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What contributes to vocational excellence? A pilot study of the individual characteristics of the WorldSkills UK 2011 squad

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Abstract

WorldSkills UK,[1] housed within the National Apprenticeship Service (NAS), partners with industry and education organisations to develop vocational talent through skills competitions. Young people aged 18-22 compete in regional and national skills competitions managed by WorldSkills UK and undergo intensive skills 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). Some members of Team UK also compete in EuroSkills[2] as part of their training.

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 as a first step toward that understanding. The study was carried out in collaboration with WorldSkills UK as it prepared competitors for the 2011 WSC in London. The research approach was adapted from earlier studies of WorldSkills competitors in Finland, which relied on a multidimensional model of vocational excellence comprising three main explanatory factors: natural abilities, intrinsic characteristics such as motivation, and external conditions.

The pilot study, carried out in the run-up to WSC London 2011, included survey data from 76 squad members (57 male, 19 female) who participated in training and competitions to be selected for the WorldSkills UK team that would compete in London. Using statistical methods suited to small sample sizes, the research compared survey results for squad versus team members, male versus female squad members and medal winners versus non-winners at WSC London 2011. Limitations to the research are the reliance on self-report data and small sample sizes that make it more difficult to identify statistically significant effects.

The analysis did not yield many significant findings. The most important pattern of results is that motivational factors, an aspect of intrinsic characteristics, are most important for medal winners. Medal winners had the lowest level of drive to compete and had concerns about appearing incompetent to others. Further studies are needed to see if this pattern holds and what the implications might be for WorldSkills UK training.

The research is continuing into the Team UK squad, who are preparing for WSC Leipzig 2013, and will also include a control group of young people who do not participate in the WorldSkills UK programme.

[1] For more information on WorldSkills International and WSC, see www.worldskills.org.
[2] For more information on EuroSkills, see www.euroskills.org.

Introduction

In its 2009 report, *Ambition 2020: World Class Skills and Jobs for the UK*, the UK Commission for Employment and Skills (UKCES) set out the aim for the UK to become one of the top countries in the world for jobs, productivity and skills, reaffirming goals set in the 2006 Leitch review of skills. To reach such ambitions, policymakers focus on improving levels of qualifications in the country, including those acquired through vocational education and training (VET). A recent review of vocational education commissioned by Michael Gove, the Education Secretary (The Wolf Review, DfE, 2011), is but one of many studies on the topic attempting to identify the strengths and weaknesses of VET (Stasz, 2011). The Wolf Review concluded that vocational education is still failing many young people. It underscored the already substantial evidence regarding the low quality of some vocational education courses, the emphasis on 'tick box' assessment, and the low return on investment for qualifications below Level 3, to name but a few problems.

Notwithstanding such criticisms of VET in the UK, in a 2011 EU-wide survey, 70per cent of UK respondents believed that 'vocational education and training has a positive image' and 65 per cent agreed that it 'leads to professions which are highly demanded in the labour market' (Eurobarometer, 2011). On the other hand, 36 per cent of UK survey respondents said they would recommend general education to a young person who is finishing compulsory education, compared to 26 per cent in favour of vocational education. These results are the opposite of those found in 2004, when respondents were much more likely to recommend vocational education over general education (57 per cent and 25 per cent, respectively) (Eurobarometer, 2004).

Of course, examples of success can be found among any shortcomings. One such example is WorldSkills UK,[3] housed within the National Apprenticeship Service (NAS), which partners with industry and education organisations to develop vocational talent through skills competitions. Young people aged 18-22 compete in regional and national skills competitions managed by WorldSkills UK and undergo intensive development to build their skills to world-class standard in order to be

[3] Formerly known as UKSkills.

selected, first as part of the UK squad and then for Team UK. Team UK competes in WorldSkills[4] competitions (WSC). Some members of Team UK also compete in EuroSkills[5] as part of their training.

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 as a first step toward that understanding. The study was carried out in collaboration with WorldSkills UK as it prepared competitors for the 2011 WorldSkills competition in London (WSL). 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?

Theoretical Framework and Approach

This study builds on research carried out at the Research Centre for Vocational Education (RCVE), based at the University of Tampere, Finland. It adopts a theoretical model and approach first used to explore the acquisition of vocational expertise among SkillsFinland[6] 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 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):

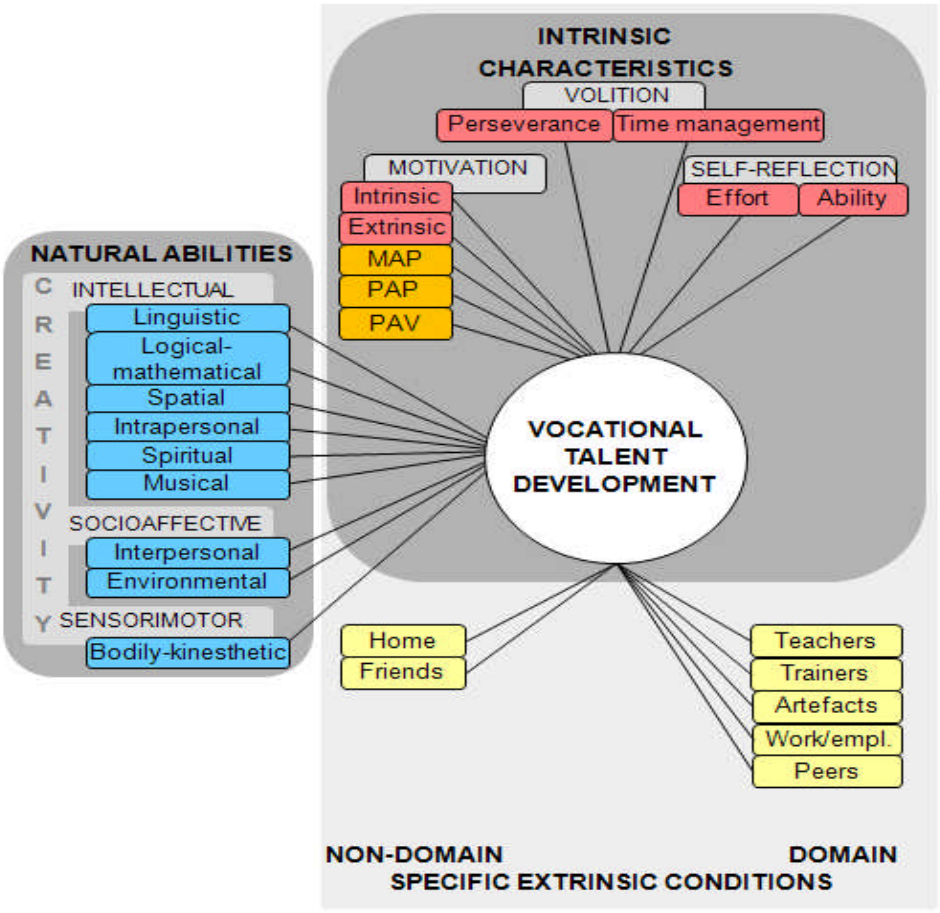
- Natural abilities include intellectual, affective abilities and bodily-kinaesthetic abilities (expressed as multiple intelligences domains)

[4] For more information on WorldSkills International and WSC, see www.worldskills.org.
[5] For more information on EuroSkills, see www.euroskills.org.
[6] Skills Finland is the Finnish equivalent of WorldSkills UK. For more information, see www.skillsfinland.fi.

- 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 WSC, 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 which 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 2011. The squad consisted of 86 young people who had undergone a selection process that began with numerous regional and national skills 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 competitions helped identify candidates for a shortlist of potential squad members, and most candidates also attended an interview and submitted recommendations from third parties. The shortlisted 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 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 international 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=86) in June 2011.

Team selection involved a four-day competition event replicating as much as possible the conditions of a WorldSkills competition. Of the 43 squad members selected for the WorldSkills UK team, 32 were male (74.4 per cent) and 11 were female (25.6 per cent). Their ages ranged from 18 to 23 years (M=20.8, SD=1.289). The non-competitor group (N=43) – squad members who were not selected for the team – consisted of 32 males (74.4 per cent) and 11 females (25.6 per cent). Their ages ranged from 19 to 24 years (M=20.8, SD=1.214).

