Learning environments to develop vocational excellence

Project 2

DuVE: Developing and understanding vocational excellence

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Preface

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

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

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

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

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

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

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

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

- Project 1: Modelling the Characteristics of Vocational Excellence
- Project 2: Learning Environments to Develop Vocational Excellence
- Project 3: Benefits of Developing Vocational Excellence
- Project 4: Further Education College Participation in WorldSkills and other Skills Competitions
- Project 5: WorldSkills UK Competitors and Entrepreneurship
- Project 6: Training Managers: Benefits from and Barriers to WorldSkills UK Participation

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

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

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Executive Summary

WorldSkills UK, under the auspices of Find a Future, selects and prepares young people, mostly aged 18-22, to compete in the WorldSkills Competition. Prior to competition, these young people have developed a range of skills and knowledge in their chosen field through coursework and/or workplace experience. Potential competitors, either from Further Education or university, or in employment as apprentices or employees, build upon this prior experience when competing in numerous regional and national skill competitions held throughout the UK. It is these competitions that form the building blocks for selection into Team UK. This research focuses specifically on how the learning and working environment experienced by WorldSkills UK participants can affect team selection and potential success at WSC. It addresses three key questions:

- What are the features of the learning environments for WorldSkills UK participants and non-participants?
- Do these differ for squad and team members? Or for WorldSkills UK participants versus non-participants?
- Are these features related to performance at the WSC?

The results presented in this report are based on 474 survey responses. We surveyed 114 team members, 167 squad members, 114 young people who were not selected for the squad (Non-squad), 51 young people not involved in WorldSkills (Non-WS) and 28 employers from across the 2009, 2011, 2013 and 2015 WSC. Using statistical analysis, the survey responses are compared across these groups and in seven different areas: participation in and understanding of the work environment; task performance; learning resources and access; judgement, decision-making, problem solving and reflection; experience, task transition and career progression; learner status, worker status and formalisation; and organisational development. Overall the findings show that aspects of the seven areas work together to help the young person develop their skills and knowledge to a high level for these workplaces – no one area is more significant than another – and there are strong sectoral/skill cluster distinctions with regards to the work environment and the types of tasks performed at work.

1 Introduction

The WorldSkills Competition (WSC) is recognised by many as the pinnacle of excellence in vocational education and training (VET). From its beginnings in the early 1950s this competition has evolved into a global contest. The WSC São Paulo 2015 competition involved approximately 1200 young contestants from 59 countries who competed in 46 skill areas (Appendix A). These competitors are apprentices/ employees in a workplace, or full- or part-time students in further or higher education. The competitions are set at high international standards and medals are awarded for excellence. Thus, the WSC provides both a benchmark for high performance and an objective way to determine what contributes to vocational excellence.

WorldSkills UK selects the most talented young people[1] to compete in WSC, through a multi-stage process. They may be identified at numerous regional and national skill competitions held throughout the UK or through the National Apprenticeship Awards, Awarding Bodies, City & Guilds Awards of Excellence, Sector and Industry Awards and through Sector Skills Councils. During the first stage of the process, candidates attend a residential induction programme. Advancement from the shortlist to the squad involves two weeks training followed by a 'pressure test' benchmarked to the WorldSkills International standards for facilities, test projects (often it is the test project from a previous WSI competition), marking schemes and rigour. Successful candidates are selected to the squad and participate in a training programme over approximately six months (including further competitions). Squad members compete for places on Team UK at an annual Skills Show, in a four-day competition event replicating as much as possible the conditions of a WSC. Those selected for Team UK continue with intensive skill development and training[2] to build their skills to world-class standard.

Most participants in this process have spent some time in the workplace, either as a full-time employee (apprentice), part-time employee or on some form of internship, although some are full-time students. While part of their skill development takes place within educational institutions, especially Further Education colleges, the majority of their learning and training occurs in the workplace. Prior research conducted by the research team has identified a number of factors that promote learning in the workplace (James and Holmes, 2012; James, Holmes and Mayhew, 2013).

[1] The UK first entered a team in the WSC in 1953. The upper age limit to compete at a WSC is 22; the exception to this rule is for the skills areas of Information Network Cabling, Manufacturing Team Challenge, Mechatronics, and Aircraft Maintenance where the age limit is 25 years in the year of competition.
[2] Some members of Team UK also compete in EuroSkills as part of their training: http://www.euroskills.org

This study builds upon that work to understand better the learning and working environments of young people involved in WorldSkills UK training.

It addresses three questions:

- What are the features of the learning environments for WorldSkills UK participants?
- Do these differ for squad and team members? Or for WorldSkills UK participants versus non-participants?
- Are these features related to performance at the WSC?

Structure of the report

This research builds upon a previous phase of research on learning environments conducted with the 2009, 2011 and 2013 squads (James, Holmes and Mayhew, 2013). Section 2 provides details about the approach and methods used. Section 3 analyses the learning environments within the participants' workplaces to better understand the opportunities for developing skills and knowledge. Section 4 focuses on the relationships between aspects of the learning environment to understand any differences between WorldSkills UK participants versus non-participants, and between squad, team and medal winners. We conclude with Section 5.

