").

As expected with a sample consisting of competitors in skills competitions, 'Performance-avoidance goal orientation' was self-evaluated as the least dominating factor (Table 22), a finding that concurs with Finnish competitors (Nokelainen, 2015) and with the studies of the UK squads for WSC London 2011 and WSC Leipzig 2013.

Table 22: Average Self-reported Scores on Measures of Patterns of Adaptive Learning (*N*=168)

	Non-squad (*n*=81)	Squad (*n*=87)
Patterns of Adaptive Learning	*M*(*SD*)	*M*(*SD*)
Mastery goal orientation	4.8(.352)	4.8(.248)
Performance-approach goal orientation	4.7(.470)	4.8(.435)
Performance-avoidance goal orientation	3.5(.888)	3.4(.876)

Gender

Results of the Mann-Whitney *U* test (Table 23) did not reveal any statistically significant differences between male and female respondents. Also, the BCM results indicated that participants' gender could not be predicted by these three goal orientation factors. This finding concurs with our previous studies of the UK squads for WSC London 2011 and WSC Leipzig 2013.

Table 23: Differences in Patterns of Adaptive Learning by Gender (*n*=87)

Patterns of Adaptive Learning	Gender[a]				
	Male *M*(*SD*)	Female *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Mastery goal orientation	4.8(.200)	4.8(.300)	-1.145	.252	.12
Performance-approach goal orientation	4.7(.400)	4.8(.400)	-.792	.429	.08
Performance-avoidance goal orientation	3.4(.900)	3.6(.700)	-.535	.592	.06

[a] Males *n*=68, females *n*=19.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): Small effect size = .10; Medium = .30; Large = .50.

WSC Team Membership

Table 24 shows that non-competing squad members rated their goal orientations higher than competing members. The rating for mastery goal orientation (e.g., "I want to be as good as possible in my own skill area.") was statistically significant, [$Z(1,87)=-2.191$, $p=.028$]. In contrast, results of our previous studies with WSC London 2011

and WSC Leipzig 2013 squad did not reveal any significant differences between competing and non-competing respondents.

Table 24: Differences in Patterns of Adaptive Learning Between the WSC Competitors and Non-selected Squad Members (*n*=87)

Patterns of Adaptive Learning	Compete in WSC[a]				
	No *M*(*SD*)	Yes *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Mastery goal orientation	4.9(.200)	4.7(.300)	-2.191	.028	.21
Performance-approach goal orientation	4.8(.400)	4.7(.500)	-1.731	.084	.16
Performance-avoidance goal orientation	3.6(.900)	3.2(.900)	-1.920	.055	.18

[a] Non-selected *n*=48, selected *n*=39.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): Small effect size = .10; Medium = .30; Large = .50.

Success in the WSC

Kruskal-Wallis *H* test results showed no difference between success in WSC Sao Paulo and goal orientations (Table 25). Bayesian analysis confirms this finding. However, medal winners self-reported higher performance-avoidance goal orientation than B or C group members did (e.g., avoiding demonstration of incompetence). Our previous study with WSC 2011 London competitors also showed that performance-avoidance goal oriented competitors performed best [$\chi^2(2,37)=11.374$, $p=.003$, $\eta^2=.15$] . The opposite result was found in a study of 77 Finnish WorldSkills competitors[5] (Nokelainen, 2012).

Table 25: Differences in Patterns of Adaptive Learning by WSC Competition Success (*n*=39)

Patterns of Adaptive Learning	Success in WSC[a]					
	A *M*(*SD*)	B *M*(*SD*)	C *M*(*SD*)	χ^{2b}	*p*	η^{2c}
Mastery goal orientation	4.7(.300)	4.7(.300)	4.7(.300)	.010	.995	.00
Performance-approach goal orientation	4.7(.300)	4.8(.300)	4.2(1.000)	2.966	.227	.03
Performance-avoidance goal orientation	3.4(.700)	3.2(1.000)	3.2(.700)	.247	.884	.00

[a] "A" group (gold, silver and bronze medal winners) *n*=9, "B" group (medallion for excellence winners, score ≥ 500) *n*=24, "C" group (score < 500 points) *n*=6.
[b] Kruskal-Wallis *H* test.
[c] Scale for the effect size indicator ($\eta^2=Z/N$): Small effect size = .01; Medium = .06; Large = .14.