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. Seventy-six squad members completed the survey, for a response rate of 88 per cent. The sample consisted of 57 (75 per cent) male and 19 (25 per cent) female respondents. Their ages ranged from 18 to 24 years (M=20.8, SD=1.238). Of the survey sample

(*N*=76), 37 were selected for the team (28 males and nine females) and 39 were in the non-competitor group (29 males and 10 females).

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).[7] Participants would have taken part in the national skills competitions organised by WorldSkills UK and might have also participated in international competitions. It should be noted that the WorldSkills competition is considered more demanding than national or other international competitions.

The self-evaluation section (Nokelainen, in press) measured participants' characteristics with 92 questions (see Appendix A) 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. *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

[7] 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 (for example, terminology, background questions pertaining to school subjects). The Finnish study also included interviews with competitors, trainers and parents.

6. *Learning motivation*: intrinsic goal orientation, extrinsic goal orientation, meaningfulness of studies, control beliefs, efficacy beliefs, test anxiety

WorldSkills London competitors' (N=37 who completed the survey) scores (ranged from 479 to 539 points M=515, SD=19.984) and rank (gold, silver, bronze, medallion for excellence, other) were added to the survey data. Due to the small number of competitors in WorldSkills London, we used only rank information in the analysis. The categorical 'WSL_success'-dependent variable contained the following three classes: 1) gold, silver or bronze; and 2) medallion for excellence ≥500 points; and other <500 points.

Research questions

Following from the two key research questions outlined in 'Introduction' above, 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) male and female squad members, (b) squad members who were and were not selected for Team UK and (c) the most and least successful WSL 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, WSL 2011.

Due to small sample sizes, statistical analyses were performed with non-parametric methods (for example, Spearman rank order correlations, Mann-Whitney *U*test andKruskal-Wallis *H*-test). Some research questions were further investigated with non-parametric non-frequentistic Bayesian classification modelling (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 (for example, 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, 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 (that is, 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 et al., 2007; Nokelainen, 2008).

Each research question was investigated in two stages. First, we calculated location and dispersion descriptive statistics (*M, SD*) for the whole sample (*N*=76). Second, we made three comparisons of group differences based on participants' gender (*N*=76, Mann-Whitney *U* test), selection to the WSL team (*N*=76, Mann-Whitney *U* test) and success at the WSL (*N*=37 Kruskal-Wallis *H* test). The third comparison was made between the following groups of WSL competitors: A group (*N*=12) consists of WSL gold, silver or bronze medal winners, B group (*N*=11) consists of medallion for excellence winners who scored 500 points or more, and the C group (*N*=14) consists of WSL competitors whose scored less than 500 points.

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). Second, 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. Third, this pilot study does

not include a control group of similar young people who do not compete or participate in WorldSkills UK training.

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 observed WorldSkills London success. Results presented in Table 1 show that participants' age has a medium-size negative correlation with the past competition success– younger students are more successful ($r_S(53)=-.26$, $p=.046$). Mathematics grade has a strong negative correlation with English and science grades ($r_S(62)=-.93$, $p<.001$ and $r_S(62)=-.51$, $p<.001$). An interesting finding is that mathematics correlates positively, but not significantly, with success in prior vocational competitions ($r_S(53)=.21$), while grades in other subjects are negatively correlated with prior competition performance (English, $r_S(53)=-.32$, $p=.02$; science, $r_S(54)=-.36$, $p=.008$; sports, $r_S(24)=-.11$, not significant). Grades and past competition success are not significantly related to performance in the WSL competition, a result which may be partly due to the small size of the sample.

Table 1: Correlations between background variables and WorldSkills London performance (*N*=76)

Variables	Mathematics[a]	English[a]	Science[a]	Sports[a]	Past competition success[b]	WorldSkills London success[c]
Age	.06	-.06	.18	.04	-.26*	.20
Mathematics		-.93***	-.51***	-.31	.21	-.20
English			.46***	.25	-.32*	.27
Science				.30	-.36**	.25
Sports					-.11	.25
Past competition success						-.21

Note. *= $p \leq .05$, **= $p \leq .01$, ***= $p \leq .001$. 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 London success (*N*=37): 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 (MIPQ) IX (Tirri and 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 parentheses):

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 and Ruohotie, 2009; Nokelainen, in press), squad members rated bodily-kinaesthetic ('handiness') most strongly (*M*=4.6, *SD*=.504, 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 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*=76)

Natural abilities	*M*(*SD*)
Bodily-kinaesthetic	4.6(.504)
Interpersonal	4.0(.826)
Mathematical-logical	3.9(.838)
Spatial	3.7(.691)
Musical	3.4(.984)
Environmental	3.3(.941)
Intrapersonal	3.3(.805)
Spiritual	3.2(.842)
Linguistic	2.3(.867)

Gender

Table 3 shows that males' ratings were higher than females' in most dimensions. However, average differences reached statistical significance in only one dimension: male respondents self-evaluated their spatial abilities (for example, the ability to visualise things in 3D) higher than females did ($Z(1,76)=-2.530$, $p=.011$). This result has a medium effect size ($r=.29$) according to Cohen (1988).

Table 3: Average self-reported scores on measures of natural abilities, by gender (*N*=76)

Natural abilities	Gender[a]				
	Male *M*(*SD*)	Female *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Linguistic	2.3(.917)	2.3(.712)	-.331	.741	.04

Mathematical-logical	3.9(.810)	3.6(.895)	-1.423	.155	.16
Spatial	3.8(.687)	3.3(.579)	-2.530*	.011	.29
Bodily-kinaesthetic	4.7(.459)	4.4(.580)	-1.951	.051	.22
Musical	3.5(.995)	3.2(.939)	-1.270	.204	.15
Interpersonal	4.0(.876)	4.1(.670)	-.170	.865	.02
Intrapersonal	3.3(.842)	3.3(.700)	-.169	.866	.02
Spiritual	3.2(.873)	3.2(.762)	-.084	.933	.01
Environmental	3.3(.976)	3.1(.823)	-1.105	.269	.13

Note. *= $p \leq .05$.
[a] Males n=57, 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.

Interestingly, quite opposite results were found in an earlier study with Finnish WorldSkills competitors[8] (Nokelainen, 2012). These results should be interpreted with caution, however, as there were three times as many males as females in the sample.

WorldSkills London team membership

As we can see from Table 4, the individuals who were selected to represent the UK at WSL (n=37) did not significantly differ from the non-selected individuals (n=39) in any of the nine multiple intelligence dimensions.

Table 4: Differences in self-reported natural abilities between WorldSkills London competitors and non-selected squad members

	Compete in WSL[a]				
Natural abilities	**No** ***M*(*SD*)**	**Yes** ***M*(*SD*)**	***Z*[b]**	***p***	***r*[c]**

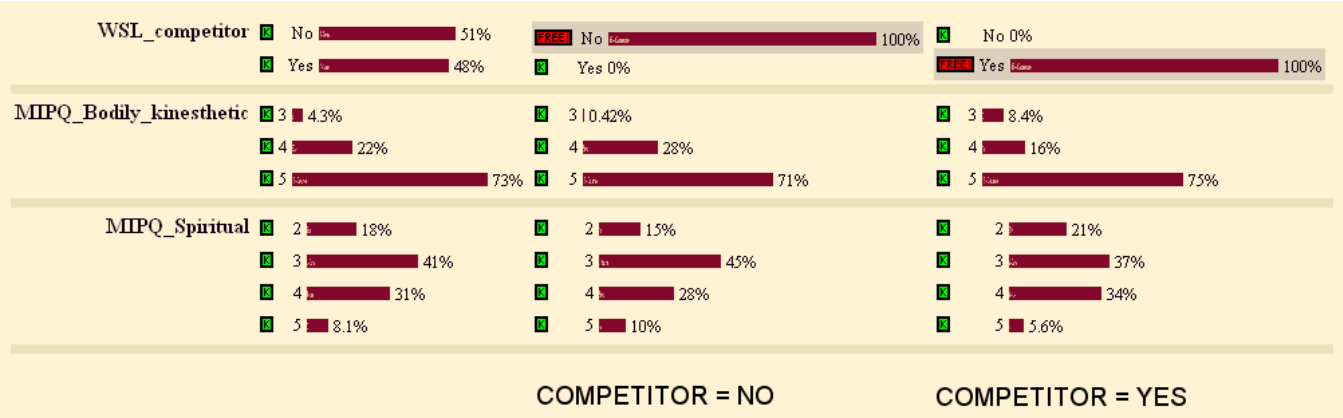
[8]Mann-Whitney*U*test with a Finnishcombinedsample (N=110) fromthreeWorldSkillsteams (2007, 2009, 2011) showedthatfemalesratedlinguistic, musical, interpersonal, intrapersonal (Z(1,108)=-2.910, p=.004), spiritual (Z(1,108)=-4.125, p<.001) and environmental (Z(1,108)=-2.631, p=.009) dimensionshigherthanmalesdid.