2 Approach and methods

There is much research on learning in the workplace (inter alia, Billett, 1995, 2002; Lave and Wenger, 1999; Eraut, 2000, 2004). For this research we adopted the work of Eraut and his colleagues (2007) and Fuller and Unwin (2003a). Eraut and his colleagues developed a typology (Table 1, Appendix B) to characterize how individuals gain understanding, construct knowledge and skill, recognise the knowledge resources in the workplace and how to access them, and make judgements on their work to refine performance. The acquired knowledge and skills are then utilised, reinforced and transferred to enhance performance.

Fuller and Unwin's research into apprenticeships found that an expansive work environment, as opposed to a restrictive one, is characterised by a number of features placed on a continuum (Table 2, Appendix B) that create more, stronger, and richer learning opportunities for an apprentice to develop a greater breadth and depth of knowledge and skills.

The learning typology and continuum were used to develop a survey that focused on identifying those aspects of the workplace that contribute to offering more expansive working environments. The survey was piloted with the help of a trainer from WorldSkills UK who had worked closely with the employers and young people vying for selection into the 2009 WorldSkills UK Team.

2.1 Participants

The survey sample consisted of the young people in the WorldSkills UK squads in 2009, 2011, 2013 and 2015, employers of 2009 and 2013 team members, and a group of young people pursuing similar occupations but not involved in WorldSkills UK for 2013 only (see Appendix C). The majority of the squad members in 2009 and 2011 completed the survey at the beginning of their team selection week. The 2013 and 2015 participants completed the survey at the beginning of their squad selection week, which resulted in survey responses from squad and non-squad members for these years. The Non-WS group in 2013 were contacted through two colleges. The person responsible for apprenticeship at these colleges selected a group of young people from a similar range of skills to those in the UK squad. That individual administered the hardcopy survey and posted completed surveys to the research team. Employers completed a postal survey and returned it in a self-addressed envelope. A total of 474 surveys were available for analysis (see Table 1).

Table 1: Breakdown of participants

	2009	2011	2013	2015
Team	21	31	23	39
Squad	36	36	47	48
Non-squad	--	--	33	81
Non-WS	--	--	51	--
Employers	11	--	17	--
Total	68	67	171	168

Once the results of the 2009, 2011, 2013 and 2015 WSC were available, team members were further designated as medal winners or non-medal winners.

2.2 Analysis

The survey consisted of two parts. Items in Part One were drawn from the typology shown in Table B1 (see Appendix B) and were intended to get the respondent to think about their workplace. These data were not used in the analysis. Items in Part Two were drawn from the continuum shown in Table B2 (see Appendix B) and addressed seven main areas (described further in Section 3). Responses to survey items were recorded on a Likert scale, ranging from one to five where five is the most positive. These data were entered into Excel, along with the respondent's status (Non-WS, squad, team, medal winner etc.). We performed mean calculations for the responses (Table 3 below) and calculated the percentage of responses to the questions using the Likert scale for descriptive analysis in Section 3.

With several elements to the expansive learning environment framework (Fuller and Unwin 2010), it is likely that many of these dimensions appear together as a package, so that many survey responses are highly correlated. Section 4 shows that these elements can indeed be reduced to a much smaller number of underlying factors. We used exploratory factor analysis to identify the underlying patterns in the responses and simplify them into broader measures of the participant's workplaces. The two main factors were then labelled Environment and Tasks. Environment pertains to the learning environment within the work environment and Tasks to the range and complexity of tasks undertaken in the work environment. The assumption here was that many responses in the survey will be correlated and will reflect a single underlying cause. As with all factor analyses, we faced a choice over how many underlying variables there were to consider. We applied three criteria for exclusion:

- The Kaiser criterion – a sufficiently small amount of additional explanatory power to the existing model[3];
- A scree plot – which looks to see the point at which the additional explanatory power of extra variables begins to plateau; and
- A parallel analysis – this criterion suggests adding factors up to the point where one more would produce no extra explanatory power than if it were random noise.

Both the Kaiser criterion and the scree plot pointed to there being two underlying factors. As shown in Section 4, these factors are linked to 'the learning environment in the workplace' and 'complexity and range of task performed' hence the labels of Environment and Task as explained above. The parallel analysis suggested including an additional two factors. The new factors in this later model related to the social aspects of the working environment and the extent to which self-assessment was important. However, it became apparent in the later analysis that these additional factors were not adding any particular insights which could not be captured by the simple two factor model – for example, despite being estimated as different factors, there was still a lot of overlap between them, and the loadings on the variables included in the four factor model tended to be low. There was also the problem of interpretation – our two factor model is easy to interpret, while the four factor model is more confusing. Therefore, in our analysis in Section 4, we predominantly focus on the two factor model.

We applied the varimax rotation to our identified factors – this is a method of finding the simplest (and easiest to interpret) structure so that each survey question maps as heavily as possible onto just a single factor. Scores for the identified factors were then estimated for each individual.

2.3 Limitations

There are three important study limitations. First, the study relies on self-report. Second, while most squad members completed surveys, the findings cannot necessarily be generalised to all workplaces outside of those involved with potential WorldSkills competitors. Thirdly, the small numbers of respondents limits the ability to identify differences where they do exist.