[5] Kruskal-Wallis *H* test with a Finnish combined sample (*N*=77) from two WorldSkills teams (2009, 2011) showed that the A group (medal winners) had higher Mastery-approach goal orientation (*M*=4.8, *SD*=.332) than the C group (*M*=4.4, *SD*=.851), *Z*(1,48)=-2.352, *p*=.019. Results also showed that there was no difference in Performance-avoidance goal orientation between A, B or C groups.

WSC Squad vs. Non-squad

As we can see from the Table 26, the individuals who were squad members for the WorldSkills Sao Paulo (*n*=87) did not significantly differ from the individuals who were not (*n*=81) in any of the dimensions. However, performance-approach goal orientation (e.g., "My aim is to show others that I am in the top level in my skill area.") was slightly higher in the WSC Squad (*M*=4.8, *SD*=.400) than in the group who did not make the squad (*M*=4.7, *SD*=.500).

Table 26: Differences in Patterns of Adaptive Learning Between the WSC Squad (*n*=87) and Non-squad Group Members (*n*=81)

Patterns of Adaptive Learning	Non-squad [a] *M*(*SD*)	WSC Squad [a] *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Mastery goal orientation	4.8(.400)	4.8(.200)	-1.057	.291	.08
Performance-approach goal orientation	4.7(.500)	4.8(.400)	-1.766	.077	.14
Performance-avoidance goal orientation	3.5(.900)	3.4(.900)	-.284	.776	.02

[a] Non-squad *n*=81, WSC squad *n*=87.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): Small effect size = .10; Medium = .30; Large = .50.

Learning Motivation

Descriptive Statistics

Learning motivation was measured with an adaptation of the Abilities for Professional Learning Questionnaire (APLQ, see Nokelainen & Ruohotie, 2002). APQL is based on the Motivated Strategies for Learning Questionnaire by Pintrich and his colleagues (1991), but adapted for vocational education. The instrument consists of six motivational dimensions measured with 12 statements (example statements from the survey in parentheses):

1. Intrinsic goal orientation ("I am very interested in my skill area as well as new information related to it.")
2. Extrinsic goal orientation ("I want to be number one in my skill area in the next World Skills Competition.")
3. Meaningfulness of studies ("I believe that WorldSkills training will be of practical benefit to me in the future.")
4. Control beliefs ("I am able to learn even the most difficult work methods if I practice hard enough."
5. Efficacy beliefs ("I am confident that I will master even the most difficult work methods in my training."),
6. Test anxiety ("While doing a routine task in WorldSkills competition, I am also thinking about the really challenging tasks to come.").

An earlier study with Finnish WorldSkills competitors showed that all motivational factors, except nervousness in testing situations, were considered important (Nokelainen, 2015). Finnish competitors evaluated the role of ability (Efficacy beliefs) in their success a little higher than the role of effort (Control beliefs). Further, results indicated that the most successful Finnish competitors (A group) had a higher belief in WorldSkills training as a benefit for

their future career (Meaningfulness of studies) than those who did not succeed in WorldSkills competition (C group).

Results for the UK squad concur with the Finnish study (see Table 27); the average ratings for all but the test anxiety scale approach the upper range (4="Agree" and 5="Totally agree"). These data also show that respondents rate ability ('Efficacy beliefs') over effort ('Control beliefs') as an explanation for success in skills competitions. [6]

Table 27: Location and Dispersion Descriptive Statistics of Learning Motivation (*N*=168)

	Non-squad (*n*=81)	Squad (*n*=87)
Learning Motivation	*M*(*SD*)	*M*(*SD*)
Intrinsic goal orientation	4.1(.691)	4.2(.617)
Extrinsic goal orientation	4.5(.586)	4.6(.532)
Meaningfulness of studies	4.7(.464)	4.8(.359)
Control beliefs	3.8(.759)	3.8(.706)
Efficacy beliefs	4.0(.692)	4.2(.658)
Test anxiety	3.4(.808)	3.3(.831)

Gender

The results of Mann-Whitney *U* tests in Table 28 show no gender-related differences on the six learning motivation factors. Bayesian analysis confirms this finding. There were also no significant gender differences in our earlier studies of UK squads.

