Understanding and Developing Vocational Excellence

A study of the WorldSkills UK Squad 2013

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Summary

WorldSkills UK, housed within the National Apprenticeship Service (NAS), contributes to the development of vocational talent in the UK by training young people to compete in WorldSkills Competitions (WSC), through partnership with employers and education organisations. As a developer of vocational talent it is interested in understanding what factors contribute to talent development. To that end, WorldSkills UK and NAS are supporting the ESRC Centre on Skills, Knowledge and Organisational Performance (SKOPE) to carry out research on young competitors. This report focuses on young people involved with WorldSkills UK in preparation for WSC Leipzig 2013. It follows on from an earlier pilot study of the WSC London 2011 squad.

The research approach is adapted from studies of WorldSkills competitors in Finland, who participate through SkillsFinland. That 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. Competition results provide an objective way to measure vocational excellence.

This study was carried out in the run up to WorldSkills Leipzig 2013 and includes survey data from 112 squad members, selected by WorldSkills UK to further train and compete for places on Team UK. Using statistical methods suited to small sample sizes, the research compares survey results for three groups: male versus female squad members; squad members versus team members; and medal winners versus non-medal winners at WSC Leipzig 2013. 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 the pilot study, the analysis does not reveal many significant findings. Over two studies, however, the pattern of results for both 2011 and 2013 competitors indicates that motivational factors, an aspect of intrinsic characteristics, were more important for medal winners than perceptions of natural abilities or external conditions. In particular, 2013 medal winners were motivated by a strong interest in their field, a drive to compete and confidence in their own ability. This result and its implications for WorldSkills UK training will be further explored as the research continues to include the WSC 2015 squad and a control group.

Introduction

Skills competitions provide a showcase for demonstrating and rewarding vocational excellence. They are seen as an important strategy for raising the attractiveness of vocational education and training (VET) in Europe, as evidenced by policy directives (e.g., Bruges Communiqué) and recent research (Guthrie *et al* 2012). Competitions are held at world, regional and national levels, and many countries, including the UK, compete at the world level. The UK has participated in the WorldSkills Competition (WSC) since 1953. WorldSkills UK, an initiative within the National Apprenticeship Service (NAS), partners with industry and education organisations to develop vocational talent through skills competitions. It manages national skills competitions for young people aged 18-22, who undergo intensive skill development to build their skills to world-class standard in order to be selected, first as part of the UK squad, and then for Team UK. Team UK competes in WorldSkills[1] competitions (WSC).

These competitions 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. WorldSkills UK and NAS supported this research project, which was carried out in collaboration with WorldSkills UK as it prepared competitors for the 2013 WorldSkills competition (WSC) in Leipzig. 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 our pilot study of the WorldSkills UK squad who trained in preparation for WSC London 2011 (reported in Nokelainen, Stasz and James 2013).

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[2] competitors (Nokelainen 2012, in press; Nokelainen and Ruohotie 2002, 2009). 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

[1] For more information on WorldSkills International and WSC see :www.worldskills.org
[2] Skills Finland is the Finnish equivalent of WorldSkills UK. For more information see http://www.skillsfinland.fi

Gagné's research on development of talent (Gagné 2004, 2010) and Howard Gardner's research on multiple intelligences (Gardner 1983, 1993). The model maps the development of vocational competence in terms of natural abilities, intrinsic characteristics, and extrinsic conditions (see Figure 1):

- Natural abilities include intellectual, affective abilities and body-kinesthetic 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 trainers and teachers, work experiences and peers.

The main 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 scores, and comparisons can be made between medal winners and other competitors in terms of their abilities, characteristics and external conditions.

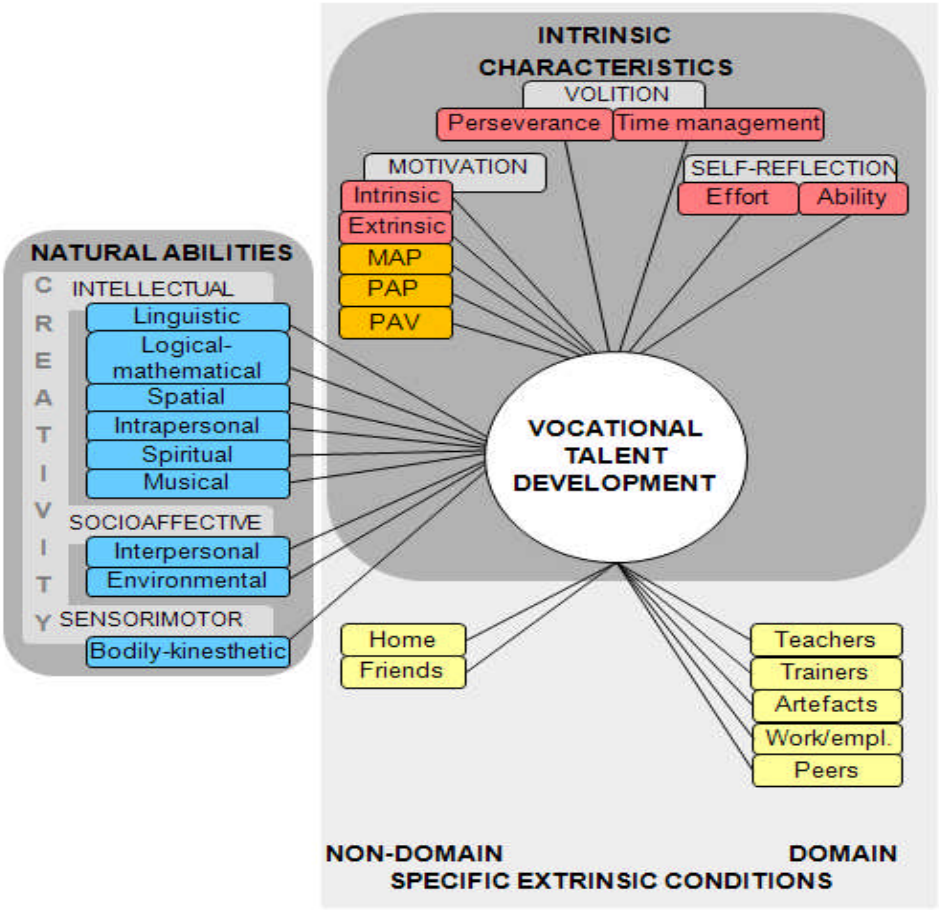

Figure 1: Developmental model of vocational talent

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 members of the WorldSkills UK squad in preparation for WSC Leipzig 2013. The squad consisted of 118 young people who had undergone a selection process that began with 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 sources 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 involved a 'pressure test'. Candidates received 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 WSC), marking schemes and rigour. After participating in a training programme over approximately six months (including further competitions) Team UK was selected in June 2013. Team selection followed a four-day competition event that replicated as much as possible the conditions of a WorldSkills Competition.

During team selection, 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. 112 squad members completed the survey, for a response rate of 94.9 per cent. The sample for this study consisted of 88 (79%) male and 24 (21%) female respondents. Their ages ranged from 17 to 22 years (Mean (*M*)=19.6, Standard Deviation (*SD*)=1.250). Of the sample (n=112) 28 were selected for the team (23 males and 5 females), leaving 84 in the non-competitor group (65 males and 19 females).[3]

[3] There were actually 33 team members selected from the squad; five declined to participate in the survey.