Linguistic	2.3(.905)	2.4(.837)	-.506	.613	.06
Mathematical-logical	3.7(.823)	4.0(.846)	-1.457	.145	.17
Spatial	3.7(.713)	3.6(.673)	-.659	.510	.08
Bodily-kinaesthetic	4.6(.447)	4.5(.562)	-.650	.516	.07
Musical	3.5(1.020)	3.4(.957)	-.255	.798	.03
Interpersonal	4.0(.785)	4.0(.878)	-.152	.879	.02
Intrapersonal	3.3(.806)	3.2(.810)	-.595	.552	.07
Spiritual	3.2(.794)	3.1(.899)	-.251	.802	.03
Environmental	3.3(.952)	3.2(.937)	-.534	.594	.06

[a] Non-selected *n*=39, selected *n*=37.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): small effect size = .10; medium = .30; large = .50.

However, results of the BCM analysis with a classification accuracy of 59.2 per cent showed weak evidence that the WSL competitors were not as practical (bodily-kinaesthetic intelligence, 8.4 per cent versus 0.4 per cent) or reflective (spiritual intelligence, 21 per cent versus 15 per cent) as those who were not selected to represent the UK in WSL (see Figure 2).

Figure 2: Bayesian network of multiple intelligence dimensions predicting selection to the WorldSkills UK team for WorldSkills London



Success at WorldSkills London

Although medal winners (A group) self-evaluated to have higher mathematical-logical, bodily-kinaesthetic and environmental abilities than those who did not succeed in the WSL (C group), our general conclusion, supported also by BCM analysis, is that the WorldSkills UK team performance in the WSL competition was not related to these factors (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).

Table 5: Differences in average self-reported natural abilities by WorldSkills London competition success (*N*=37)

Natural Abilities	Success at WSL[a]					
	A *M*(*SD*)	B *M*(*SD*)	C *M*(*SD*)	χ^{2b}	*p*	η^{2c}
Linguistic	2.1(.985)	2.5(.765)	2.4(.748)	1.451	.484	.02
Mathematical-logical	4.2(.804)	3.9(.832)	3.9(.913)	1.357	.507	.02
Spatial	3.7(.745)	3.4(.692)	3.7(.608)	1.721	.423	.02
Bodily-kinaesthetic	4.7(.374)	4.7(.593)	4.3(.640)	3.816	.148	.05
Musical	3.5(1.063)	3.4(1.086)	3.3(.805)	.970	.616	.01
Interpersonal	3.9(.926)	4.1(.904)	3.9(.868)	.390	.823	.01
Intrapersonal	3.1(.733)	3.4(.822)	3.1(.881)	1.261	.532	.02
Spiritual	3.2(.789)	3.2(.882)	3.1(1.048)	.280	.869	.00
Environmental	3.4(.827)	3.3(1.153)	3.0(.867)	1.856	.395	.02

[a]A group (gold, silver and bronze medal winners) n=12, B group (medallion for excellence winners, score ≥ 500) n=11, C group (score < 500 points) n=14.
[b]Kruskal-Wallis *H*-test.
[c] Scale for the effect size indicator ($\eta^2=Z/N$): small effect size = .01; medium = .06; large = .14.

Ethical sensitivities

Descriptive statistics

Ethical sensitivities were measured with an adaptation of the Ethical Sensitivity Scale (ESS, see Tirri and Nokelainen, 2011b), which is based on Narvaez's operationalisation of ethical sensitivity (1993; Narvaez and Endicott, 2001). Its main purpose is to scale respondents' orientations on ethical issues. We collected data on the following six dimensions (example statements from the survey are given in parentheses):[9]

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 people's 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 6 shows that the third dimension, 'caring by connecting to others', has the highest average and lowest standard deviation (indicating unanimity in responses). These young vocational skills competitors seem to care about others and take other people's viewpoints into account before making important decisions. High-value mean scores on the other dimensions suggest that most participants are ethically sensitive.

[9]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 and Nokelainen, 2011b, p.64).

Table 6: Average self-reported scores on measures of ethical sensitivity (*N*=76)

Ethical sensitivities	***M*(*SD*)**
Caring by connecting to others	4.2(.753)
Generating interpretations and options	3.9(.829)
Working with interpersonal and group differences	3.9(.773)
Taking the perspectives of others	3.7(.819)
Identifying the consequences of actions and options	3.7(.794)
Reading and expressing emotions	3.6(.834)

Gender

The results of the Mann-Whitney *U* test show that there is only one gender-related difference in the sample (Table 7): males self-evaluated their ability to work with interpersonal and group differences better than females did ($Z(1,76)=-2.069$, $p=.034$). This finding is somewhat surprising as earlier studies found that females generally tend to rate their ethical skills higher than males do (Tirri and Nokelainen, 2011a, p.71).

Table 7: Differences in self-reported scores on measures of ethical sensitivity, by gender (*N*=76)

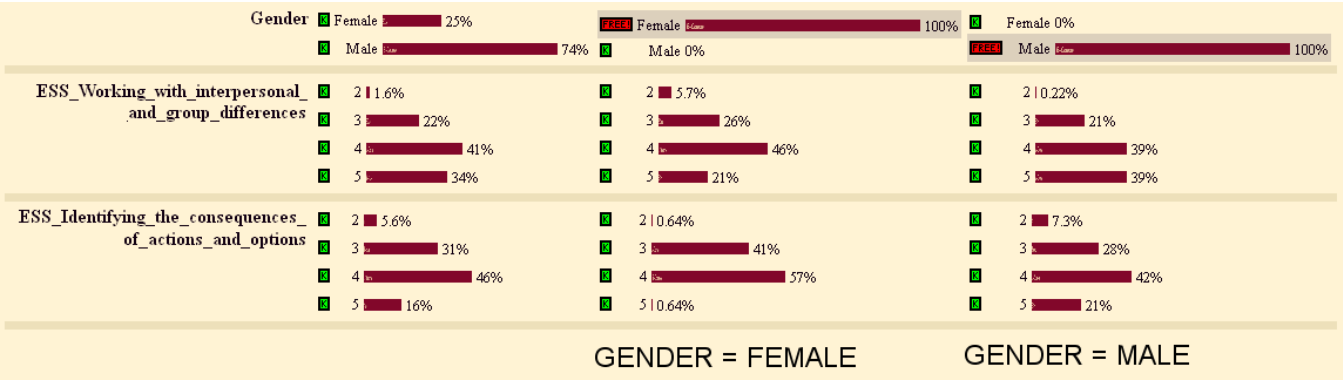
Ethical sensitivities	**Gender[a]**				
	Male	**Female**			
	***M*(*SD*)**	***M*(*SD*)**	***Z*[b]**	***p***	***r*[c]**
Reading and expressing emotions	3.6(.890)	3.6(.664)	-.192	.848	.02
Taking the perspectives of others	3.7(.818)	3.6(.843)	-.323	.747	.04
Caring by connecting to others	4.1(.792)	4.4(.584)	-1.404	.160	.16
Working with interpersonal and group differences	4.0(.785)	3.6(.672)	-2.069*	.039	.24
Generating interpretations and	3.9(.815)	3.7(.869)	-1.056	.291	.12

options					
Identifying the consequences of actions and options	3.7(.842)	3.7(.653)	-.098	.922	.01

Note. *= $p \leq .05$.
[a] Males n=57, 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.

However, the BCM analysis, with a classification accuracy of 76.4 per cent, revealed two ethical sensitivity indicators as predictors for gender:'4. Working with interpersonal and group differences' and '6. Identifying the consequences of actions and options'. Analysis of predictive distribution of the fourth ethical sensitivity factor showed that 39 per cent of males (versus 21 per cent of females) would select the 'totally agree' response option for a question such as 'I take other people's viewpoints into account before making important decisions in my life' in a population that resembles our sample (Figure 3).