Table 28: Gender Related Differences in Learning Motivation (*n*=87)

	Gender[a]				
Learning Motivation	Male *M*(*SD*)	Female *M*(*SD*)	Z^b	*p*	r^c
Intrinsic goal orientation	4.2(.600)	4.2(.600)	-.532	.595	.06
Extrinsic goal orientation	4.6(.600)	4.7(.400)	-.133	.894	.01
Meaningfulness of studies	4.8(.400)	4.9(.300)	-1.710	.087	.18
Control beliefs	3.8(.700)	3.6(.600)	-.862	.389	.09
Efficacy beliefs	4.2(.700)	4.1(.600)	-.675	.500	.07
Test anxiety	3.3(.800)	3.4(.900)	-.218	.827	.02

[6] In a study by Tirri and Nokelainen (2011) a sample of Finnish mathematics Olympians tended to attribute success and failure to both ability and effort. They compared this finding to European studies, where mathematic Olympians were reported to attribute success and failure more often to ability, and to American studies, where mathematics Olympians attributed success and failure more often to effort.

[a] Males *n*=68, females *n*=19.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): Small effect size = .10; Medium = .30; Large = .50.

WSC Team Membership

Somewhat surprisingly, squad members who were selected to compete in WSC reported lower levels of extrinsic goal orientation (e.g., "It is important for me to do well in WorldSkills training and show others what I am capable of.") than those who were not selected (Table 29), [$Z(1,87)=-2.060$, $p=.039$]. Non-competing members also indicated that they are more interested in their skill areas (Meaningfulness of studies) than competing members, and that they believe more in effort than ability as an explanation for their success. Although these results were not statistically significant, they were confirmed with Bayesian analysis results.

Table 29: Differences in Learning Motivation Between the WSC Competitors and Non-selected Squad Members (*n*=87)

Learning Motivation	Compete in WSC[a]				
	No *M*(*SD*)	Yes *M*(*SD*)	Z[b]	*p*	r[c]
Intrinsic goal orientation	4.3(.600)	4.2(.600)	-.932	.352	.09
Extrinsic goal orientation	4.8(.400)	4.5(.600)	-2.060	.039	.19
Meaningfulness of studies	4.9(.300)	4.8(.400)	-1.823	.068	.17
Control beliefs	3.9(.700)	3.6(.700)	-1.848	.065	.17
Efficacy beliefs	4.1(.600)	4.3(.700)	-1.576	.115	.15
Test anxiety	3.3(.800)	3.3(.800)	-.643	.520	.06

[a] Non-selected *n*=48, selected *n*=39.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): Small effect size = .10; Medium = .30; Large = .50.

Success in WSC

Kruskal-Wallis *H* test results showed no statistically significant differences between success at WSC Sao Paulo 2015 and learning motivation (Table 30). However, Bayesian Classification Modeling (see Figure 7) confirms (with 76.9% classification accuracy) that test anxiety is highest in the A and C groups.