The Survey

The demographic section of the survey consisted of 37 questions and gathered information on: participants' age, gender, attainment in GCSE subjects (e.g., Mathematics, English, Science grades from A* to E) and past vocational skills competition success (1 = Gold, 2 = Silver or bronze, 3=Other).[4] Participants would have taken part in competitions organised by WorldSkills UK and might have also competed 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 2012, in press) 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-kinesthetic, Musical, Interpersonal, Intrapersonal, Spiritual, Environmental;

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 Leipzig competitors' (*N*=28) scores (*M*=513.4) and rank (Gold, Silver, Bronze, Medallion for Excellence, Certificate of Participation) were added to the survey data. Due to the small number of competitors in WorldSkills Leipzig, we used only rank information in the analysis. The categorical dependent variable contained three groups:

[4] 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). The Finnish study also included interviews with competitors, trainers and parents.

1) Gold, silver or bronze medal, 2) Medallion for Excellence ≥500 points in the competition, 3) Certificate of Participation <500 points).

Research Questions

Following from the two key research questions outlined in the Introduction and 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 were not selected for Team UK and (b) for Team UK members, those who were most and least successful at WSC Leipzig 2013.

Statistical analyses

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).[5] 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.[6] This approach derives the most probable set of predictor (or independent) variables for a given class variable (gender, WSL team membership and WSL 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 was that it allowed 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 (Mean, Standard Deviation) for the whole sample (N=112). Second, we compared three groups based on participants' 1) gender (N=112, Mann-Whitney *U* test), 2) selection to the WorldSkills UK team (N=112, Mann-Whitney *U* test), and 3) success in the WSL (*N*=28 Kruskal-Wallis *H* test). The third comparison was made between

[5] 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 Leipzig 2013.

[6] BCM resembles Linear Discriminant Analysis, but instead of using a 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.

the following groups of WSL competitors: A group (*n*=5) consists of WSL gold, silver or bronze medal winners, B group (*N*=17) consists of Medallion for Excellence winners who scored 500 points or more, and C group (*N*=6) consists of WSL competitors whose scored less than 500 points.

Study limitations

Some limitations to the research should be noted. First, the study relied on self-report data that is not independently verified. For example, we accepted 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 used statistical methods suited for small sample sizes, the small sample may make it more difficult to detect a true difference where one exists (Type II error). Third, this study did not include a control group of similar young people who do not compete or participate in WorldSkills UK training. We are in the process of gathering these data, which will be incorporated into future analyses.

Results

Relationships among background variables

Correlational analysis was conducted to investigate relationships between respondents' self-reported age, school success in general subjects, past vocational competition success and actual WorldSkills Leipzig success. Results presented in Table 1 show that grade in Mathematics is significantly, positively correlated with grades in English, Science and Sports. Interestingly, success in Sports is positively, but not significantly correlated with competition performance [$r_S(15)=.337$]. Grades and past competition success are positively, but not significantly related to performance in the WS competition, a result which may be partly due to the small size of the sample. The same was true of the WorldSkills London 2011 competitors (Nokelainen *et al* 2013).

Table 1: Correlations Between Background Variables and WorldSkills Leipzig Performance (*N*=112)

Variables	Mathematics[a]	English[a]	Science[a]	Sports[a]	Past competition success[b]	WorldSkills Leipzig success[c]
Age	.100	.007	.056	.124	-.199	-.157
Mathematics		.535**	.648**	.603**	.180	.192
English			.578**	.439**	.135	.182
Science				.625**	.196	.179
Sports					.025	.337
Past competition success						.055

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 Leipzig success (*n*=28): 1=Gold, silver or bronze, 2=Medallion for Excellence (≥500 points), 3=Other (<500 points).

Natural Abilities

Descriptive Statistics

Natural abilities were measured with an adaptation of Multiple Intelligences Profiling Questionnaire IMIPQ IX (Tirri & Nokelainen, 2011b) based on Howard Gardner's Theory of Multiple Intelligences (Gardner, 1983, 1993). MIPQ consists of the 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-kinesthetic ("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, in press), competitors rated Bodily-kinaesthetic ('handiness') most strongly (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, high self-evaluated Interpersonal ('social') ability of UK respondents differs slightly 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: Average Self-reported Scores on Measures of Natural Abilities (*N*=112)

Natural Abilities	*M*(*SD*)
Bodily-kinaesthetic	4.4(.614)
Mathematical-logical	3.9(.767)
Interpersonal	3.8(.797)
Spatial	3.7(.652)

Musical	3.4(.939)
Intrapersonal	3.4(.753)
Spiritual	3.3(.889)
Environmental	3.2(.963)
Linguistic	2.4 (.817)

The squad for WSC London 2013 also rated bodily-kinaesthetic abilities highest (M= 4.6, SD = .504) and linguistic lowest (M = 2.3, SD = .867), and the magnitude of mean scores was similar to those reported in Table 2.

Gender

As shown in Table 3, females' ratings were significantly higher than males' in linguistic, interpersonal, and intrapersonal dimensions. Male respondents estimated their mathematical-logical abilities significantly higher than females did. These results show small to medium effect sizes (Cohen, 1988).

Table 3: Average Self-reported Scores on Measures of Natural Abilities, by Gender (*N*=112)

Natural Abilities	Gender[a]				
	Male *M*(*SD*)	Female *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Linguistic	2.2(.747)	3.0(.803)	-3.884	.000	.37
Mathematical-logical	4.0(.705)	3.4(.840)	-3.191	.001	.30
Spatial	3.7(.650)	3.6(.665)	-.753	.451	.07
Bodily-kinesthetic	4.5(.584)	4.3(.705)	-1.398	.162	.13
Musical	3.4(.915)	3.4(1.040)	-.025	.980	.00
Interpersonal	3.7(.787)	4.1(.760)	-2.459	.014	.23
Intrapersonal	3.3(.718)	3.7(.817)	-2.096	.036	.20
Spiritual	3.2(.882)	3.6(.856)	-1.940	.052	.18
Environmental	3.1(.978)	3.5(.827)	-1.875	.061	.18

[a] Males *n*=88, females *n*=24.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): Small effect size = .10; Medium = .30; Large = .50.

These findings are similar to an earlier study with Finnish WorldSkills competitors[7] (Nokelainen, 2012). However, they are somewhat different to our earlier results with the squad for WSC London 2011, where males rated

[7] Mann-Whitney U test with a Finnish combined sample (*N*=110) from three WorldSkills teams (2007, 2009, 2011) showed that females rated linguistic, musical, interpersonal, intrapersonal [$Z(1,108)=-2.910$, $p=.004$], spiritual [$Z(1,108)=-4.125$, $p<.001$] and environmental [$Z(1,108)=-2.631$, $p=.009$] dimensions higher than males did.

themselves higher than females on most dimensions and significantly so on spatial abilities. The results for both 2011 and 2013 participants should be interpreted with caution, however, as there were many more males as females in the samples.

WSL Team Membership

As we can see from Table 4, the individuals who were selected to represent the UK at WorldSkills Leipzig (*n*=28) did not significantly differ from the non-selected individuals (*n*=84) in any of the nine multiple intelligence dimensions. This finding should be interpreted with caution as the group sizes are not equal (84 vs. 28). This replicates the results for the WorldSkills London 2011 sample.