Figure 3: Bayesian network of an ethical sensitivity fact or predicting gender



WorldSkills London 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 fifth and sixth (most abstract) ethical sensitivity dimensions higher than the non-selected squad members.[10] Further evidence is needed to verify that ethical sensitivity is one of the factors that

[10] A recent study with academically gifted Finnish mathematics Olympians suggested a positive relation between higher-order moral judgement, operationalising the post-conventional level (fifth and sixth stages) of Kohlberg's moral theory (1969), and the fifth and sixth dimensions of ethical sensitivity (Tirri and Nokelainen, 2012).

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 WorldSkills London competitors and non-selected squad members (*N*=76)

Ethical sensitivities	Compete in WSL[a]				
	No	Yes			
	***M*(*SD*)**	***M*(*SD*)**	***Z*[b]**	***p***	***r*[c]**
Reading and expressing emotions	3.6(.767)	3.5(.906)	-.987	.324	.11
Taking the perspectives of others	3.7(.719)	3.7(.926)	-.124	.901	.01
Caring by connecting to others	4.3(.714)	4.1(.791)	-1.058	.290	.12
Working with interpersonal and group differences	3.9(.785)	3.8(.760)	-.820	.412	.09
Generating interpretations and options	3.8(.713)	3.9(.947)	-.746	.456	.09
Identifying the consequences of actions and options	3.7(.793)	3.8(.806)	-.200	.842	.02

Note. *= $p \leq .05$.
[a]Non-selected n=39, selected n=37.
[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 at WorldSkills London

The 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 low self-evaluations on the third ethical sensitivity dimension compared to other WSL competitors ($\chi^2(2,37)=6.424$, $p=.040$, $\eta^2=.09$). Furthermore, the BCM analysis confirmed only a weak connection between the sixth ethical sensitivity factor ('Identifying the consequences of actions and options') and success at WSL.

Table 9: Differences in ethical sensitivity by WorldSkills London competition success (n=37)

Ethical Sensitivities	Success at WSL[a]					
	A	B	C			
	M(*SD*)	*M*(*SD*)	*M*(*SD*)	χ^{2b}	*p*	η^{2c}
Reading and expressing emotions	3.5(.891)	3.4(.970)	3.6(.932)	.660	.719	.01
Taking the perspectives of others	3.6(.793)	3.7(1.272)	3.7(.751)	.684	.710	.01
Caring by connecting to others	3.7(.807)	4.5(.742)	4.2(.658)	6.424*	.040	.09
Working with interpersonal and group differences	3.5(.838)	4.1(.664)	3.7(.725)	3.019	.221	.04
Generating interpretations and options	4.0(.964)	3.9(.970)	3.8(.987)	.225	.894	.00
Identifying the consequences of actions and options	3.7(.965)	3.9(.539)	3.6(.870)	.849	.654	.01

Note. * = $p \leq .05$.
[a]A group (gold, silver and bronze medal winners) *N*=12, B group (medallion for excellence winners, score ≥ 500) n=11, C group (score < 500 points) *N*=14.
[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. On the other hand, 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 and Ruohotie, 2009; Nokelainen, in press). These questions operationalised the following four factors (example statements appear in parentheses):

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 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.

Table 10: Average self-reported scores on measures of talent development (*N*=76)

Influential factors	***M*(*SD*)**
Non-domain-specific extrinsic conditions	4.3(.677)
Domain-specific extrinsic conditions	4.6(.447)
Domain-specific intrinsic motivation	4.8(.342)
Domain-specific extrinsic motivation	4.7(.491)

Gender

Results of both non-parametric Mann-Whitney*U* tests (Table 11) and the BCM analysis show that there are no self-reported gender-related differences in domain- and non-domain-specific factors with regard to vocational talent development.

Table 11: Differences in average scores on measures of talent development by gender (*N*=76)

Influential factors	Gender[a]				
	Male	Female			
	M(*SD*)	*M*(*SD*)	*Z*[b]	*p*	*r*[c]
Non-domain-specific extrinsic conditions	4.3(.671)	4.3(.713)	-.057	.955	.01
Domain-specific extrinsic conditions	4.6(.428)	4.5(.512)	-.181	.857	.02
Domain-specific intrinsic motivation	4.8(.336)	4.7(.361)	-1.033	.302	.12
Domain-specific extrinsic motivation	4.7(.473)	4.7(.554)	-.028	.977	.00

[a] Males *N*=57, 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.

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.

Table 12: Differences in talent development between the WSL competitors and non-selected squad members (*N*=76)

Influential factors	Compete in WSL[a]				
	No	Yes			
	M(*SD*)	*M*(*SD*)	*Z*[b]	*p*	*r*[c]
Non-domain-specific extrinsic conditions	4.3(.656)	4.3(.709)	-.319	.750	.04
Domain-specific extrinsic conditions	4.5(.486)	4.6(.406)	-.368	.713	.04
Domain-specific intrinsic motivation	4.8(.323)	4.8(.365)	-.321	.748	.04
Domain-specific extrinsic motivation	4.7(.493)	4.7(.495)	-.068	.946	.01

[a]Non-selected n=39, selected n=37.
[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 at WorldSkills London

Competitors who performed best at the WSL (A group) reported the lowest level of domain-specific extrinsic motivation (that is, drive to compete) ($\chi^2(2,37)=7.703$, $p=.021$, $\eta^2=.10$, see Table 13). Although the sample is small, the effect size is at a medium level. This result could indicate that competitors with higher extrinsic motivation who did not win medals (B group) may have compensated for a perceived lack of skill with a strong motivation to do as well as they could. On the other hand, the result could mean that B group members may be as skilled as A group members, but that they tried too hard (or took too many risks) and thus failed to win medals. The first hypothesis is supported by the finding that even the lowest-performing C group reported having a higher level of extrinsic motivation than the medal winners (A group).

Table 13: Differences in talent development by a WorldSkills London competition success (n=37)

Influential factors	Success at WSL[a]					
	A	B	C			
	M(*SD*)	*M*(*SD*)	*M*(*SD*)	χ^{2b}	*p*	η^{2c}
Non-domain-specific extrinsic conditions	4.5(.603)	4.0(.789)	4.4(.712)	2.415	.299	.03
Domain-specific extrinsic conditions	4.5(.430)	4.7(.361)	4.6(.436)	.892	.640	.01
Domain-specific intrinsic motivation	4.8(.322)	4.8(.424)	4.8(.376)	1.145	.564	.02
Domain-specific extrinsic motivation	4.4(.634)	5.0(.151)	4.7(.435)	7.703*	.021	.10

Note. * = $p \leq .05$.
[a]A group (gold, silver and bronze medal winners) *N*=12, B group (medallion for excellence winners, score ≥ 500) n=11, C group (score < 500 points) *N*=14.
[b]Kruskal-Wallis *H* test.
[c] Scale for the effect size indicator ($\eta^2=Z/N$): small effect size = .01; medium = .06; large = .14.

Abilities needed for WorldSkills training

Descriptive statistics

Nokelainen (in press) found that essential abilities to succeed in WorldSkills training could be categorised into three classes (sample statements in parentheses): social ('Bounce back from failures or injustices'), cognitive ('Apply new work methods') and entrepreneurial ('See problematic work tasks as positive challenges'). 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*=76)

Skills needed in WorldSkills training	*M*(*SD*)
Social abilities	4.6(.466)
Cognitive abilities	4.7(.379)
Entrepreneurial abilities	4.7(.457)

Gender

A comparison of male and female group medians indicated that males tended to self-evaluate their entrepreneurial abilities (or talent) higher than females did ($Z(1,76)=-3.239$, $p=.001$, $r=.37$) (Table 15). This result was confirmed in the BCM analysis. The results of the Mann-Whitney *U* test showed that males also rated their cognitive abilities higher than females did ($Z(1,76)=-2.203$, $p=.028$, $r=.25$). This result was not found in the Bayesian analysis.