Table 30: Differences in Learning Motivation by WSC Competition Success (*n*=39)

Learning Motivation	Success in WSC[a]					
	A *M*(*SD*)	B *M*(*SD*)	C *M*(*SD*)	χ^{2}[b]	*p*	η^{2}[c]
Intrinsic goal orientation	4.1(.400)	4.2(.600)	4.0(.800)	1.126	.569	.01
Extrinsic goal orientation	4.6(.400)	4.5(.700)	4.3(.900)	.100	.951	.00
Meaningfulness of studies	4.7(.400)	4.8(.300)	4.7(.600)	.321	.852	.00

Control beliefs	3.6(.700)	3.7(.600)	3.3(.900)	1.795	.408	.02
Efficacy beliefs	4.2(.600)	4.3(.700)	4.4(.500)	.432	.806	.00
Test anxiety	3.6(.700)	3.1(.900)	3.8(.700)	3.275	.194	.03

[a] "A" group (gold, silver and bronze medal winners) *n*=9, "B" group (medallion for excellence winners, score ≥ 500) *n*=24, "C" group (score < 500 points) *n*=6.
[b] Kruskal-Wallis *H* test.
[c] Scale for the effect size indicator ($\eta^2=Z/N$): Small effect size = .01; Medium = .06; Large = .14.

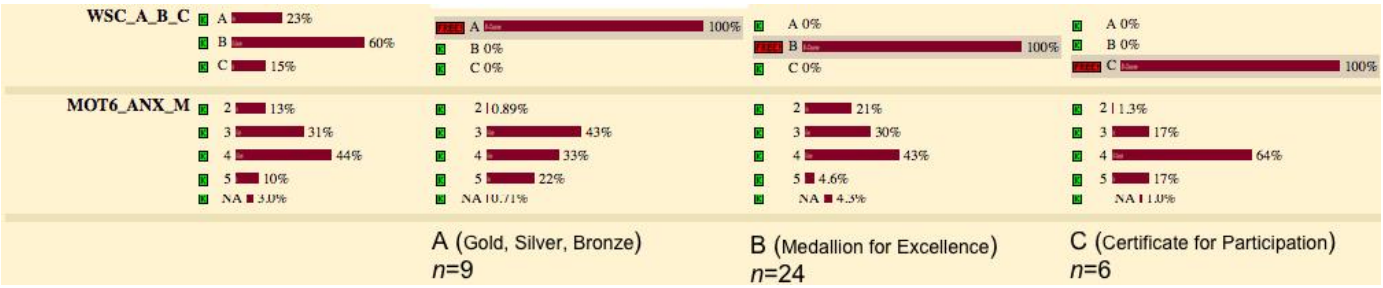


Figure 7: Bayesian Network Showing a Connection Between Test Anxiety and WorldSkills Success.

WSC Squad vs. Non-squad Group

As we can see from Table 31, the individuals who were squad members for the WorldSkills Sao Paulo (*n*=87) did not significantly differ from the individuals who were not (*n*=81) in any of the dimensions.

Table 31: Differences in Learning Motivation Between the WSC Squad (*n*=87) and Non-squad Group Members (*n*=81)

Learning Motivation	Non-squad [a] *M*(*SD*)	WSC Squad [a] *M*(*SD*)	*Z* [b]	*p*	*r* [c]
Intrinsic goal orientation	4.1(.700)	4.2(.600)	-.980	.327	.08
Extrinsic goal orientation	4.5(.600)	4.6(.500)	-1.016	.310	.08
Meaningfulness of studies	4.7(.500)	4.8(.400)	-.911	.362	.07
Control beliefs	3.8(.800)	3.8(.700)	-.035	.972	.00
Efficacy beliefs	4.0(.700)	4.2(.700)	-1.410	.159	.11
Test anxiety	3.4(.800)	3.3(.800)	-.981	.327	.08

[a] Non-squad group *n*=81, WSC squad *n*=87.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): Small effect size = .10; Medium = .30; Large = .50.