It is also important to note the survey was designed specifically for assessing the workplace and does not incorporate any data or analysis of individual's attributes, such as their psychological suitability

[3] In technical terms, the explanatory power of each factor is captured by the eigenvalue. The Kaiser criterion suggests the analysis should stop looking for additional factors once this value falls below 1, which would be the same amount of explanatory power we would expect from a single survey question unconnected with all the other responses.

for competition or reactions under pressure. These individual attributes are the focus of a parallel DUVE study (see Nokelainen et al., 2013a; Nokelainen et al, 2013b; Nokelainen et al., 2015).

3 Learning environments within work environments

The survey was designed to identify aspects of the workplace that contribute to offering more expansive learning environments. The underlying premise is that the more aspects of the workplace an employee is given access to – the elements identified as constituting an expansive work environment – the better the opportunities for developing skills and knowledge, leading to vocational excellence. The survey items addressed seven areas:

1. Participation and understanding of the workplace;
2. Task performance;
3. Access to resources to help learning;
4. Judgement, decision-making, problem-solving and reflection;
5. Experience, task transition and career progression;
6. Status as a worker and a learner; and
7. Organisational development.

Table 3 shows the mean scores for the survey questions (the numbers in column 1 denote how items relate to the seven listed areas). Six results were significantly different for Non-WS, nine for Non-squad and two for medal winners. These significant results will be discussed further in the following sections about the seven areas that constitute an expansive learning environment in the workplace.

Non-WS respondents are those who have not participated in competitions. Non-squad are those who tried out for the 2013 and 2015 squads but did not make it. Squad are the squad members of the 2009, 2011, 2013 and 2015 squads. Team are the UK team members from 2009, 2011, 2013 and 2015. We refer to the medal winners where the differences in responses warrant mention. We do not refer to the employer data in this section given the small number of responses. Table2 shows the response rates for the surveys.

Table 2: Response rate for surveys

	2009	2011	2013	2015
Team	81%	100%	100%	98%
Squad	95%	97%	100%	100%
Non-squad	--	--	100%	100%
Non-WS	--	--	100%	--

Table 3: Mean scores by respondent

				Squad			
Question	**All[4]**	**Non-WS**	**Non-squad**	**Non-team**	**Team**	**Medal winners**	**Employers**
1a Variety of situations and processes	3.90	3.78	3.75	3.94	3.96	3.92	3.75
1b Colleagues	4.38	4.51	4.25	4.31	4.32	4.34	4.10
1c Goals and aims	4.38	4.51	**4.12**	4.37	4.45	4.44	3.85
2a Complex problems	4.10	**3.65**	**3.68**	4.13	4.04	3.99	4.03
2b Range of Skills	4.40	4.18	**4.12**	4.44	4.42	4.40	4.46
2c Work with others	4.12	4.37	4.04	4.23	4.09	4.04	4.53
2d Communication and feedback	3.73	**4.12**	3.54	3.83	3.68	3.66	4.39
3a Mentor/coach	3.50	**4.31**	3.53	3.73	3.57	3.56	4.10
3b Resources	3.84	4.02	**3.67**	3.93	3.90	3.87	4.21
3c Qualifications	4.29	4.45	4.12	4.24	4.33	4.33	4.39
3d Training	3.88	4.18	3.72	3.87	3.87	3.88	4.57
4a Performance	4.22	4.10	**3.98**	4.17	4.31	4.31	4.35
4b Make decisions	4.01	**3.68**	**3.68**	4.02	4.07	4.09	3.92
4c Solve problems	4.17	**3.82**	**3.82**	4.15	4.25	4.25	4.10
4d Time to reflect	3.49	3.52	**3.16**	3.57	3.49	3.46	3.50
5a Experience	3.67	3.86	3.54	3.81	3.71	**3.59**	3.78
5b Work through tasks	3.67	**3.98**	3.61	3.75	3.75	**3.63**	3.78
5c Career progression	3.93	4.02	3.77	3.93	4.01	4.03	3.64
6a Acknowledgement	3.96	4.02	3.73	3.95	3.94	3.93	4.21
6b Recognised as learner	4.00	4.08	**3.76**	4.05	4.04	3.98	4.21
7a Business goals	3.46	3.81	3.75	3.94	3.96	3.92	3.92
N =	446	51	114	167	114	91	28

Note: 1. The numbers in **bold** in the Non-WS column are significantly different (at the 5% level) to those who had some WS experience (i.e. team, squad and non-squad) participants. 2. The numbers in bold in the Non-squad column are significantly different (at the 5% level) to those who had made the UK squad. 3. There are no statistically significant differences between team and non-team members within the UK squad. 4. The numbers highlighted in the medal column are significantly different than the team members who did not win a medal.

3.1 Participation and understanding of the workplace

Research shows that working environments that afford greater participation, or at least knowledge of the broader workplace, support workers better to develop skills and knowledge necessary for their occupation (Lave and Wenger, 1991; Fuller and Unwin, 2003b). All participants worked on and understood a variety of situations and processes in the workplace, and knew what their colleagues

[4] Excluding employers.

work involved. However, non-squad members knew significantly less than squad and team members about the goals and aims of the workplace.