Table 15: Differences in skills needed in WorldSkills training by gender (*N*=76)

Skills needed in WorldSkills training	Gender[a]				
	Male	Female			
	M(*SD*)	*M*(*SD*)	*Z*[b]	*p*	*r*[c]
Social abilities	4.6(.469)	4.6(.465)	-.522	.602	.06
Cognitive abilities	4.8(.337)	4.6(.450)	-2.203*	.028	.25
Entrepreneurial abilities	4.8(.389)	4.4(.530)	-3.239**	.001	.37

Note. * = $p \leq .05$.
Note. ** = $p \leq .01$.
[a]Males n=57, 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.

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 WSL competitors and non-selected squad members (*N*=76)

Skills needed in WorldSkills training	Compete in WSL[a]				
	No	Yes			
	M(*SD*)	*M*(*SD*)	*Z*[b]	*p*	*r*[c]
Social abilities	4.7(.362)	4.6(.549)	-.766	.444	.09
Cognitive abilities	4.8(.411)	4.7(.348)	-.606	.545	.07
Entrepreneurial abilities	4.7(.461)	4.7(.457)	-.732	.464	.08

[a]Non-selected n=39, selected n=37.
[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 at WorldSkills London

The Kruskal-Wallis *H* test showed that competitors' performance at the WSL was not statistically related to their social, cognitive or entrepreneurial abilities.

Table 17: Differences in skills needed in WorldSkills training by WorldSkills London competition success (*N*=37)

Skills needed in WorldSkills training	Success at WSL[a]					
	A	B	C			
	M(*SD*)	*M*(*SD*)	*M*(*SD*)	χ^{2b}	*p*	η^{2c}
Social abilities	4.5(.674)	4.6(.512)	4.6(.492)	.135	.935	.00
Cognitive abilities	4.7(.322)	4.8(.202)	4.7(.451)	1.086	.581	.01
Entrepreneurial abilities	4.6(.469)	4.8(.344)	4.6(.535)	.829	.661	.01

[a]A group (gold, silver and bronze medal winners) *N*=12, B group (medallion for excellence winners, score ≥ 500) n=11, C group (score < 500 points) *N*=14.
[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 distinguished between mastery and performance goals, approach and avoidance goals, and task and ego involvement (Ames, 1992; Elliot and 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 (for example, '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 (for example, '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 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*=76)

Patterns of adaptive learning	*M*(*SD*)
Mastery goal orientation	4.9(.279)
Performance-approach goal orientation	4.8(.328)
Performance-avoidance goal orientation	3.8(.868)

Gender

Results of the Mann-Whitney *U* test (Table 19) 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.

Table 19: Differences in patterns of adaptive learning, by gender (*N*=76)

Patterns of adaptive learning	Gender[a]				
	Male	Female			
	M(*SD*)	*M*(*SD*)	*Z*[b]	*p*	*r*[c]
Mastery goal orientation	4.9(.227)	4.8(.382)	-1.779	.075	.20
Performance-approach goal orientation	4.8(.282)	4.7(.434)	-.883	.377	.10
Performance-avoidance goal orientation	3.9(.891)	3.7(.808)	-.846	.397	.10

[a]Males n=57, 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.

WorldSkills London team membership

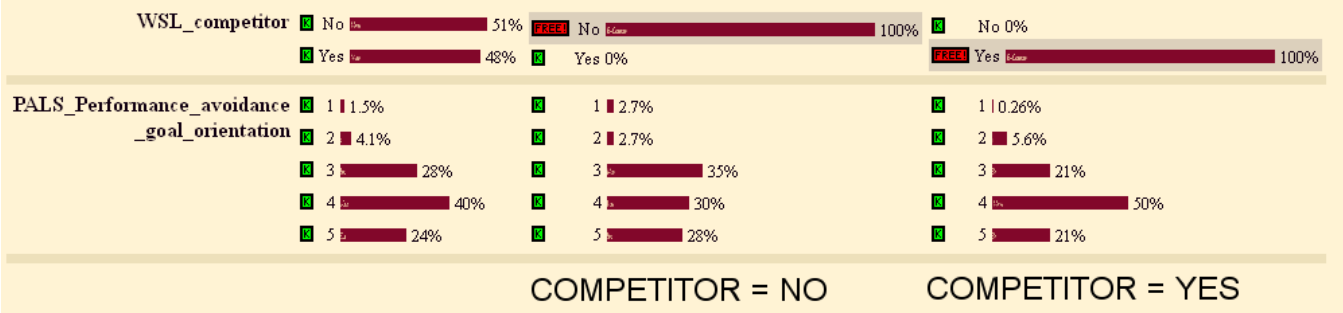
Table 20 shows that WSL competitors self-evaluated their performance-avoidance goal orientation (for example, 'I don't want to embarrass myself in front of the others') higher than the non-selected competitors did. Although this finding is not statistically significant, it was also present in the most probable Bayesian network with a classification accuracy of 59.2 per cent (Figure 4).

Table 20: Differences in patterns of adaptive learning between WorldSkills London competitors and non-selected squad members (*N*=76)

Patterns of adaptive learning	Compete in WSL[a]				
	No	Yes			
	M(*SD*)	*M*(*SD*)	*Z*[b]	*p*	*r*[c]
Mastery goal orientation	4.9(.218)	4.8(.330)	-.937	.349	.11
Performance-approach goal orientation	4.9(.283)	4.8(.366)	-1.309	.191	.15
Performance-avoidance goal orientation	3.8(.947)	3.9(.788)	-.314	.753	.04

[a]Non-selected n=39, selected n=37.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): small effect size = .10; medium = .30; large = .50.

Figure 4: Bayesian network of performance-avoidance goal orientation predicting selection to the UK WorldSkills London team



Success at WorldSkills London

Kruskal-Wallis *H* test results are presented in Table 21. An interesting finding is that performance-avoidance goal-oriented competitors (for example, 'I avoid showing others if I am facing difficulties in WSC training exercises) performed best in WorldSkills London ($\chi^2(2,37)=11.374$, $p=.003$, $\eta^2=.15$).The opposite result was found in a study of 77 Finnish WorldSkills competitors[11] (Nokelainen, 2012). This result could indicate cultural differences or reflect lack of power in the current sample due to the small number of participants (*N*=37).

[11]Kruskal-Wallis*H*test with a Finnishcombinedsample (*N*=77) fromtwoWorldSkillsteams (2009, 2011) showedthat the A group (medalwinners) 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.

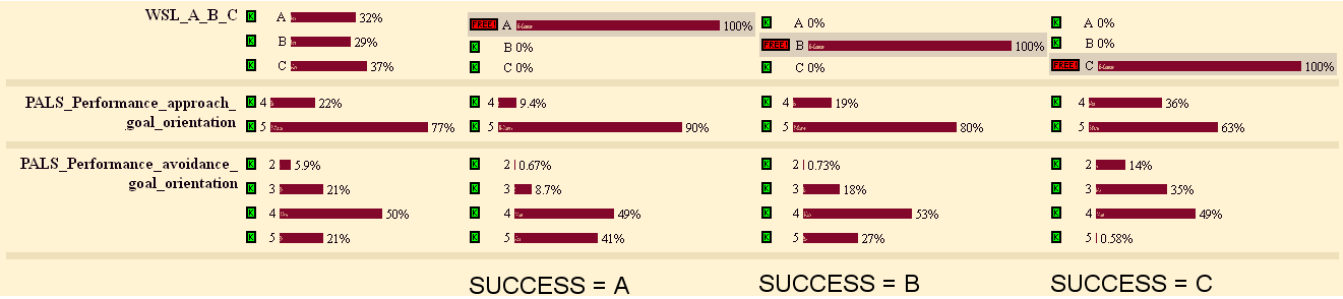
Table 21: Differences in patterns of adaptive learning by WorldSkills London competition success (*N*=37)

Patterns of adaptive learning	Success at WSL					
	A	B	C			
	M(*SD*)	*M*(*SD*)	*M*(*SD*)	χ^{2b}	*p*	η^{2c}
Mastery goal orientation	4.9(.223)	4.9(.135)	4.7(.469)	2.039	.361	.03
Performance-approach goal orientation	4.8(.302)	4.8(.342)	4.7(.434)	.773	.679	.01
Performance-avoidance goal orientation	4.3(.515)	4.2(.639)	3.3(.783)	11.374**	.003	.15

Note. ** = $p \leq .01$.
[a]A group (gold, silver and bronze medal winners) *N*=12, B group (medallion for excellence winners, score ≥ 500) n=11, C group (score < 500 points) *N*=14.
[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 results of the BCM (with a classification accuracy of 73.2 per cent) suggest that both performance-approach and performance-avoidance-oriented competitors are more likely to succeed in WorldSkills competitions (Figure 5).