Summary and Conclusions

This report presents survey findings from young people involved with WorldSkills UK in advance of WSC Sao Paulo 2015 to identify factors related to the development of vocational excellence. The analysis compared survey data for three groups: female and male squad members; non-competitors versus team members who competed at WSC Sao Paulo; and medal versus non-medal winners. These analyses repeat those for two prior studies that involved UK squad members in the run up to WSC London 2011 (Nokelianen et al., 2013) and WSC Leipzig 2013 (Nokelainen et al., 2014). In addition, the study included a group consisting of 81 young people who were not selected for the squad. The main findings from this study are as follows:

- Looking first at **background characteristics,** grades in school were not significantly related to performance at WSC Sao Paulo 2015, which is a similar finding to our studies of WSC Leipzig 2013 and WSC London 2011 UK squads.
- Overall, participants most highly rated having three **natural abilities:** body-kinaesthetic (handiness), mathematical-logical and spatial. The first two also received highest ratings for squads in 2011 and 2013. Comparing by gender, females rated their linguistic abilities significantly higher, while males rated mathematical-logical abilities higher. This finding is consistent with results from the UK squad in 2013. Interpersonal abilities were negatively related to medal success in 2015.
- Findings from this study concur with our prior research that young vocational skills competitors have a high degree of **ethical sensitivity.** Females rated themselves significantly higher than males did on two dimensions: 'Taking the perspective of others' and 'Working with interpersonal and group differences'. There is no consistent pattern of gender differences across the three UK squads. In contrast to our earlier findings with 2011 and 2013 UK squads, it seems that ethical sensitivity is one of the factors that differentiated between the squad members who were selected to compete at WSC 2015 and those who were not selected: those not selected rated themselves higher on two dimensions: 'Taking the perspective of others' and 'Identifying the consequences of actions and options'. In contrast, while our earlier studies indicated that medal winners reported being less ethically sensitive, this was not the case with the 2015 Sao Paulo competitors.
- The four factors related to **talent development** (domain-and non-domain specific conditions and intrinsic and extrinsic motivation) were consistently rated as highly important for UK squad members in 2011, 2013 and 2015. In 2013 and 2015, females rated several factors higher than males did. In a departure from the earlier studies, the 2015 squad members who were not selected for the team had higher ratings than team members on four dimensions, but only one was statistically significant (domain specific conditions, such as teacher encouragement). With regard

to competition success, there is a mixed pattern overall, with no association found for talent development in 2015 and inconsistent findings in prior years.

- Respondents in 2015 highly rated all three **abilities needed for WorldSkills training** (social, cognitive and entrepreneurial), which is consistent with UK squad members in earlier years. Gender differences show a mixed pattern. In 2015 and 2013 females rated entrepreneurial abilities (and in 2013 also the other abilities) as significantly more important than males, while the opposite was true in 2011. While social and entrepreneurial abilities differentiated non-competitors from team members in 2015, this was not the case in either 2011 or 2013. Competitors' performance in WSC Sao Paulo was not statistically related to their social, cognitive or entrepreneurial abilities, which was also true for WSC London 2011 and WSC Leipzig 2013 competitors.
- **Adaptive learning** concerns ones goal orientation. As would be expected for competitors in skills competitions, the ratings show that their goals are oriented toward achieving mastery and they are less concerned about showing incompetence or failure to others. This pattern is consistent across 2011, 2013 and 2015. Squad members who were selected to compete in WSC reported lower levels of mastery goal orientation (e.g., "It is important for me to do well in WorldSkills training and show others what I am capable of.") than those who were not. This study and the WSC London 2011 study, suggest that the top performers had higher self-ratings on performance-avoidance goal orientation (avoiding demonstration of incompetence).
- Concerning **learning motivation,** UK squad members from 2011, 2013 and 2015 consistently rate ability over effort as an explanation for success in skills competitions. This is true for females and males. Overall, learning motivation does not distinguish between medal winners and others. But there is some suggestion from both 2015 and 2011 that medal winners experience higher test anxiety than others.
- In sum, several characteristics are associated with **medal winners**. Motivational factors, such as interest in one's field, were related to winning in all three teams. In 2013 and 2015, medal winners were motivated by not wanting to appear incompetent. In 2015, getting along with other people was negatively associated with medal winning. Medal winners may also experience higher test anxiety than others.
- Finally, we found no significant differences between UK skills participants (squad) and non-participants. The results showed some tendency for squad members to be more performance goal orientated than those not selected for the squad, suggesting that they were more motivated. The lack of significant differences in characteristics between those selected and not selected suggests that the selection process plays the most crucial role in determining who should advance to the squad.