3.2 Task performance

Completing the test project at WorldSkills requires a breadth and depth of knowledge and skill developed in the workplace and built upon through the WSC training. We analysed four aspects of task performance: tackling complex problems; using a range of skills; working with others; and receiving communication and feedback. There were clear differences between the squad and those who did not make the squad or were non-WS. These respondents reported having less opportunity to tackle complex problems and develop a range of skills. Across the three groups who were involved in WS (non-team, team and medal winners), the responses were more positive than those who were not involved. Interestingly, there was no significant difference between non-squad and the squad and team concerning working with others and communication and feedback. There was a difference however, with the non-WS respondents who reported receiving significantly more communication and feedback. The participants overall were generally less positive about communication and feedback than the other three areas of task performance.

3.3 Access to resources

Individuals develop vocational skill and knowledge through the direct and indirect guidance of others in the workplace (Billett, 1999) or school/college, and through having access to other resources as part of the learning process. Consequently, having access to a variety of resources in the workplace – a mentor/coach, other workers, materials, customers, competitors, suppliers, qualifications and training – would seem important for developing vocational excellence to compete at an international level. The non-WS group reported having significantly more access to a mentor/coach than the other respondents, all of whose results were remarkably similar. This non-WS group also reported having somewhat more access to resources than did others, and the non-squad group reported having significantly less access to resources than the squad. All groups of respondents reported encouragement to gain qualifications, and the non-WS group reported receiving the most training in the workplace.

3.4 Judgement, decision-making, problem-solving and reflection

The competition environment is highly pressurised and the smallest decision can impact greatly on outcomes. Workplaces too are fraught with their own tensions, and workers need to solve problems and make decisions. Competitors and workers also need to be able to assess their own performance

and reflect on their work. The non-squad group reported significantly lower answers in this area, In contrast, the squad (non-team, team and medal winners) reported having significantly more opportunity to assess their own performance, make decisions in their job, solve problems and reflect on their work. Reflection on their work practices, however, was judged to be lower than the other three categories.

3.5 Experience, task transition and career progression

Fuller and Unwin (2003a, p. 8) identified three key elements for developing knowledge and skill in the workplace:

- Breadth: access to learning fostered by cross-company experiences built into programme;
- Gradual transition to full participation; and
- Post-apprenticeship vision: progression for career.

The more expansive these elements are in a workplace, the more opportunity there will be for developing vocational knowledge. Interestingly, medal winners reported having significantly less opportunity to gain experience across the company and the time to work through tasks to develop skill and knowledge than others. The lack of experience and time given in the workplace may be explained to a certain extent by the WSC training they are undergoing.

3.6 Status as a worker and a learner

Workplaces that comprise more expansive elements recognise workers' accomplishments and their status as learners. All respondents thought there was some acknowledgement of their work; however the non-squad believed themselves to be significantly less recognised as a learner than the other groups of respondents. Interestingly, non-team and team members responded that they were recognised a little more in their workplaces than medal winners were in theirs, but the difference is not significant.

3.7 Organisational development

In an expansive learning environment, training/learning is used 'as a vehicle for aligning the goals of developing the individual and organisational capability' (Fuller and Unwin, 2003a, 8). In so far as the goals of the respondents were taken into account, there was no statistically significant difference between the groups.

Summary

On average, respondents' scores on aspects of the learning environment were fairly high, suggesting that the workplaces represented in this study were more expansive than restrictive. Most differences were found between non-squad and squad members, suggesting that some features of the workplace—especially areas 2 and 4 — are associated with vocational success because achieving squad status depends partly on competition performance.

4 The relationship between aspects of the learning environment at work

Applying the three criteria discussed in Section 2.2, we identified two factors underlying the responses to the survey.[5] Factor 1, the most important factor, largely combines responses to do with the work environment, and particularly how the working environment facilitates learning and development. In what follows, we refer to this as ENVIRONMENT. Factor 2 relates most strongly to questions about the complexity and range of task performed at work. We refer to this measure in the remainder of the report as TASK. Each of these variables is computed for all participants of the survey. The statistical analysis conducted for these findings appears in Appendix D. Table D1 in Appendix D shows the estimated factor loadings (where loadings below 0.4 are omitted for ease of reading).

4.1 Distribution of ENVIRONMENT and TASK

These two factors are distributed across different subgroups of our survey sample (see Table D3, Appendix D) and highlight a number of key trends:

- The group surveyed from outside the skills competitions (Non-WS) tended to score higher on average than the WS competitors for ENVIRONMENT, but lower for TASK. Without further investigation, it is not clear why these two groups might differ, and if this is related to their participation in skills competitions;
- The 2013 and 2015 squad members scored higher for both TASK and ENVIRONMENT on average than competitors that did not make the squad.
- Team members scored higher for TASK and lower for ENVIRONMENT on average than squad members who did not make the team;
- Medal winners scored lower for both measures, on average, than non-medal winners; and there are strong sectoral/skill cluster distinctions (Table 4 below)[6].

[5] Table D1 shows the eigenvalue (representing variation in the data explained by each factor) falls below 1 for factor 3, so the Kaiser criterion would recommend 2 factors. Figure 1 (Appendix D) similarly shows that these eigenvalues flatten off after factor 2, again suggesting two factors. As noted previously, the parallel analysis suggests five factors, although it is only a marginal improvement over the 2-factor model, as indicated by how close the factor analysis and parallel analysis lines become at this point.