Table 4: Differences in Self-Reported Natural Abilities Between the WSL Competitors and Non-selected Squad Members (*N*=112)

Natural Abilities	Compete in WSL[a]				
	No *M*(*SD*)	Yes *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Linguistic	2.4(.807)	2.2(.828)	-1.515	.130	.14
Mathematical-logical	3.9(.761)	3.9(.800)	-.128	.898	.01
Spatial	3.6(.634)	3.7(.712)	-1.049	.294	.10
Bodily-kinesthetic	4.4(.665)	4.6(.404)	-1.136	.256	.11
Musical	3.4(.951)	3.3(.916)	-.357	.721	.03
Interpersonal	3.8(.821)	3.8(.733)	-.680	.497	.06
Intrapersonal	3.3(.769)	3.4(.713)	-.608	.543	.06
Spiritual	3.2(.901)	3.5(.839)	-1.400	.162	.13
Environmental	3.1(.948)	3.4(.999)	-1.138	.255	.11

[a] Non-selected *n*=84, selected *n*=28.
[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 WSL

According to non-parametric analyses, success in WorldSkills Leipzig competition was not related to competitors' natural abilities (see Table 5). However, this finding should be interpreted with caution, as the competitor sub-sample is extremely small and thus the power to reject null hypothesis when it does not hold is low (sensitive to Type II error). This result is similar to findings for the WorldSkills London 2011 sample.

Table 5: Differences in Average Self-Reported Natural Abilities by WSL Competition Success (*n*=28)

Natural Abilities	Success in WSL[a]					
	A *M*(*SD*)	B *M*(*SD*)	C *M*(*SD*)	χ^b	*p*	η^c
Linguistic	2.1(.487)	2.2(.823)	2.2(1.156)	.031	.985	.00
Mathematical-logical	4.1(1.037)	3.8(.834)	3.9(.580)	.359	.836	.00
Spatial	3.7(.647)	3.6(.759)	4.3(.387)	4.127	.127	.04
Bodily-kinesthetic	4.6(.224)	4.6(.434)	4.5(.485)	.256	.880	.00
Musical	2.7(.518)	3.5(.978)	3.5(.813)	4.112	.128	.04
Interpersonal	3.7(.737)	3.8(.843)	3.7(.431)	.028	.986	.00
Intrapersonal	3.5(.512)	3.3(.653)	3.8(1.000)	1.196	.550	.01
Spiritual	3.7(.627)	3.5(.749)	3.5(1.289)	.147	.929	.00
Environmental	3.9(1.090)	3.2(.987)	3.5(.913)	2.763	.251	.02

[a] A group (gold, silver and bronze medal winners) n=5, B group (medallion for excellence winners, score ≥ 500) n=17, 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.

The results of the Bayesian Classification Modelling (see Figure 2) show (71.4% classification accuracy) that after the best predictor search four multiple intelligences factors are related to the WorldSkills Leipzig success. Further, Figure 2 shows the probability distribution of survey response options (1 "totally disagree" – 5 "totally agree") for these four variables if we "know" that a participant is a member of the A, B or C group. It also shows the range of nominal values (corresponding to the survey's response options) in the averaged variables. For example, the fifth response option ("totally agree") is not present in the MIPQ1_LINGU_M (linguistic intelligence) mean variable as the respondents have seldom used that response option for single items belonging to that factor. If we fix the class variable to value "A" (the medal winners, see second column from the left), the Bayesian network shows the probability distributions of the four predictor variables relating to this knowledge. By investigating the probability values of the fifth response option ("totally agree"), we may conclude that the A group members rate themselves lower on their linguistic (1.5% probability, "MIPQ1_LINGU_M" variable), intrapersonal (1.5%, "MIPQ7_INTRA_M") and spiritual intelligence (1.5%, "MIPQ8_SP_M") than competitors in two other groups (probabilities range from 6.2 – 48.0%). According to the results in Figure 2, most of the predictive distributions are non-linear by nature and thus quite difficult to interpret. For example, the least successful competitors are the most diverse group with regard to spiritual intelligence: there is a 32% probability for them to choose "disagree", but also 48% probability for them to choose "totally agree".

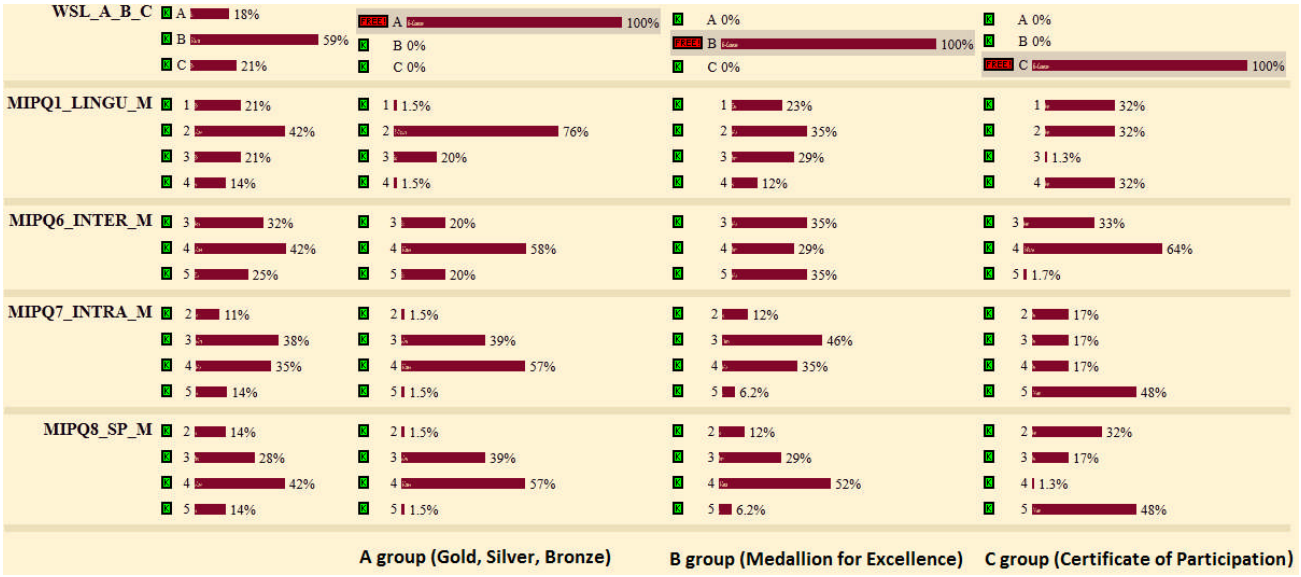

Figure 2: Bayesian Network of Multiple Intelligences Factors Related to WorldSkills Competition Success (A=Gold, silver and bronze medal winners, B=Medallion for Excellence winners with a total score ≥ 500, C=Competitors with a score < 500).

Ethical Sensitivities

Descriptive Statistics

Ethical sensitivities were measured with an adaptation of the Ethical Sensitivity Scale (ESS, see Tirri & Nokelainen, 2011a), which is based on Narvaez's operationalization of ethical sensitivity (1993; Narvaez & Endicott, 2001). Its main purpose is to scale the respondents' orientation toward ethical issues. We collected data on the following six dimensions (example statements from the survey in parenthesis):[8]

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.")
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.").

[8] 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, 2011b, p. 64)

Table 6 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 suggests that most participants are ethically sensitive. Results from the 2011 squad also show high average scores across these measures.

Table 6: Average Self-reported Scores on Measures of Ethical Sensitivity (*N*=112)

Ethical Sensitivities	*M*(*SD*)
Taking the perspectives of others	4.2(.734)
Generating interpretations and options	4.0(.801)
Identifying the consequences of actions and options	4.0(.758)
Working with interpersonal and group differences	3.8(.690)
Caring by connecting to others	3.7(.764)
Reading and expressing emotions	3.6(.745)

Gender

Results of Mann-Whitney *U* test show that there are no gender-related significant differences in the sample (Table 7). However, in parallel with earlier studies, females tend to rate their ethical skills higher than males do (e.g., Tirri & Nokelainen, 2011a, p. 71).