Figure 5: Bayesian network of performance-avoidance and performance-approach goal orientations predicting 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)



Learning motivation

Descriptive statistics

Learning motivation was measured with an adaptation of the Abilities for Professional Learning Questionnaire (APLQ, see Nokelainen and Ruohotie, 2002). APQL is based on the Motivated Strategies for Learning Questionnaire developed 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 are given 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 WorldSkills 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 a 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, in press). 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 competitions (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). The data also show that respondents rate ability over effort as an explanation for success in skills competitions.[12]

[12]In a study by Tirri and Nokelainen (2011a), 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 mathematics 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 22: Location and dispersion descriptive statistics of learning motivation (*N*=76)

Learning motivation	***M*(*SD*)**
Intrinsic goal orientation	4.4(.557)
Extrinsic goal orientation	4.7(.469)
Meaningfulness of studies	4.8(.368)
Control beliefs	3.9(.687)
Efficacy beliefs	4.5(.571)
Test anxiety	3.4(.775)

Gender

Although the results of Mann-Whitney *U* tests in Table 23 were not statistically significant, they show that male respondents' self-evaluated learning motivation was higher than females' in all but one dimension.

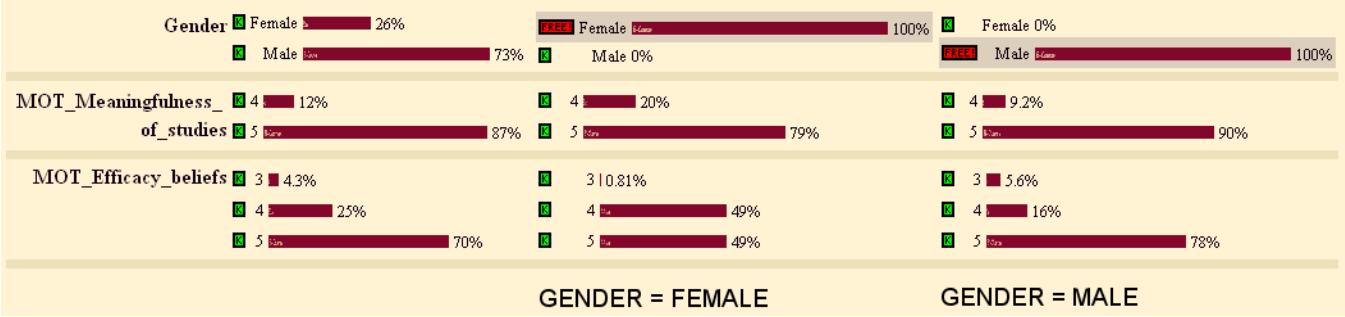
Table 23: Gender-related differences in learning motivation (*N*=76)

Learning motivation	Gender[a]				
	Male *M*(*SD*)	Female *M*(*SD*)	*Z*[b]	*p*	*r*[c]
Intrinsic goal orientation	4.4(.564)	4.2(.509)	-1.755	.079	.20
Extrinsic goal orientation	4.7(.480)	4.7(.448)	-.240	.810	.03
Meaningfulness of studies	4.8(.318)	4.6(.467)	-1.951	.051	.22
Control beliefs	3.9(.729)	3.8(.558)	-.208	.835	.02
Efficacy beliefs	4.6(.563)	4.4(.591)	-1.217	.223	.14
Test anxiety	3.4(.799)	3.3(.711)	-.607	.544	.07

[a] Males n=57, 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.

These results were repeated in the BCM results (Figure 6). As the female group is quite small compared to male group, these findings should be interpreted with caution.

Figure 6: Bayesian network for two learning-motivation factors predicting gender



WorldSkills London team membership

Non-parametric analysis did not reveal any differences in learning motivation between those who were selected to compete in WSL and those who were not (Table 24). However, BCM (77.6 per cent classification accuracy) showed that the competitors reported a higher level of intrinsic goal orientation than those not selected

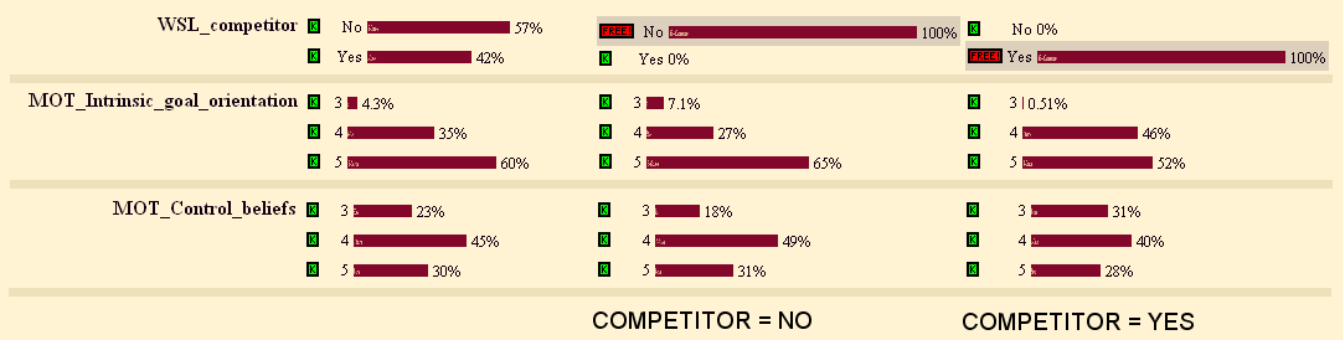
to compete at WSL (Figure 7). WSL competitors were also less likely to attribute success to effort (control belief) than were the non-selected squad members, although the difference is not significant.

Table 24: Differences in learning motivation between WorldSkills London competitors and non-selected squad members (*N*=76)

Learning motivation	Compete in WSL[a]				
	No	Yes			
	M(*SD*)	*M*(*SD*)	*Z*[b]	*p*	*r*[c]
Intrinsic goal orientation	4.4(.601)	4.4(.516)	-.233	.816	.03
Extrinsic goal orientation	4.7(.457)	4.6(.484)	-.804	.422	.09
Meaningfulness of studies	4.8(.411)	4.8(.322)	-.122	.903	.01
Control beliefs	4.0(.658)	3.7(.703)	-1.497	.134	.17
Efficacy beliefs	4.6(.502)	4.5(.640)	-.240	.810	.03
Test anxiety	3.5(.827)	3.3(.712)	-1.014	.311	.12

[a]Non-selected n=39, selected n=37.
[b] Mann-Whitney *U* test.
[c] Scale for the effect size indicator ($r=Z/\sqrt{N}$): small effect size = .10; medium = .30; large = .50.

Figure 7: Bayesian network for intrinsic goal orientation and control beliefs predicting selection to the UK WorldSkills London team



Success at WorldSkills London

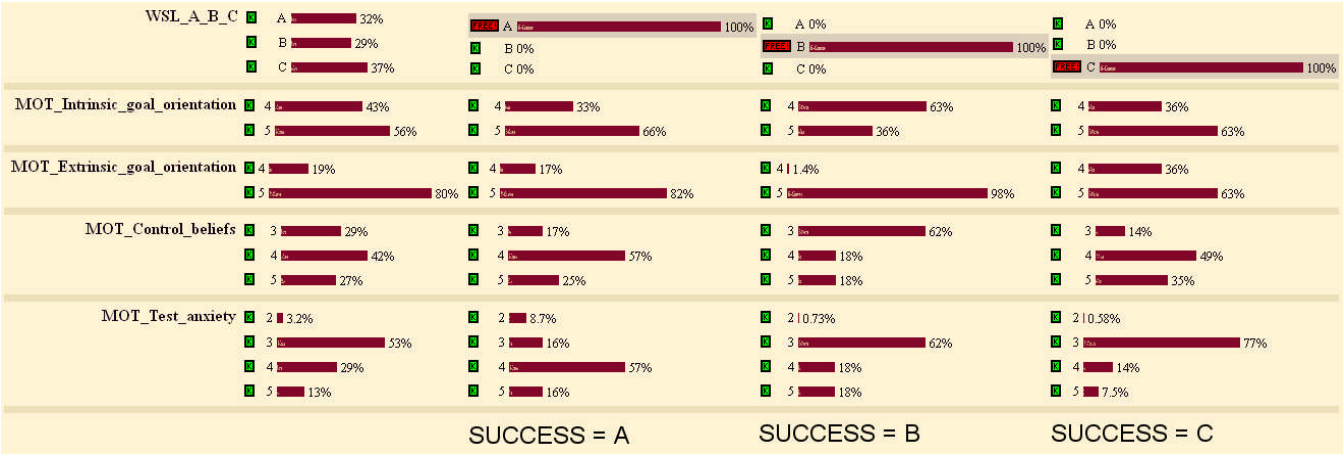
Table 25 shows two interesting, although not statistically significant, findings. Those who excelled in the most demanding skills competition (A and B groups) are more competition-oriented (extrinsic goal orientation) than those who failed to score at least 500 points. Another finding was that both the B and C groups reported lower test anxiety than the A group. These results were also found in BCM analysis (Figure 8).