[6] It is important to bear in mind with these results that all factors are relative within this sample, for example low for ENVIRONMENT does not mean low in absolute terms, rather that it is lower than average fro those involved in WS.

Table 4: Distinctions between sector and skill clusters

	Relatively high TASK	Relatively low TASK
Relatively high ENVIRONMENT	ICT Social and personal	Manufacturing and engineering
Relatively low ENVIRONMENT	Construction Transportation	Creative

4.2 WorldSkills performance

We used the two factors – ENVIRONMENT and TASK – to try to understand how the working environment affects performance in skills competitions. Firstly, we look at the prospects of making the squad from the team. The 2013 and 2015 surveys were administered to a group of participants that did not make the squad (Non-squad). We estimate a logit model on the probability of being selected from the squad for the team. The results are shown in Table D4, Appendix D. This analysis shows that both ENVIRONMENT and TASK had a positive effect on the likelihood of progressing to the squad, with the former being statistically significant. To illustrate, an individual who scored the mean average level for both ENVIRONMENT and TASK (for 2013 and 2015 combined) is predicted to make the squad with a probability of 52% in 2015 and 68% in 2013. For an individual who scored one standard deviation higher for ENVIRONMENT (which in our data would place them in the top quintile for that variable), this increased to 60% and 75% respectively. Compared to our earlier analysis, which only had data for WorldSkills 2013 (James, Holmes and Mayhew, 2013), the larger sample size has lent support to our conclusion that aspects of the competitors' learning environments are associated with better performance in skills competitions.

Our second analysis concentrates on those who made the UK team for WorldSkills in 2009, 2011, 2013 and 2015, relative to those in the squad who did not. We again estimate a logit model on the probability of being selected for the team having already made the squad for the team (Table D5, Appendix D). The results can be summarised as follows:

- Although TASK and ENVIRONMENT did not individually explain why some people made the team and some did not, the combination of the two did make a small but significant effect on selection. In particular, participants with higher scores for both TASK and ENVIRONMENT were more likely to make the final team selection (and presumably performed better in the competition leading to selection).

- To illustrate, an individual who scored one standard deviation higher than the mean on both ENVIRONMENT and TASK would be predicted to make the team with a probability 5-6 percentage points higher than someone who scored at the mean level for both those variables.

- Selection did not depend significantly on the year of competition or the particular skill cluster the competitor had entered.

Finally, we performed a similar analysis for the prospect of winning medals once a competitor had made the team, but found no significant effects from either TASK or ENVIRONMENT, nor their interaction. We have argued previously (James and Holmes, 2012) that these results suggest that the training given to competitors to prepare them for the competition is likely to be more important than the more general training they have received earlier through their apprenticeships and learning within their working environments.

5 Conclusions and recommendations

Within the WSC context, developing vocational excellence involves a number of people: the young person, colleagues in the workplace, and WorldSkills trainers to name a few. The young people competing at a WSC receive a substantial amount of training outside of the workplace to bring their skills levels up to the international standards and the propensity of the young person to take up learning opportunities is obviously a key factor. Yet, clearly the workplace plays a role, even within a group of relatively high achievers. This research focused solely on the workplace to try and understand its significance in developing vocational excellence. Our research argues that the workplaces involved with WorldSkills are affecting several aspects of performance.

The main findings are:

- Aspects of the seven areas of the framework considered work together to help the young person develop their skill and knowledge to a high level, and these areas all tend to be on the expansive end of the continuum in the workplaces represented in this study;
- There are strong sectoral/skill cluster distinctions with regards to the work environment ("ENVIRONMENT') and the types of tasks performed at work ("TASK"). Within this sample, construction and transportation are low for ENVIRONMENT but high for TASK; manufacturing is the opposite. ICT is high for both ENVIRONMENT and TASK.
- Participants with higher scores for both TASK and ENVIRONMENT showed signs of performing better, in particular in their progression into the squad, where ENVIRONMENT had a strongly significant effect on progression.
- Of those selected for the squad, the final team members scored higher for TASK and lower for ENVIROMENT on average than squad members who did not make the team. We find that the more expansive the workplace on the two factors combined, the more likely the young person is to make the team. On their own, neither of these factors make a significant contribution; it is the combination of the environment and support for the young person by the firm with the particular tasks in which they are engaged that is key to team selection;
- In keeping with our earlier findings, medal winners scored lower for both measures, on average, than non-medal winners. However, neither factor proved significant for predicting medal success.

- The group surveyed from outside the skills competitions (Non-WS) tended to score higher on average than the competitors for ENVIRONMENT, but lower for TASK. Further investigation is needed to understand this result.

Overall, with a larger sample size, this research builds upon and reinforces previous findings that the more 'expansive' a workplace (Fuller and Unwin 2003a) – on both ENVIRONMENT and TASK measures – the more likely the young person is going to have the necessary and sufficient skill base to begin working towards meeting WorldSkills international standards in that skill and potentially winning a medal.

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7 References

Billett, S. (1995). Workplace learning: its potential and limitations. *Education and Training*, Vol. 37, No. 5, pp. 20-27.