Table 7: Differences in Self-reported Scores on Measures of Ethical Sensitivity, by Gender (*N*=112)

Ethical Sensitivities	Gender[a]				
	Male *M*(*SD*)	Female *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Reading and expressing emotions	3.6(.727)	3.8(.807)	-1.253	.210	.12
Taking the perspectives of others	4.2(.789)	4.5(.440)	-1.454	.146	.14
Caring by connecting to others	3.6(.771)	4.0(.693)	-1.824	.068	.17
Working with interpersonal and group differences	3.8(.700)	4.0(.636)	-1.261	.207	.12
Generating interpretations and options	3.9(.827)	4.2(.670)	-1.371	.171	.13
Identifying the consequences of actions and options	4.0(.763)	4.1(.741)	-.837	.403	.08

[a] Males *n*=88, females *n*=24.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): Small effect size = .10; Medium = .30; Large = .50.

The BCM analysis with a classification accuracy of 82.1% revealed one ethical sensitivity indicator as predictor for gender: 'Working with interpersonal and group differences'. Analysis of probability distribution of this factor

showed that 95.2 per cent of females (vs. 77.0% 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 3). This is the opposite finding to 2011, where 39% of males said ‘totally agree’ to this question, compared to 21% of females.

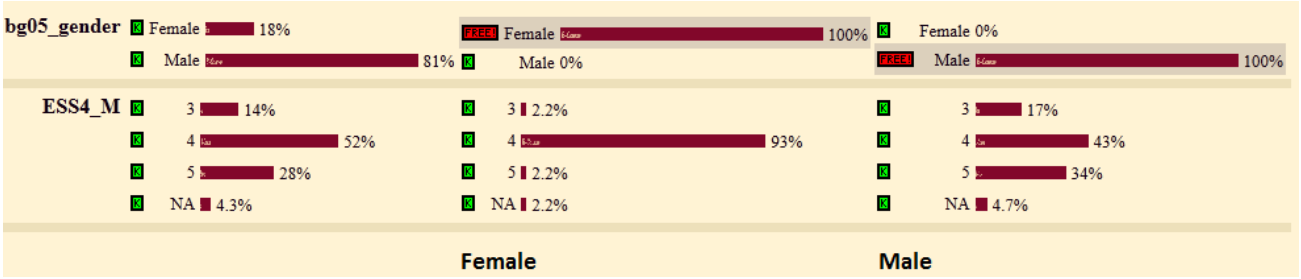

Figure 3: Bayesian Network of an Ethical Sensitivity Factor Predicting Gender

WSL Team Membership

The analyses did not show any statistically significant differences between the WSL competitors and non-selected squad members. However, the results in Table 8 show that the WSL competitors self-evaluated the first and fourth ethical sensitivity dimensions higher than the non-selected squad members did. This is in contrast to our earlier study with the WSC London 2011 UK squad[9], where competitors gave higher ratings to the most abstract ethical sensitivity dimensions (fifth and sixth in the list in Table 8). Further evidence is needed to verify that ethical sensitivity is one of the factors that differentiate between the squad members who were selected to compete at WSL and those who were not selected.

Table 8: Differences in Ethical Sensitivity Between the WSL Competitors and Non-selected Squad Members (*N*=112)

Ethical Sensitivities	Compete in WSL[a]				
	No *M*(*SD*)	Yes *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Reading and expressing emotions	3.6(.743)	3.8(.736)	-1.195	.232	.11
Taking the perspectives of others	4.2(.712)	4.2(.813)	-.040	.968	.00
Caring by connecting to others	3.7(.788)	3.7(.698)	-.028	.977	.00
Working with interpersonal and group differences	3.8(.715)	4.0(.603)	-1.006	.314	.10
Generating interpretations and options	4.0(.779)	3.9(.881)	-.166	.868	.02

[9] 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).

Identifying the consequences of actions and options	4.0(.765)	4.1(.744)	-.477	.633	.05

[a] Non-selected *n*=84, selected *n*=28.
[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 WSL

Results presented in Table 9 indicate that medal winners (A group) are less ethically sensitive than competitors in the other two groups. This is demonstrated with their significantly lower self-evaluation on the first ethical sensitivity dimension compared to other WSL competitors (Reading and expressing emotions). Also the BCM analysis suggested (with 64.3% classification accuracy) lower ethical sensitivity levels for the A group members on the second ('Taking the perspectives of others') and the seventh ('Identifying the consequences of actions and options') dimensions than it did for the two other groups. Overall, the results were similar for the WSC London 2011 team, although for that group the significant difference pertained to 'caring by connecting to others'.

Table 9: Differences in Ethical Sensitivity by WSL Competition Success (*n*=28)

Ethical Sensitivities	Success in WSL[a] A *M*(*SD*)	B *M*(*SD*)	C *M*(*SD*)	χ^{b}	*p*	η^{c}
Reading and expressing emotions	3.0(.354)	4.0(.670)	4.1(.736)	7.883	.019	.07
Taking the perspectives of others	4.2(.837)	4.4(.563)	3.8(1.291)	.761	.684	.01
Caring by connecting to others	3.4(.822)	3.8(.727)	3.8(.524)	.796	.671	.01
Working with interpersonal and group differences	3.9(.548)	4.1(.629)	3.8(.612)	.786	.675	.01
Generating interpretations and options	3.6(.742)	4.2(.700)	3.7(1.329)	2.018	.365	.02
Identifying the consequences of actions and options	3.8(.447)	4.1(.834)	4.2(.753)	.968	.616	.01

[a] A group (gold, silver and bronze medal winners) n=5, B group (medallion for excellence winners, score ≥ 500) n=17, 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.

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. The survey included 12 questions about talent development, drawn from prior research (Campbell, 1996; Nokelainen & Ruohotie, 2009; 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 10 shows that respondents considered all of these four factors to be important for vocational talent development. Consistent with earlier research in Finland (Nokelainen, in press), the least important factor for skills development was related to non-domain-specific extrinsic conditions. This was also the case for the WSC London 2011 squad.

Table 10: Average Self-Reported Scores on Measures of Talent Development (*N*=112)

Influential Factors	*M*(*SD*)
Non-domain specific extrinsic conditions	4.2(.837)
Domain specific extrinsic conditions	4.4(.564)
Domain specific intrinsic motivation	4.8(.448)
Domain specific extrinsic motivation	4.4(.798)

Gender

Results of non-parametric Mann-Whitney *U* tests (Table 11) reveal quite strong self-reported gender-related differences in domain- and non-domain-specific factors with regard to vocational talent development: Females evaluated all four factors higher (and first three significantly and the fourth nearly so). BCM results showed with 82.1% classification accuracy that females are more likely to find non-domain-specific extrinsic conditions, such as an encouraging home atmosphere, more important than males. This finding is a departure from the WSC London 2011 results, which indicated no gender differences in domain- and non-domain-specific factors.

Table 11: Differences in Average Scores on Measures of Talent Development by Gender (*N*=112)

Influential Factors	Gender[a] Male *M*(*SD*)	Female *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Non-domain-specific extrinsic conditions	4.0(.853)	4.7(.507)	-3.793	.000	.36
Domain-specific extrinsic conditions	4.4(.590)	4.7(.383)	-2.447	.014	.23
Domain specific intrinsic motivation	4.7(.489)	5.0(.149)	-2.882	.004	.27
Domain-specific extrinsic motivation	4.3(.851)	4.6(.477)	-1.858	.063	.18

[a] Males *n*=88, females *n*=24.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): Small effect size = .10; Medium = .30; Large = .50.