Table 25: Differences in learning motivation by WorldSkills London competition success (n=37)

Learning motivation	Success at WSL[a]					
	A	B	C			
	M(*SD*)	*M*(*SD*)	*M*(*SD*)	χ^{2b}	*p*	η^{2c}
Intrinsic goal orientation	4.4(.557)	4.1(.452)	4.6(.475)	4.396	.111	.06
Extrinsic goal orientation	4.7(.498)	4.9(.234)	4.4(.550)	5.098	.078	.07
Meaningfulness of studies	4.8(.334)	4.8(.344)	4.8(.317)	.168	.920	.00
Control beliefs	3.7(.620)	3.4(.769)	4.0(.650)	4.843	.089	.06
Efficacy beliefs	4.5(.739)	4.6(.539)	4.4(.656)	.640	.726	.01
Test anxiety	3.6(.821)	3.2(.720)	3.1(.561)	3.644	.162	.05

Note. * = $p \leq .05$.
[a]A group (gold, silver and bronze medal winners) *N*=12, B group (medallion for excellence winners, score ≥ 500) n=11, C group (score < 500 points) *N*=14.
[b]Kruskal-Wallis *H* test.
[c] Scale for the effect size indicator (η^2=*Z*/*N*): small effect size = .01; medium = .06; large = .14.

Figure 8: 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 study examined factors related to the development of vocational excellence among a group of young people who participated in WorldSkills UK training in 2011. It compared survey results for different groups: male and female squad members, squad members versus team members (who competed in WSC London 2011) and medal winners versus non-medal winners at WSC London. The main findings from this pilot study are as follows:

- Overall, younger competitors and those with higher mathematics grades in school tended to have been more successful in past competitions. But none of the **background characteristics** measures (age, school grades, past competition success) were related to success at WSL
- Overall, participants most highly rated have three **natural abilities:** bodily-kinaesthetic (handiness), interpersonal and mathematical-logical skills. Boys tended to rate their abilities higher than did girls, and significantly so for spatial ability. But none of the ability characteristics were significantly related to either team selection or WSL performance
- Young vocational-skills competitors have a high degree of **ethical sensitivity**–they seem to care about others and take other people's viewpoints into account before making important decisions. Male competitors were more likely than female competitors to be able to work with interpersonal and group differences, a somewhat surprising finding in comparison to other studies which have found the opposite (higher ratings by girls). Medal winners reported being less ethically sensitive on one dimension: caring by connecting to others
- Overall, participants highly rated all four factors as important to **talent development** (domain and non- domain-specific conditions and external or internal motivation). Importance was similar for males and females and for WSL competitors versus non-competitors. Medal winners reported the lowest drive to compete (domain-specific extrinsic motivation)
- With regard to **abilities needed for WorldSkills training**, all three were seen as important (social, cognitive, entrepreneurial). In comparison to females, male squad members rated entrepreneurial and cognitive abilities as significantly more important. However, these abilities are not related to medal success
- **Adaptive learning** concerns ones goal orientation. The least important factor, as expected in a sample of participants in skills competitions, is avoiding demonstration of incompetence (performance-avoidance goal orientation). WSL competitors and medal winners rated this factor as more important than did squad members not selected for this competition. This finding is opposite to Finnish competitors and may suggest a cultural difference
- Looking at **motivation**, ability is rated as more important than effort in explaining success at competitions. WSL competitors reported a higher

intrinsic goal orientation than non-selected squad members. An interesting but not significant finding is that medal and medallion of excellence winners were more completion-oriented (higher extrinsic goal motivation). Medal winners reported higher rates of test anxiety

- Overall, these findings suggest that the most important contributors to vocational excellence–winning medals at WSC London 2011–were motivational in nature. Medal winners were not driven by the desire to compete but still wanted to be perceived as 'number one' in their field. They seem to be partly motivated by not wanting to appear incompetent to others. As this study was a pilot effort to adapt research from Finnish WorldSkills competitors to the UK context, the findings should be considered as preliminary. The research is continuing in 2013 and further results are needed from more competitors to determine the robustness of these results and their significance for WorldSkills UK.

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Appendix A: Descriptive statistics for WorldSkills London competitors and non-competitors

MoVE Survey

Scales and items	Compete in WorldSkills London		Total sample
	No (*n*=39) *M*(*SD*)	Yes (*n*=37) *M*(*SD*)	(*n*=76) *M*(*SD*)
Natural Abilities			
Writing is a natural way for me to express myself.	2.3(1.113)	2.5(1.096)	2.4(1.102)
At school, studies in English or social studies were easier for me than mathematics, physics and chemistry.	2.3(1.199)	2.0(1.118)	2.2(1.167)
I have recently written something that I am especially proud of, or for which I have received recognition.	1.8(1.117)	2.2(1.294)	2.0(1.219)
Metaphors and vivid verbal expressions help me learn efficiently.	2.7(1.284)	2.8(1.211)	2.7(1.242)
At school, I was good at mathematics, physics or chemistry.	3.3(1.264)	4.0(1.258)	3.6(1.293)
I can work with and solve complex problems.	4.2(.823)	4.2(.863)	4.2(.838)
Mental arithmetic is easy for me.	3.3(1.117)	3.5(1.145)	3.4(1.132)
I am good at games and problem solving, which require logical thinking.	4.2(.823)	4.2(.908)	4.2(.860)
At school, geometry and other subjects involving spatial perception were easier for me than solving equations.	3.5(.942)	3.1(1.058)	3.3(1.009)
It is easy for me to conceptualise complex and multidimensional patterns.	3.5(.942)	3.7(1.051)	3.6(.994)
I can easily imagine how a landscape looks from a bird's-eye view.	3.8(.988)	3.8(1.011)	3.8(.994)
When I read, I form pictures or visual images in my mind.	3.9(1.085)	3.8(1.236)	3.9(1.154)
I am handy.	4.7(.525)	4.7(.560)	4.7(.540)
I can easily do something concrete with my hands (e.g. knitting and woodwork).	4.8(.409)	4.6(.716)	4.7(.580)
I am good at showing someone how to do something in practice.	4.5(.600)	4.4(.758)	4.5(.682)
I was good at handicrafts (e.g. woodwork, textiles) at school.	4.5(.683)	4.4(.877)	4.5(.777)