Billett, S. (1999). Guided learning at work. *Understanding Learning at Work*, Boud, D., Garrick, J. (Eds.), London: Routledge, pp. 151-164.

Billett, S. (2002). Workplace pedagogic practices: Co-participation and learning. *British Journal of Educational Studies*, Vol. 50, No. 4, pp. 457-481.

Eraut, M. (2000). Non-formal learning and tacit knowledge in professional work. *British Journal of Educational Psychology*, Vol. 70, pp. 113-136.

Eraut, M. (2004). Informal learning in the workplace. *Studies in Continuing Education*, Vol. 26, No. 2, pp.247-273.

Eraut, M. and W. Hirsch (2007).The significance of workplace learning for individuals, groups and organisations. *SKOPE Monograph* No. 7, SKOPE: Oxfrod and Cardiff Universities.

Felstead, A., D. Gallie, F. Green, and Y. Zhou (2007). *Skills at Work 1986-2006*. SKOPE: Oxford and Cardiff Universities.

Fuller, A. and L. Unwin (2003a). Learning as apprentices in the contemporary UK workplace. *Journal of Education and Work*, Vol. 16, No. 4, pp. 407-426.

Fuller, A. and L. Unwin (2003b). Creating a 'modern apprenticeship': a critique of the UK's multi-sector, social inclusion approach. *Journal of Education and Work*, Vol. 16, No. 1, pp. 5-25.

Fuller, A. and L. Unwin (2010). *The NAS toolkit: Expansive Apprenticeships: A Guide for Employers, Training Providers and Colleges of Further Education*. London: National Apprenticeship Service.

James, S. and C. Holmes (2012). Developing Vocational Excellence: Learning Environments within Work Environments. *SKOPE Research Paper No. 112*. Cardiff: Cardiff University, SKOPE.

James, S., C. Holmes, and K. Mayhew (2013). Learning environments to develop vocational excellence. *Unpublished report to the National Apprenticeship Service*, Oxford: SKOPE.

Lave, J. and E. Wenger (1991). *Situated learning: legitimate peripheral participation*. Cambridge: Cambridge University Press.

Mayhew, K., S. James, M. Chankseliani, A. Laczik (2013). Benefits of Developing Vocational Excellence. *Unpublished report to the National Apprenticeship Service*, Oxford: SKOPE.

Nokelainen, P., C. Stasz, and S. James (2013a). Understanding and Developing Vocational Excellence. A study of the WorldSkills UK Squad 2013. *Unpublished report to the National Apprenticeship Service*, Oxford: SKOPE.

Nokelainen, P., C. Stasz, and S. James (2013b). Understanding and Developing Vocational Excellence. Research Brief. *Unpublished report to the National Apprenticeship Service*, Oxford: SKOPE.

Nokelainen, P., C. Stasz, and S. James (2015). Understanding and Developing Vocational Excellence. A study of the WorldSkills UK Squad 2015. *Unpublished report to Find a Future*, Oxford: SKOPE.

8 Appendices

Appendix A – Skills clusters of WorldSkills Competitions

Transportation and Logistics
Car painting
Automobile technology
Aircraft maintenance
Autobody repair
Construction and building technology
Stonemasonry
Wall and floor tiling
Plumbing and heating
Electrical installations
Bricklaying
Plastering and drywall systems
Painting and decorating
Cabinetmaking
Joinery
Carpentry
Landscape gardening
Refrigeration
Creative arts and fashion
Floristry
Fashion technology
Graphic design technology
Visual merchandising/window dressing
Jewellery
Manufacturing and engineering technology
Electronics
Industrial control
Polymechanics/automation
Manufacturing team challenge
Mechatronics
Mechanical engineering design – CAD
CNC Turning
CNC Milling
Welding
Mobile robotics
Construction metal work
Sheet metal technology
Prototype modelling
Plastic die engineering
Information and communication technology
Information network cabling
IT software solutions for business
IT network and systems administration
Print media technology
Web design
Social and personal services
Hairdressing
Beauty therapy

Confectionery/pastry cook
Cooking
Restaurant service
Health and social care

Appendix B –Theoretical Approaches

Table B1: A typology of learning for and in the workplace
Source: Eraut et al., 1998; cited in Eraut, 2000, p. 6

Understanding	**Skills**
Understanding of situations and systems	Technical skills
Understanding of colleagues and work unit	Learning skills
Understanding of own organisation	Interpersonal skills
Understanding of self	Thinking skills
Strategic understanding	
Propositional knowledge	**Judgment**
General knowledge taught during initial training for occupation	Quality of work
	Evaluation
Specialised occupational knowledge	Strategic decisions
Firm-specific knowledge (technical)	Staff issues
Knowledge of systems and procedures	Prioritising
Knowledge resources and how to access them	
People in the department/work group	
People elsewhere in the organisation	
Internally available materials: manuals, records, databases, learning materials	
Networks of customers, competitors, suppliers	
Professional networks	
Higher Education institutions	
Local networks	
Previous employers	

Table B2: The expansive/restrictive continuum
Source: Fuller and Unwin, 2003a, p. 8