WSL Team Membership

Data presented in Table 12 show that there are no self-reported differences related to team membership on influential factors to vocational talent development. The BCM analysis confirms this result. Data from the WSC London 2011 squad showed the same results.

Table 12: Differences in Talent Development Between the WSL Competitors and Non-selected Squad Members (*N*=112)

Influential Factors	Compete in WSL[a] No *M*(*SD*)	Yes *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Non-domain specific extrinsic conditions	4.1(.852)	4.2(.808)	-.108	.914	.01
Domain specific extrinsic conditions	4.4(.596)	4.4(.469)	-.382	.702	.04
Domain specific intrinsic motivation	4.8(.480)	4.8(.333)	-1.319	.187	.12
Domain specific extrinsic motivation	4.3(.841)	4.4(.667)	-.122	.903	.01

[a] Non-selected *n*=84, selected *n*=28.
[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 WSL

Data presented in Table 13 show that there are no self-reported differences related to WorldSkills competition success on influential factors to vocational talent development. Quite interestingly, the most successful competitors used only one response option ("totally agree") on questions related to domain-specific intrinsic motivation (e.g., 'my own interest in the field'). In 2011, medal winners had a significantly lower score on domain-specific extrinsic motivation (drive to compete), whereas the 2013 medal winners reported a higher drive to compete than the other two groups did.

Table 13: Differences in Talent Development by WSL Competition Success (*n*=28)

Influential Factors	Success in WSL[a] A *M*(*SD*)	B *M*(*SD*)	C *M*(*SD*)	χ^{b}	*p*	η^{c}
Non-domain-specific extrinsic conditions	3.8(1.151)	4.3(.769)	4.1(.585)	1.727	.422	.02
Domain-specific extrinsic conditions	4.5(.303)	4.5(.534)	4.3(.415)	1.051	.591	.01
Domain-specific intrinsic motivation	5.0(.000)	4.8(.355)	4.8(.408)	1.842	.398	.02
Domain-specific extrinsic motivation	4.6(.652)	4.4(.697)	4.3(.683)	1.023	.600	.01

[a] A group (gold, silver and bronze medal winners) n=5, B group (medallion for excellence winners, score ≥ 500) n=17, 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.

Abilities Needed for WorldSkills Training

Descriptive Statistics

Essential abilities to succeed in WorldSkills training can be categorised into three classes (sample statements in parenthesis): 1) Social ("Bounce back from failures or injustices."); 2) Cognitive ("Apply new work methods."); and 3) Entrepreneurial ("See problematic work tasks as positive challenges.")(Nokelainen in press). The first class represents *skills*, the second *intelligence* and the third *aptitude*. Table 14 shows that all three components were reported to be related to success in training and were considered equally important.

Table 14: Average Self-reported Scores on Measures of Skills Needed in WorldSkills Training (*N*=112)

Skills Needed in WorldSkills Training	*M*(*SD*)
Social abilities	4.5(.613)
Cognitive abilities	4.6(.563)
Entrepreneurial abilities	4.6(.605)

Gender

Comparison of males' and females' responses indicates that females tended to self-evaluate their social, cognitive and entrepreneurial abilities higher than males did (Table 15). However, both groups estimated the importance of these skills to be high (mean range from 4.4 – 4.8). Although the differences are statistically significant, their effect size is marginal. Only the second factor ('Cognitive abilities') showed gender-related difference in the BCM analysis. These results are a departure from the 2011 findings, where males had higher ratings than females on entrepreneurial abilities and cognitive abilities.

Table 15: Differences in Skills Needed in WorldSkills Training by Gender (*N*=112)

Skills Needed in WorldSkills Training	Gender[a] Male *M*(*SD*)	Female *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Social abilities	4.4(.655)	4.8(.260)	-2.938	.003	.28
Cognitive abilities	4.6(.608)	4.8(.293)	-2.003	.045	.19
Entrepreneurial abilities	4.5(.649)	4.8(.319)	-2.309	.021	.22

[a] Males *n*=88, females *n*=24.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): Small effect size = .10; Medium = .30; Large = .50.

WSL Team Membership

Statistical analyses did not reveal any differences between the selected and non-selected WSL competitors (see Table 16); both groups rated all three abilities highly.

Table 16: Differences in Skills Needed in WorldSkills Training Between the WSL Competitors and Non-selected Squad Members (*N*=112)

Skills Needed in WorldSkills Training	Compete in WSL[a] No *M*(*SD*)	Yes *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Social abilities	4.5(.643)	4.5(.523)	-.186	.852	.02
Cognitive abilities	4.6(.595)	4.7(.462)	-.403	.687	.04
Entrepreneurial abilities	4.6(.620)	4.7(.562)	-.622	.534	.06

[a] Non-selected *n*=84, selected *n*=28.
[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 WSL

Competitors' performance in WorldSkills Leipzig was not statistically related to their social, cognitive or entrepreneurial abilities (see Table 17).

Table 17: Differences in Skills Needed in WorldSkills Training by WSL Competition Success (*n*=28)

Skills Needed in WorldSkills Training	Success in WSL[a] A *M*(*SD*)	B *M*(*SD*)	C *M*(*SD*)	χ^b	*p*	η^c
Social abilities	4.5(.506)	4.5(.539)	4.6(.584)	.037	.982	.00
Cognitive abilities	4.8(.433)	4.7(.482)	4.6(.492)	.717	.699	.01
Entrepreneurial abilities	4.9(.224)	4.6(.626)	4.6(.585)	1.448	.485	.01

[a] A group (gold, silver and bronze medal winners) n=5, B group (medallion for excellence winners, score ≥ 500) n=17, 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.

Patterns of Adaptive Learning

Descriptive Statistics

Goal orientation theory differentiates 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 example, their 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 refers 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 relates 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 18), a finding that concurs with Finnish competitors (Nokelainen, in press).

Table 18: Average Self-reported Scores on Measures of Patterns of Adaptive Learning (*N*=112)

Patterns of Adaptive Learning	*M*(*SD*)
Mastery goal orientation	4.8(.498)
Performance-approach goal orientation	4.6(.609)
Performance-avoidance goal orientation	3.5(.966)

Gender

There are no significant differences between male and female respondents (Table 19). The BCM results indicate that participants' gender could not be predicted by these three goal orientation factors.

Table 19: Differences in Patterns of Adaptive Learning by Gender (*N*=112)

Patterns of Adaptive Learning	Gender[a]				
	Male *M*(*SD*)	Female *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Mastery goal orientation	4.7(.549)	4.9(.177)	-1.304	.192	.12
Performance-approach goal orientation	4.6(.658)	4.8(.340)	-1.914	.056	.18
Performance-avoidance goal orientation	3.5(.969)	3.6(.971)	-.433	.665	.04

[a] Males *n*=88, females *n*=24.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator (*r*=*Z*/√*N*): Small effect size = .10; Medium = .30; Large = .50.

WSL Team Membership

Table 20 shows that there was no difference between competing and non-competing respondents' goal orientations.

Table 20: Differences in Patterns of Adaptive Learning Between the WSL Competitors and Non-selected Squad Members (*N*=112)

Patterns of Adaptive Learning	Compete in WSL[a]				
	No *M*(*SD*)	Yes *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Mastery goal orientation	4.8(.527)	4.8(.408)	-.544	.586	.05
Performance-approach goal orientation	4.6(.671)	4.7(.367)	-.415	.678	.04
Performance-avoidance goal orientation	3.5(.997)	3.5(.881)	-.267	.790	.03

[a] Non-selected *n*=84, selected *n*=28.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator (*r*=*Z*/√*N*): Small effect size = .10; Medium = .30; Large = .50.