- A consistent finding across the research was that motivation may play an important role in success. The implication is that uncovering the factors that influence motivation of UK skills participants, which can be positive or negative (text anxiety, not wanting to show failure), could be a focus of training.

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Appendix A: Descriptive Statistics for WSC Competitors and Non-competitors

DuVE Survey

Scales and items	Compete in WorldSkills Sao Paulo		Non-squad group
	Yes (*n*=39) *M*(*SD*)	No (*n*=48) *M*(*SD*)	(*N*=81) *M*(*SD*)
Natural Abilities			
Writing is a natural way for me to express myself.	2.4(1.071)	2.5(1.167)	2.4(.960)
At school, studies in English or social studies were easier for me than mathematics, physics and chemistry.	2.1(1.273)	2.6(1.300)	2.3(1.177)
I have recently written something that I am especially proud of, or for which I have received recognition.	1.8(.986)	1.7(1.063)	1.9(1.155)
Metaphors and vivid verbal expressions help me learn efficiently.	2.4(1.119)	2.6(1.084)	2.8(1.081)
At school, I was good at mathematics, physics or chemistry.	3.9(1.085)	3.4(1.165)	3.9(1.051)
I can work with and solve complex problems.	4.0(.932)	3.9(1.010)	3.9(.905)
Mental arithmetic is easy for me.	3.5(.997)	3.1(1.184)	3.3(1.049)
I am good at games and problem solving, which require logical thinking.	4.1(.826)	4.0(.967)	3.9(.885)
At school, geometry and other subjects involving spatial perception were easier for me than solving equations.	3.4(1.093)	3.3(1.047)	3.4(1.118)
It is easy for me to conceptualize complex and multidimensional patterns.	3.9(.739)	3.7(.893)	3.8(.894)
I can easily imagine how a landscape looks from a birds-eye view.	3.8(.959)	3.8(.963)	3.6(1.178)
When I read, I form pictures or visual images in my mind.	4.0(1.000)	4.0(.989)	3.9(1.065)
I am handy.	4.5(.854)	4.5(.804)	4.7(.570)
I can easily do something concrete with my hands (e.g. knitting and woodwork).	4.5(.942)	4.7(.552)	4.7(.592)
I am good at showing someone how to do something in practice.	4.2(.790)	4.2(.722)	4.2(.776)
I was good at handicrafts (e.g. woodwork; textiles) at school.	4.1(1.095)	4.4(.871)	4.4(.872)

Scales and items	Compete in WorldSkills Sao Paulo		Non-squad group
	Yes (*n*=39) *M*(*SD*)	No (*n*=48) *M*(*SD*)	(*N*=81) *M*(*SD*)
After hearing a tune once or twice I am able to sing or whistle it quite accurately.	3.4(1.161)	3.9(1.028)	3.3(1.136)
When listening to music, I am able to pick out individual instruments and recognize melodies.	3.3(1.272)	3.2(1.071)	3.0(1.280)
I can easily keep the rhythm when drumming a melody.	3.2(.997)	3.6(1.200)	3.3(1.183)
I notice immediately if a melody is out of tune.	3.2(1.204)	3.5(1.254)	3.1(1.290)
Even in strange company, I can easily find someone to talk to.	3.2(1.136)	3.2(.944)	3.3(1.034)
I get along easily with different types of people.	3.6(1.112)	3.7(.887)	3.8(1.013)
I make contact easily with other people.	3.4(1.071)	3.6(.920)	3.5(1.031)
In negotiations and group work, I am able to support the group to find a consensus.	3.5(.942)	3.8(.778)	3.7(.843)
I am able to analyze my own motives and ways of action.	3.9(.933)	4.0(.824)	3.7(.828)
I often think about my own feelings and sentiments and seek reasons for them.	3.4(1.054)	3.5(.825)	3.5(1.002)
I spend time regularly reflecting on the important issues in life.	3.5(1.232)	3.7(.993)	3.5(.937)
I like to read psychological or philosophical literature to increase my self-knowledge.	2.4(1.088)	2.3(1.148)	2.2(1.152)
In my busy everyday life I find it important to take time to think and reflect.	3.2(1.144)	3.5(.944)	3.4(1.027)
Even ordinary every-day life is full of amazing things.	3.9(1.046)	3.7(.944)	3.8(.949)
I often reflect on the meaning of life.	3.0(1.469)	3.1(1.153)	2.9(1.107)
It is important to me to share a quiet moment with others.	3.0(1.213)	3.4(.978)	3.4(1.041)
I enjoy the beauty and experiences related to nature.	3.7(1.069)	3.7(.893)	3.7(1.190)
Protecting the environment is important to me.	3.3(.999)	3.3(1.034)	3.4(1.058)
I pay attention to what I consume in order to protect the environment.	2.8(1.151)	2.9(1.130)	2.7(1.147)