▪ **Expansive environment**	▪ **Restrictive**
▪ Participation in multiple communities of ▪ practice inside and outside the workplace	▪ Restricted participation in multiple communities of practice
▪ Primary community of practice has shared ▪ 'participative memory': cultural inheritance of apprenticeship	▪ Primary community of practice has little or no 'participative memory': no or little tradition of apprenticeship
▪ Breadth: access to learning fostered by cross-company experiences built in to programme	▪ Narrow: access to learning restricted in terms of tasks/knowledge/location
▪ Access to range of qualifications including ▪ knowledge-based VQ	▪ Access to competence-based qualification only
▪ Planned time off-the-job including for college attendance and for reflection	▪ Virtually all-on-job: limited opportunities for reflection
▪ Gradual transition to full participation	▪ Fast – transition as quick as possible
▪ Apprenticeship aim: rounded expert/full participant	▪ Apprenticeship aim: partial expert/full participant
▪ Post-apprenticeship vision: progression for career	▪ Post-apprenticeship vision: static for job
▪ Explicit institutional recognition of, and support for, apprentices' status as learner	▪ Ambivalent institutional recognition of, and support for, apprentice's status as learner
▪ Apprenticeship is used as vehicle for aligning the goals of developing the individual and organisational capability	▪ Apprenticeship is used to tailor individual capability to organisational need
▪ Apprenticeship design fosters opportunities to	▪ Apprenticeship design limits opportunity to

extend identity through boundary crossing	extend identity: little boundary crossing experienced
▪ Reification of apprenticeship highly developed (e.g. through documents, symbols, language, tools) and accessible to apprentices	▪ Limited reification of apprenticeship, patchy access to reificatory aspects of practice

Appendix C – Non-WorldSkills participants skill area

Healthcare	Mechanical maintenance
Caring	Mechanical engineering
Business Administration	Mechanical engineering
Change and Configuration Management	Engineering toolmaking
Accountancy	Mechanical engineering
Business Administration	Engineer
Business Administration	Engineering
Business Administration	Mechanical engineering
Administration	Mechanical engineering
Stonemasonry	Engineering
Stonemasonry	Mechanical Engineering
Stonemasonry	Engineering
Stonemasonry	Steel works maintenance
Stonemasonry	Toolmaker
Stonemasonry	Cookery
Stonemasonry	Cookery
Business Administration	Cookery
Business Administration	Cookery
Business Administration	Cookery
Business Administration	Hairdressing
Caring	Hairdressing
Childcare	Hairdressing
Childcare	
Childcare	
Childcare	
Childcare	
Childcare	
Childcare	
Childcare	
N = 51	

Appendix D – Factor analysis

Table D1: Factor analysis.

Note: Kaiser criterion identifies 2 factors, as the third factor has an eigenvalue less than one.

Factor	Eigenvalue	Difference	Proportion of variance explained	Cumulative variance explained	Parallel Analysis
Factor1	6.528	4.770	0.772	0.772	0.454
Factor2	1.759	1.234	0.208	0.980	0.382
Factor3	0.524	0.152	0.062	1.042	0.330
Factor4	0.372	0.153	0.044	1.086	0.280
Factor5	0.220	0.066	0.026	1.112	0.224
Factor6	0.153	0.054	0.018	1.130	0.180
Factor7	0.099	0.022	0.012	1.142	0.145
Factor8	0.077	0.037	0.009	1.151	0.107
Factor9	0.040	0.046	0.005	1.156	0.070
Factor10	-0.006	0.015	-0.001	1.155	0.038
Factor11	-0.021	0.019	-0.002	1.153	0.014
Factor12	-0.040	0.023	-0.005	1.148	-0.016
Factor13	-0.063	0.055	-0.007	1.141	-0.049
Factor14	-0.117	0.012	-0.014	1.127	-0.082
Factor15	-0.129	0.018	-0.015	1.111	-0.115
Factor16	-0.147	0.009	-0.017	1.094	-0.142
Factor17	-0.156	0.037	-0.018	1.076	-0.178
Factor18	-0.193	0.017	-0.023	1.053	-0.210
Factor19	-0.210	0.026	-0.025	1.028	-0.245
Factor20	-0.236	--	-0.028	1.000	-0.296