Success in the WSL

Success at the WSC Leipzig 2013 was not related to goal orientations. Bayesian analysis confirms this finding. However, our previous study with UK competitors showed that 'Performance-avoidance goal oriented competitors'

performed best in WCS London 2011 [$\chi^2(2,37)=11.374$, $p=.003$, $\eta^2=.15$] . The opposite result was found in a study of 77 Finnish WorldSkills competitors[10] (Nokelainen, in press).

Table 21: Differences in Patterns of Adaptive Learning by WSL Competition Success (*n*=28)

Patterns of Adaptive Learning	Success in WSL[a]					
	A *M*(*SD*)	B *M*(*SD*)	C *M*(*SD*)	χ^b	*p*	η^c
Mastery goal orientation	4.8(.447)	4.7(.449)	4.9(.272)	.523	.770	.00
Performance-approach goal orientation	4.7(.435)	4.7(.412)	4.8(.172)	.254	.881	.00
Performance-avoidance goal orientation	3.5(.506)	3.5(1.000)	3.6(.880)	.214	.899	.00

[a] "A" group (gold, silver and bronze medal winners) n=5, "B" group (medallion for excellence winners, score ≥ 500) n=17, "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.

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.").

[10] 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.

All motivational factors, except nervousness in testing situations, were considered important to Finnish competitors (Nokelainen, in press). They evaluated the role of ability (Efficacy beliefs) in their success a little higher than the role of effort (Control beliefs). Further, 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 22); 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. [11] These results are similar to those found for the WSC London 2011 squad.

Table 22: Location and Dispersion Descriptive Statistics of Learning Motivation (*N*=112)

Learning Motivation	*M*(*SD*)
Intrinsic goal orientation	4.2(.660)
Extrinsic goal orientation	4.5(.642)
Meaningfulness of studies	4.8(.489)
Control beliefs	3.6(.653)
Efficacy beliefs	4.1(.712)
Test anxiety	3.3(.736)

Gender

Analyses reveal no gender-related differences on the six learning motivation factors (Table 23). Bayesian analysis confirms this finding.

[11] In a study by Tirri and Nokelainen (2012) 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.

Table 23: Gender Related Differences in Learning Motivation (*N*=112)

Learning Motivation	Gender[a]				
	Male *M*(*SD*)	Female *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Intrinsic goal orientation	4.1(.689)	4.2(.551)	-.499	.618	.05
Extrinsic goal orientation	4.5(.654)	4.6(.608)	-.616	.538	.06
Meaningfulness of studies	4.7(.519)	4.9(.338)	-1.570	.116	.15
Control beliefs	3.6(.679)	3.6(.561)	-.127	.899	.01
Efficacy beliefs	4.2(.741)	4.0(.590)	-1.410	.158	.13
Test anxiety	3.3(.753)	3.2(.675)	-1.078	.281	.10

[a] Males *n*=88, females *n*=24.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): Small effect size = .10; Medium = .30; Large = .50.

WSL Team Membership

Analyses did not reveal any differences in learning motivation between those who were selected to compete in WSL and those who were not (Table 24). Bayesian analysis confirms this finding.

Table 24: Differences in Learning Motivation Between the WSL Competitors and Non-selected Squad Members (*N*=112)

Learning Motivation	Compete in WSL[a]				
	No *M*(*SD*)	Yes *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Intrinsic goal orientation	4.2(.679)	4.1(.604)	-1.045	.296	.10
Extrinsic goal orientation	4.5(.692)	4.7(.452)	-.727	.468	.07
Meaningfulness of studies	4.8(.518)	4.7(.396)	-1.119	.263	.11
Control beliefs	3.6(.697)	3.6(.510)	-.245	.807	.02
Efficacy beliefs	4.1(.751)	4.3(.568)	-.971	.331	.09
Test anxiety	3.3(.755)	3.2(.683)	-.562	.574	.05

[a] Non-selected *n*=84, selected *n*=28.
[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 WSL

Table 25 shows two interesting, although not statistically significant findings. Those who excelled in the most demanding skills competition (A and B groups) believe more in ability as an explanation for their success than those who failed to score at least 500 points. Another finding was that both the B and C groups reported a bit higher control beliefs (success due to effort) than the A group.

Table 25: Differences in Learning Motivation by WSL Competition Success (*n*=28)

Learning Motivation	Success in WSL[a] A *M*(*SD*)	B *M*(*SD*)	C *M*(*SD*)	χ^b	*p*	η^c
Intrinsic goal orientation	4.1(.418)	4.1(.690)	4.0(.548)	.178	.915	.00
Extrinsic goal orientation	4.5(.612)	4.7(.400)	4.6(.492)	1.100	.577	.01
Meaningfulness of studies	4.9(.224)	4.7(.431)	4.8(.418)	1.286	.526	.01
Control beliefs	3.4(.418)	3.6(.600)	3.7(.258)	1.051	.591	.01
Efficacy beliefs	4.4(.652)	4.4(.523)	4.0(.632)	1.958	.376	.02
Test anxiety	3.3(.671)	3.1(.740)	3.3(.612)	.424	.809	.00

[a] "A" group (gold, silver and bronze medal winners) n=5, "B" group (medallion for excellence winners, score ≥ 500) n=17, "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.

The BCM analysis confirmed (64.3% classification accuracy) these findings. In addition, BCM indicated that A and B group members had slightly higher extrinsic goal orientation than C group members (Figure 8). These results are somewhat different from the WSC London 2011 competitors: medal and medallion winners were more competitive-oriented than those scoring less than 500 points (C group), and medal winners had higher test anxiety.

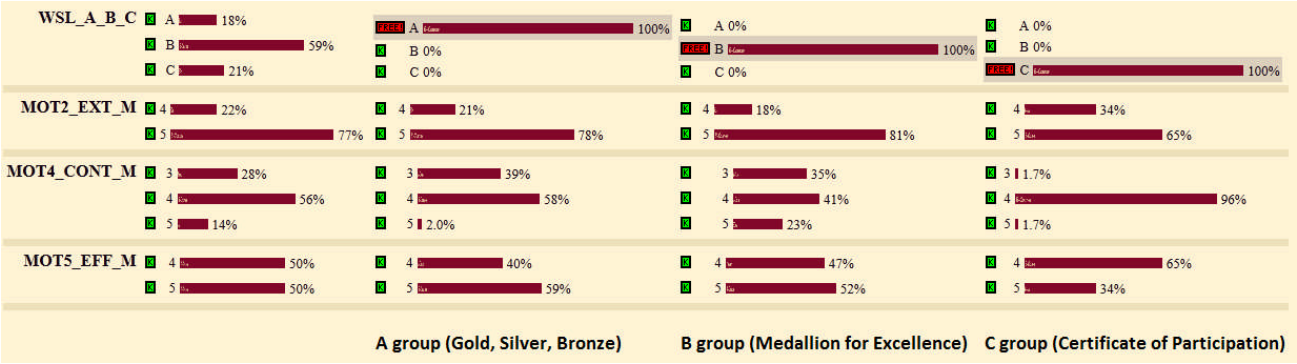

Figure 4: Bayesian Network Showing a Connection Between Motivational Factors and WorldSkills Success (A=Gold, silver and bronze medal winners, B=Medallion for Excellence winners with a total score ≥ 500, C=Competitors with a score ≤ 500).