Scales and items	Compete in WorldSkills London		Total sample
	No (*n*=39) *M*(*SD*)	Yes (*n*=37) *M*(*SD*)	(*n*=76) *M*(*SD*)
After hearing a tune once or twice I am able to sing or whistle it quite accurately.	3.8(.970)	3.8(1.198)	3.8(1.080)
When listening to music, I am able to pick out individual instruments and recognise melodies.	3.2(1.307)	3.3(1.239)	3.3(1.266)
I can easily keep the rhythm when drumming a melody.	3.3(1.177)	3.2(1.266)	3.3(1.215)
I notice immediately if a melody is out of tune.	3.5(1.335)	3.2(1.158)	3.3(1.250)
Even in strange company, I can easily find someone to talk to.	3.9(.864)	3.7(1.203)	3.8(1.040)
I get along easily with different types of people.	4.1(.852)	4.2(.854)	4.2(.849)
I make contact easily with other people.	4.1(.929)	4.1(.998)	4.1(.957)
In negotiations and group work, I am able to support the group to find a consensus.	4.0(.843)	3.9(.848)	4.0(.840)
I am able to analyse my own motives and ways of action.	4.1(.732)	4.0(.816)	4.1(.772)
I often think about my own feelings and sentiments and seek reasons for them.	3.5(1.072)	3.3(1.102)	3.4(1.083)
I spend time regularly reflecting on the important issues in life.	3.6(1.229)	3.5(1.169)	3.5(1.194)
I like to read psychological or philosophical literature to increase my self-knowledge.	2.2(1.089)	2.1(1.268)	2.1(1.173)
In my busy everyday life I find it important to take time to think and reflect.	3.1(1.061)	3.0(1.213)	3.1(1.130)
Even ordinary everyday life is full of amazing things.	4.1(.826)	3.7(.962)	3.9(.903)
I often reflect on the meaning of life.	2.7(1.127)	2.7(1.175)	2.7(1.143)
It is important to me to share a quiet moment with others.	3.0(1.203)	3.1(1.362)	3.1(1.274)
I enjoy the beauty and experiences related to nature.	3.5(1.144)	3.5(1.145)	3.5(1.137)
Protecting the environment is important to me.	3.4(1.115)	3.4(1.086)	3.4(1.094)
I pay attention to what I consume in order to protect the environment.	3.1(1.119)	2.8(1.050)	3.0(1.089)

Scales and items	Compete in WorldSkills London		Total sample
	No (*n*=39) *M*(*SD*)	Yes (*n*=37) *M*(*SD*)	(*n*=76) *M*(*SD*)
Ethical Sensitivities			
I notice if someone working with me is offended at me.	3.7(.850)	3.8(.797)	3.8(.819)
I am able to express my feelings to other people if I am offended or hurt because of them.	3.5(1.048)	3.2(1.305)	3.4(1.181)
I think it is good to have close friends and associates who think in different ways.	3.5(.913)	3.5(1.108)	3.5(1.005)
I get along with people who think in different ways.	3.9(.695)	3.8(.845)	3.9(.766)
I take charge of how other people are doing.	4.4(.680)	4.2(.832)	4.3(.759)
I take care of the other people's well-being and try to contribute it.	4.1(.923)	4.0(.845)	4.1(.884)
I take other people's viewpoints into account before making important decisions in my life.	4.1(.793)	3.8(1.056)	3.9(.928)
I try to take other persons' needs into account although it is a question of my benefit.	3.8(.961)	3.7(.741)	3.8(.859)
I think about the consequences of my acts when making ethical decisions.	4.0(.811)	4.1(1.040)	4.0(.922)
I believe there can be several right solutions to ethical problems.	3.6(.818)	3.8(.967)	3.7(.890)
I notice when I am facing a moral issue at school, WSC training or work.	3.7(.793)	3.8(.806)	3.7(.794)
Influential factors to vocational talent development			
An encouraging home atmosphere.	4.6(.718)	4.6(.652)	4.6(.683)
Stimulating influence of a particular friend.	4.0(.843)	4.1(.874)	4.1(.853)
Stimulating influence of a teacher or trainer.	4.3(.655)	4.5(.696)	4.4(.680)
Seeing impressive demonstrations of skill (e.g., furniture design, hairstyling, cabinet making).	4.4(.818)	4.4(.723)	4.4(.769)
My own interest in the field.	4.8(.469)	4.7(.454)	4.8(.460)
My desire to learn new things.	4.9(.339)	4.8(.467)	4.8(.404)
Interest in extending my own limits.	4.8(.485)	4.8(.467)	4.8(.473)

Scales and items	Compete in WorldSkills London		Total sample
	No (*n*=39)	Yes (*n*=37)	(*n*=76)
	M(*SD*)	*M*(*SD*)	*M*(*SD*)
Interest in competing with others in vocational skills.	4.5(.721)	4.5(.697)	4.5(.705)
My desire to succeed in vocational competitions.	4.8(.432)	4.9(.424)	4.9(.425)
Employment opportunities in the future.	4.8(.615)	4.9(.398)	4.8(.521)
Team spirit amongst WS competitors.	4.6(.847)	4.6(.728)	4.6(.787)
The company of people sharing similar interests.	4.6(.641)	4.6(.599)	4.6(.617)
Skills needed in WorldSkills training			
Bounce back from failures or injustices.	4.8(.413)	4.7(.520)	4.7(.468)
Do team work.	4.6(.633)	4.6(.728)	4.6(.678)
Manage conflict situations.	4.7(.471)	4.4(.765)	4.6(.642)
Improve existing work methods.	4.8(.490)	4.8(.479)	4.8(.481)
Apply new work methods.	4.8(.370)	4.8(.374)	4.8(.369)
Create new work methods.	4.7(.503)	4.8(.397)	4.8(.452)
Take responsibility and controlled risks.	4.7(.525)	4.6(.538)	4.7(.528)
See problematic work tasks as positive challenges.	4.8(.490)	4.7(.530)	4.7(.508)
Recognise impossible work tasks.	4.7(.582)	4.5(.559)	4.6(.572)

Scales and items	Compete in WorldSkills London		Total sample
	No (*n*=39) *M*(*SD*)	Yes (*n*=37) *M*(*SD*)	(*n*=76) *M*(*SD*)
Patterns of adaptive learning			
I want to learn as many new things as I can.	4.9(.223)	4.9(.419)	4.9(.334)
I want to be as good as possible in my own skill area.	5.0(.000)	4.9(.229)	5.0(.161)
I try to understand issues presented in the WSC training as thoroughly as possible.	4.7(.498)	4.7(.530)	4.7(.512)
I would like others (family, friends, teachers, trainers, trainees) to respect my craftsmanship.	4.7(.614)	4.7(.450)	4.7(.537)
My aim is to be in the top 'A group' in my WSC training team.	4.9(.223)	4.7(.571)	4.9(.309)
I don't want to embarrass myself in front of the others.	4.9(.223)	4.8(.374)	4.2(1.132)
I avoid showing others if I am facing difficulties in WSC training exercises.	4.1(1.222)	4.3(1.029)	3.4(1.265)
It is important to me that my teacher/trainer thinks I am a smart person.	3.5(1.315)	3.2(1.205)	3.9(1.204)
My aim is to show others that I am in the top level in my skill area.	3.7(1.276)	4.0(1.118)	4.8(.444)

Scales and items	Compete in WorldSkills London		Total sample
	No (*n*=39) *M*(*SD*)	Yes (*n*=37) *M*(*SD*)	(*n*=76) *M*(*SD*)
Learning motivation			
I prefer to try challenging work methods from which I can learn something new.	4.6(.595)	4.7(.475)	4.6(.538)
I am able to learn even the most difficult work methods if I practise hard enough.	4.8(.409)	4.6(.603)	4.7(.522)
I expect to do extremely well in my WorldSkills training.	4.6(.598)	4.5(.736)	4.5(.664)
I am confident that I will master even the most difficult work methods in my training.	4.6(.598)	4.5(.651)	4.5(.621)
I want to be number one in my skill area in the next WorldSkills competition.	4.9(.270)	4.8(.479)	4.9(.390)
While doing a routine task in WorldSkills competition, I am also thinking about the really challenging tasks to come.	4.4(.718)	4.4(.762)	4.4(.735)
I am very interested in my skill area as well as new information related to it.	4.8(.389)	4.8(.397)	4.8(.390)
I am nervous in all kinds of competitions (in a negative way).	2.6(1.410)	2.2(1.151)	2.4(1.296)
I find it most rewarding when I can research a new work method as thoroughly as possible.	4.2(.790)	4.1(.809)	4.1(.795)
I believe that WorldSkills training will be of practical benefit to me in the future.	4.7(.560)	4.8(.591)	4.7(.572)
If I fail in an extremely demanding work task during WorldSkills training, it is mainly because I am not trying hard enough.	3.2(1.268)	2.9(1.220)	3.0(1.243)
It is important for me to do well in WorldSkills training and show others (family, friends, teachers, trainers, trainees) what I am capable of.	4.5(.854)	4.5(.692)	4.5(.774)