Scales and items	Compete in WorldSkills Sao Paulo		Non-squad group
	Yes (*n*=39) *M*(*SD*)	No (*n*=48) *M*(*SD*)	(*N*=81) *M*(*SD*)
Ethical Sensitivities			
I notice if someone working with me is offended at me.	3.7(.898)	3.8(.824)	3.8(.933)
I am able to express my feelings to other people if I am offended or hurt because of them.	3.3(1.115)	3.6(1.047)	3.3(1.258)
I think it is good to have close friends and associates who think in different ways.	3.3(1.050)	4.0(.788)	3.7(.906)
I get along with people who think in different ways.	3.7(.898)	4.1(.674)	3.9(.871)
I take charge of how other people are doing.	4.3(.818)	4.4(.572)	4.3(.881)
I take care of the other peoples' well-being and try to contribute it.	4.1(.857)	4.2(.816)	4.1(.837)
I take other peoples' viewpoints into account before making important decisions in my life.	3.8(1.038)	4.1(.859)	4.0(.975)
I try to take other persons' needs into account although it is a question of my benefit.	3.7(.838)	3.9(.894)	3.7(1.084)
I think about the consequences of my acts when making ethical decisions.	3.7(1.025)	4.2(.797)	4.0(.915)
I believe there can be several right solutions to ethical problems.	4.1(.944)	4.1(.821)	3.9(.854)
I notice when I am facing a moral issue at school, WSC training or work.	3.7(.916)	4.1(.718)	3.9(.900)
Influential factors to vocational talent development			
An encouraging home atmosphere.	4.1(1.234)	4.4(.918)	4.2(.965)
Stimulating influence of a particular friend.	3.7(1.332)	4.0(.929)	4.0(.962)
Stimulating influence of a teacher or trainer.	4.2(.854)	4.5(.726)	4.5(.743)
Seeing impressive demonstrations of skill (e.g., furniture design, hairstyling; cabinet making).	4.2(1.080)	4.6(.684)	4.4(.826)
My own interest in the field.	4.8(.536)	4.9(.344)	4.8(.432)
My desire to learn new things.	4.8(.523)	5.0(.000)	4.8(.495)
Interest in extending my own limits.	4.8(.474)	5.0(.149)	4.8(.432)