Summary and Conclusions

This report presents survey findings from the WorldSkills UK 2013 squad to identify factors related to the development of vocational excellence. The analysis compared survey data for three groups: female and male squad members; squad members versus team members, who competed at WSC Leipzig 2013; and medal versus non-medal winners. The report also relates findings to the WorldSkills UK 2011 squad, presented in an earlier report (Nokelainen, Stasz and James 2013). The main findings from this study are as follows:

- Grades in school and past competition success were positively, but not significantly related to performance at WSC Leipzig 2013. Similarly positive, but non-significant results regarding **background characteristics** were found for the 2011 competitors.
- Overall, participants most highly rated having three **natural abilities**: body-kinaesthetic (handiness), mathematical-logical and interpersonal. Linguistic ability received the lowest rating. The highest and lowest rated abilities were the same as those reported by the WSC London 2011 competitors. Comparing by gender, girls rated their linguistic, interpersonal and intrapersonal abilities significantly higher, while boys rated mathematical-logical abilities higher. Estimates of natural ability, however, were not a determining factor in team selection. Four factors appeared to be *unrelated* to winning a medal at WSC Leipzig 2013: linguistic, interpersonal, intrapersonal and spiritual.
- Young competitors have a high degree of **ethical sensitivity**. Girls rated themselves higher than boys, especially with regard to 'working with interpersonal and group differences'. This finding is opposite to the 2011 squad, where boys' ratings were significantly higher than girls' on this indicator. WSC medal winners reported being less ethically sensitive on three indicators: 'reading and expressing emotions'; 'taking perspectives of others'; and 'identifying the consequences of actions and options'.
- Like the 2011 squad, the WSC Leipzig 2013 squad rated all four factors as important for **talent development** (domain- and non-domain specific conditions and intrinsic and extrinsic motivation). Unlike the 2011 squad, the 2013 squad showed strong gender differences: girls rated all four factors as significantly more important for vocational talent development. However, these views did not differ significantly for squad versus team members or for medal winners versus others. However, medal winners in 2013 had the highest 'drive to compete' in comparison to others, in contrast to 2011 medal winners who had significantly lower scores than non-medal winners on this dimension. 2013 medal winners also reported the strongest influence of intrinsic motivation on their talent development, suggesting that the source of their motivation was both internal (interest in their field) and external (drive to compete).
- **Adaptive learning** concerns ones goal orientation. As would be expected for competitors in skills competitions, their goals are oriented toward achieving mastery of their chosen field and high performance. They are least concerned about showing incompetence or failure to others. Goal orientation is not different for any of the groups studied, perhaps not surprising as reaching even the squad stage would require a focus on skill mastery to a high standard.
- Considering **learning motivation**, both the 2011 and 2013 squads rated ability over effort as an explanation for success in skills competitions. Motivational factors did not differ significantly for medal winners versus others. However, medal and medallion winners reported a stronger belief in their ability than did those earning certificates of participation. Conversely, in comparison to medal winners, medallion and certificate competitors rated effort higher. Taken together these findings suggest that belief or confidence in one's own abilities may be instrumental to success at WSC.

Overall, these findings suggest that the most important contributors to vocational excellence are motivational in nature. In 2011, medal winners were driven by a desire to be 'number one' in their field and by not wanting to appear incompetent to others. The 2013 medal winners were motivated by other factors, especially by strong interest in their field, a drive to compete and confidence in their own ability. While the specific dimensions of motivation differ for medal winners in the comparison years, the results so far indicate that perceptions of intrinsic characteristics may outweigh perceptions of ability and external characteristics in developing vocational excellence. This preliminary conclusion will be explored further as the research continues to include the WSC Sao Paulo 2015 squad and a control group of young people who do not compete.

Although few statistically significant relationships have been identified between key attributes (abilities, intrinsic characteristics, and extrinsic conditions) and vocational excellence (medal winning) it is important to remember that the sample sizes are quite small (only five medal winners in 2013) and this makes it more difficult to reveal differences that might exist. On the positive side, the importance of motivational factors (intrinsic characteristics) to achieving excellence has been confirmed, and it may be that these can be further enhanced through WorldSkills UK training.

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

DUVE Survey

Scales and items	Compete in WorldSkills Leipzig		Total sample
	No (*n*=84) *M*(*SD*)	Yes (*n*=28) *M*(*SD*)	(*N*=112) *M*(*SD*)
Natural Abilities			
Writing is a natural way for me to express myself.	2.7(1.180)	2.2(.957)	2.6(1.144)
At school, studies in English or social studies were easier for me than mathematics, physics and chemistry.	2.4(1.249)	2.1(1.145)	2.3(1.223)
I have recently written something that I am especially proud of, or for which I have received recognition.	1.8(1.030)	2.0(1.277)	1.9(1.094)
Metaphors and vivid verbal expressions help me learn efficiently.	2.9(1.126)	2.3(1.188)	2.7(1.163)
At school, I was good at mathematics, physics or chemistry.	3.9(1.073)	3.9(1.066)	3.9(1.066)
I can work with and solve complex problems.	4.0(.885)	4.0(.922)	4.0(.890)
Mental arithmetic is easy for me.	3.5(.962)	3.5(1.067)	3.5(.984)
I am good at games and problem solving, which require logical thinking.	4.1(.803)	4.1(.705)	4.1(.777)
At school, geometry and other subjects involving spatial perception were easier for me than solving equations.	3.2(.972)	3.5(.923)	3.3(.965)
It is easy for me to conceptualize complex and multidimensional patterns.	3.8(.888)	3.7(.713)	3.8(.846)
I can easily imagine how a landscape looks from a birds-eye view.	3.7(.986)	3.7(1.090)	3.7(1.008)
When I read, I form pictures or visual images in my mind.	3.8(1.085)	4.1(1.039)	3.9(1.073)
I am handy.	4.6(.765)	4.8(.645)	4.6(.738)
I can easily do something concrete with my hands (e.g. knitting and woodwork).	4.6(.776)	4.8(.390)	4.7(.705)
I am good at showing someone how to do something in practice.	4.1(.730)	4.3(.799)	4.2(.746)
I was good at handicrafts (e.g. woodwork; textiles) at school.	4.3(.929)	4.5(.693)	4.3(.880)

Scales and items	Compete in WorldSkills Leipzig		Total sample
	No (*n*=84)	Yes (*n*=28)	(*N*=112)
	M(*SD*)	*M*(*SD*)	*M*(*SD*)
After hearing a tune once or twice I am able to sing or whistle it quite accurately.	3.6(1.106)	3.8(.876)	3.7(1.052)
When listening to music, I am able to pick out individual instruments and recognize melodies.	3.3(1.257)	3.1(1.152)	3.2(1.230)
I can easily keep the rhythm when drumming a melody.	3.4(1.111)	3.3(1.124)	3.4(1.111)
I notice immediately if a melody is out of tune.	3.2(1.203)	3.2(1.197)	3.2(1.196)
Even in strange company, I can easily find someone to talk to.	3.6(1.067)	3.4(.956)	3.5(1.039)
I get along easily with different types of people.	4.0(.957)	4.0(.770)	4.0(.910)
I make contact easily with other people.	3.9(.929)	3.9(.891)	3.9(.915)
In negotiations and group work, I am able to support the group to find a consensus.	3.8(.808)	3.8(.701)	3.8(.780)
I am able to analyze my own motives and ways of action.	4.0(.778)	4.2(.548)	4.0(.730)
I often think about my own feelings and sentiments and seek reasons for them.	3.6(1.008)	3.9(.891)	3.7(.984)
I spend time regularly reflecting on the important issues in life.	3.5(1.155)	3.7(1.150)	3.5(1.153)
I like to read psychological or philosophical literature to increase my self-knowledge.	2.3(1.214)	2.0(1.232)	2.2(1.219)
In my busy everyday life I find it important to take time to think and reflect.	3.2(1.170)	3.5(.922)	3.3(1.118)
Even ordinary every-day life is full of amazing things.	3.7(.954)	4.1(1.052)	3.8(.988)
I often reflect on the meaning of life.	2.9(1.325)	3.3(1.117)	3.0(1.283)
It is important to me to share a quiet moment with others.	3.2(1.208)	3.1(.956)	3.2(1.146)
I enjoy the beauty and experiences related to nature.	3.6(1.169)	3.8(1.067)	3.6(1.143)
Protecting the environment is important to me.	3.1(1.095)	3.4(1.062)	3.2(1.087)
I pay attention to what I consume in order to protect the environment.	2.7(1.090)	3.0(1.138)	2.7(1.105)

Scales and items	Compete in WorldSkills Leipzig		Total sample
	No (*n*=84)	Yes (*n*=28)	(*N*=112)
	M(*SD*)	*M*(*SD*)	*M*(*SD*)
Ethical Sensitivities			
I notice if someone working with me is offended at me.	3.8(.773)	4.0(.706)	3.9(.759)
I am able to express my feelings to other people if I am offended or hurt because of them.	3.3(.999)	3.6(.971)	3.4(.995)
I think it is good to have close friends and associates who think in different ways.	4.3(.766)	4.3(.734)	4.3(.755)
I get along with people who think in different ways.	4.2(.804)	4.1(.974)	4.1(.844)
I take charge of how other people are doing.	3.6(.969)	3.5(.849)	3.5(.937)
I take care of the other peoples' well-being and try to contribute it.	3.9(.729)	3.9(.675)	3.9(.713)
I take other peoples' viewpoints into account before making important decisions in my life.	4.0(.897)	4.2(.784)	4.0(.871)
I try to take other persons' needs into account although it is a question of my benefit.	3.6(.900)	3.8(.786)	3.7(.873)
I think about the consequences of my acts when making ethical decisions.	3.9(1.019)	4.0(.980)	3.9(1.006)
I believe there can be several right solutions to ethical problems.	4.0(.826)	3.9(1.035)	4.0(.878)
I notice when I am facing a moral issue at school, WSC training or work.	4.0(.765)	4.1(.744)	4.0(.758)
Influential factors to vocational talent development			
An encouraging home atmosphere.	4.4(.815)	4.3(.863)	4.4(.824)
Stimulating influence of a particular friend.	3.9(1.066)	4.0(.922)	3.9(1.029)
Stimulating influence of a teacher or trainer.	4.3(.854)	4.3(.670)	4.3(.809)
Seeing impressive demonstrations of skill (e.g., furniture design, hairstyling; cabinet making).	4.4(.812)	4.4(.742)	4.4(.792)
My own interest in the field.	4.7(.548)	4.8(.476)	4.7(.530)
My desire to learn new things.	4.8(.617)	4.9(.315)	4.8(.558)
Interest in extending my own limits.	4.8(.470)	4.8(.390)	4.8(.450)

Scales and items	Compete in WorldSkills Leipzig		Total sample
	No (*n*=84)	Yes (*n*=28)	(*N*=112)
	M(*SD*)	*M*(*SD*)	*M*(*SD*)
Interest in competing with others in vocational skills.	4.2(.976)	4.3(.810)	4.2(.934)
My desire to succeed in vocational competitions.	4.5(.831)	4.5(.838)	4.5(.830)
Employment opportunities in the future.	4.7(.685)	4.8(.441)	4.7(.632)
Team spirit amongst WS competitors.	4.5(.874)	4.4(.685)	4.4(.828)
The company of people sharing similar interests.	4.4(.904)	4.3(.772)	4.4(.870)
Skills needed in WorldSkills training			
Bounce back from failures or injustices.	4.7(.668)	4.7(.535)	4.7(.635)
Do team work.	4.4(.869)	4.5(.838)	4.4(.858)
Manage conflict situations.	4.4(.810)	4.5(.693)	4.4(.779)
Improve existing work methods.	4.7(.679)	4.8(.441)	4.7(.627)
Apply new work methods.	4.8(.555)	4.8(.476)	4.8(.535)
Create new work methods.	4.5(.827)	4.5(.793)	4.5(.815)
Take responsibility and controlled risks.	4.6(.719)	4.6(.790)	4.6(.734)
See problematic work tasks as positive challenges.	4.6(.679)	4.8(.645)	4.6(.671)
Recognise impossible work tasks.	4.5(.827)	4.6(.634)	4.5(.781)

Scales and items	Compete in WorldSkills Leipzig		Total sample
	No (*n*=84)	Yes (*n*=28)	(*N*=112)
	M(*SD*)	*M*(*SD*)	*M*(*SD*)
Patterns of adaptive learning			
I want to learn as many new things as I can.	4.8(.597)	4.7(.535)	4.7(.579)
I want to be as good as possible in my own skill area.	4.9(.587)	5.0(.189)	4.9(.518)
I try to understand issues presented in the WSC training as thoroughly as possible.	4.7(.626)	4.7(.670)	4.7(.634)
I would like others (family, friends, teachers, trainers, trainees) to respect my craftsmanship.	4.5(.789)	4.7(.612)	4.6(.748)
My aim is to be in the top "A group" in my WSC training team.	4.6(.850)	4.7(.659)	4.6(.806)
I don't want to embarrass myself in front of the others.	4.7(.750)	4.8(.390)	4.8(.677)
I avoid showing others if I am facing difficulties in WSC training exercises.	3.7(1.293)	3.8(1.020)	3.7(1.226)
It is important to me that my teacher/trainer thinks I am a smart person.	3.2(1.139)	3.4(.994)	3.2(1.105)
My aim is to show others that I am in the top level in my skill area.	3.5(1.222)	3.4(1.289)	3.5(1.234)

Scales and items	Compete in WorldSkills Leipzig		Total sample
	No (*n*=84) *M*(*SD*)	Yes (*n*=28) *M*(*SD*)	(*N*=112) *M*(*SD*)
Learning motivation			
I prefer to try challenging work methods from which I can learn something new.	4.4(.762)	4.4(.634)	4.4(.730)
I am able to learn even the most difficult work methods if I practise hard enough.	4.5(.684)	4.6(.497)	4.6(.641)
I expect to do extremely well in my WorldSkills training.	4.1(.836)	4.1(.832)	4.1(.832)
I am confident that I will master even the most difficult work methods in my training.	4.1(.875)	4.5(.508)	4.2(.810)
I want to be number one in my skill area in the next WorldSkills competition.	4.6(.741)	4.8(.518)	4.7(.692)
While doing a routine task in WorldSkills competition, I am also thinking about the really challenging tasks to come.	4.1(.952)	4.4(.737)	4.2(.909)
I am very interested in my skill area as well as new information related to it.	4.7(.658)	4.7(.548)	4.7(.630)
I am nervous in all kinds of competitions (in a negative way).	2.5(1.102)	2.0(.881)	2.4(1.071)
I find it most rewarding when I can research a new work method as thoroughly as possible.	3.9(.860)	3.7(.897)	3.9(.871)
I believe that WorldSkills training will be of practical benefit to me in the future.	4.8(.511)	4.8(.418)	4.8(.488)
If I fail in an extremely demanding work task during WorldSkills training, it is mainly because I am not trying hard enough.	2.7(1.199)	2.6(.920)	2.6(1.132)
It is important for me to do well in WorldSkills training and show others (family, friends, teachers, trainers, trainees) what I am capable of.	4.4(.885)	4.6(.634)	4.4(.830)