Scales and items	Compete in WorldSkills Sao Paulo		Non-squad group
	Yes (*n*=39) *M*(*SD*)	No (*n*=48) *M*(*SD*)	(*N*=81) *M*(*SD*)
Interest in competing with others in vocational skills.	4.4(.782)	4.6(.813)	4.4(.768)
My desire to succeed in vocational competitions.	4.5(.682)	4.7(.769)	4.7(.632)
Employment opportunities in the future.	4.6(.637)	4.9(.383)	4.8(.481)
Team spirit amongst WS competitors.	4.5(.854)	4.7(.793)	4.6(.608)
The company of people sharing similar interests.	4.3(.818)	4.6(.886)	4.2(.926)
Skills needed in WorldSkills training			
Bounce back from failures or injustices.	4.6(.552)	4.7(.491)	4.8(.481)
Do team work.	4.2(1.001)	4.6(.645)	4.6(.610)
Manage conflict situations.	4.2(.852)	4.4(.682)	4.4(.592)
Improve existing work methods.	4.7(.620)	4.7(.538)	4.6(.649)
Apply new work methods.	4.7(.515)	4.8(.486)	4.8(.439)
Create new work methods.	4.6(.647)	4.6(.632)	4.4(.775)
Take responsibility and controlled risks.	4.4(.642)	4.7(.526)	4.6(.563)
See problematic work tasks as positive challenges.	4.6(.589)	4.8(.383)	4.6(.585)
Recognise impossible work tasks.	4.3(.898)	4.4(.834)	4.5(.654)

Scales and items	Compete in WorldSkills Sao Paulo		Non-squad group
	Yes (*n*=39) *M*(*SD*)	No (*n*=48) *M*(*SD*)	(*N*=81) *M*(*SD*)
Patterns of adaptive learning			
I want to learn as many new things as I can.	4.7(.498)	5.0(.204)	4.9(.416)
I want to be as good as possible in my own skill area.	5.0(.223)	5.0(.000)	4.9(.328)
I try to understand issues presented in the WSC training as thoroughly as possible.	4.5(.556)	4.6(.529)	4.6(.624)
I would like others (family, friends, teachers, trainers, trainees) to respect my craftsmanship.	4.5(.756)	4.7(.587)	4.5(.677)
My aim is to be in the top “A group” in my WSC training team.	4.7(.731)	4.9(.465)	4.6(.737)
I don’t want to embarrass myself in front of the others.	4.8(.413)	4.9(.351)	4.9(.429)
I avoid showing others if I am facing difficulties in WSC training exercises.	3.3(1.234)	3.8(1.262)	3.7(1.256)
It is important to me that my teacher/trainer thinks I am a smart person.	3.0(.973)	3.2(1.210)	3.4(1.088)
My aim is to show others that I am in the top level in my skill area.	3.4(1.251)	3.8(1.022)	3.4(1.193)

Scales and items	Compete in WorldSkills Sao Paulo		Non-squad group
	Yes (*n*=39) *M*(*SD*)	No (*n*=48) *M*(*SD*)	(*N*=81) *M*(*SD*)
Learning motivation			
I prefer to try challenging work methods from which I can learn something new.	4.5(.683)	4.6(.583)	4.4(.680)
I am able to learn even the most difficult work methods if I practise hard enough.	4.5(.555)	4.6(.529)	4.5(.656)
I expect to do extremely well in my WorldSkills training.	4.3(.751)	4.1(.824)	4.1(.686)
I am confident that I will master even the most difficult work methods in my training.	4.4(.736)	4.1(.775)	4.0(.827)
I want to be number one in my skill area in the next WorldSkills competition.	4.7(.569)	4.9(.416)	4.6(.621)
While doing a routine task in WorldSkills competition, I am also thinking about the really challenging tasks to come.	4.1(1.061)	4.0(1.179)	4.0(.921)
I am very interested in my skill area as well as new information related to it.	4.6(.584)	4.8(.560)	4.6(.698)
I am nervous in all kinds of competitions (in a negative way).	2.6(1.042)	2.6(1.138)	2.8(1.167)
I find it most rewarding when I can research a new work method as thoroughly as possible.	3.9(.812)	4.0(.933)	3.9(.900)
I believe that WorldSkills training will be of practical benefit to me in the future.	4.9(.339)	5.0(.146)	4.9(.443)
If I fail in an extremely demanding work task during WorldSkills training, it is mainly because I am not trying hard enough.	2.7(1.251)	3.2(1.318)	3.0(1.322)
It is important for me to do well in WorldSkills training and show others (family, friends, teachers, trainers, trainees) what I am capable of.	4.3(.910)	4.7(.562)	4.5(.870)