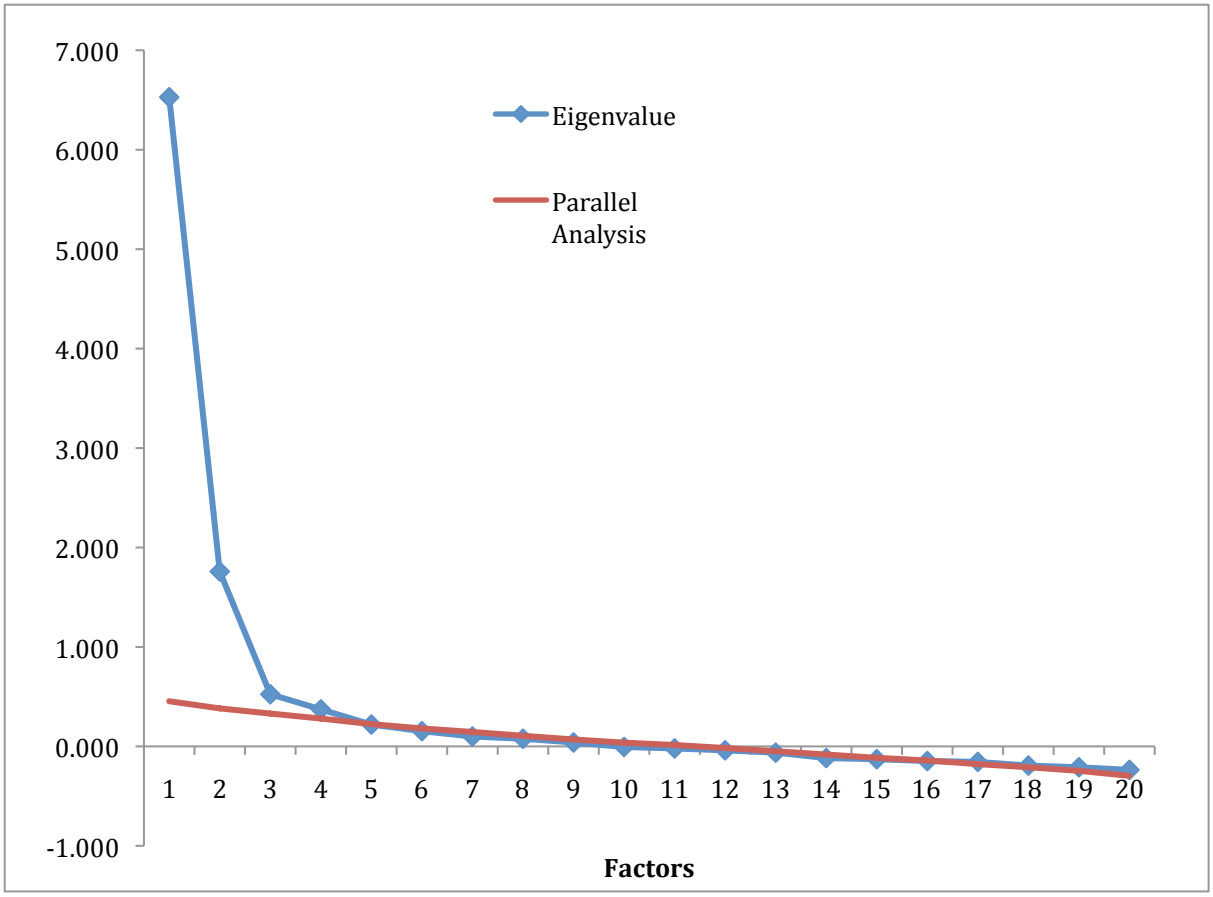

Figure 1: Scree plot of eigenvalues of factor analysis and Parallel Analysis.

Note: the scree plot indicates using two factors (as the eigenvalues plateau after factor 3). The Parallel Analysis suggests using four factors, as this is the point where the factor analysis eigenvalue falls below the parallel analysis value. The figure shows how marginal this is beyond factor 2.

Table D2: Factor loadings and labels.

Note: loadings below 0.4 omitted for clarity.

Factor loadings - 2 factors	**Factor 1**	**Factor 2**
competitor: 1a variety of situations and processes		0.4371
competitor: 1b work with colleagues		
competitor: 1c understand workplace goals and aims	0.4265	
competitor: 2a tackle complex problems		0.6833
competitor: 2b use a range of skills		0.6156
competitor: 2c work with others	0.5486	
competitor: 2d receive communication and feedback	0.7303	
competitor: 3a have mentor or coach	0.6268	
competitor: 3b access to learning resources	0.6328	
competitor: 3c encourage to gain qualifications	0.5842	
competitor: 3d receive training	0.6863	
competitor: 4a assess own performance		0.4067
competitor: 4b make decisions		0.7602
competitor: 4c solve problems		0.7801
competitor: 4d time to reflect	0.5282	
competitor: 5a experience across company	0.5879	
competitor: 5b work through tasks	0.6257	
competitor: 5c aware of career progression	0.6287	
competitor: 6a work acknowledged	0.6768	
competitor: 6b recognised as learner	0.6629	
Label	ENVIRONMENT	TASK

Table D3: Distribution of TASK and ENVIRONMENT

Group	n	Environment	Task
WorldSkills competitors	378	-0.049	0.043
Non-WS	50	0.371	-0.320
2013 and 2015 only, not including non-WS group:			
Not squad	110	-0.196	-0.254
Squad	149	0.132	-0.004
Only including squad:			
Not team	110	-0.196	-0.254
Team	107	-0.012	0.179
Only including team:			
Not medal	21	0.150	0.221
Medal	86	0.-0.052	0.169
Not including control group:			
2009	55	-0.088	0.255
2011	64	-0.186	0.478
2013	99	0.021	-0.097
2015	160	-0.024	-0.119
Skill clusters:			
Manufacturing	83	0.149	-0.292
ICT	9	0.331	0.200
Social and personal	60	0.133	-0.050
Transportation	40	-0.274	0.164
Construction	153	-0.231	0.246
Creative	33	0.131	-0.083

TableD4: Logit regression of probability of making the squad.

Note: ** = significant at 5% level; n.s. = not significant at 10% level.

Environment	0.0.360** *(0.15)*	0.338** *(0.15)*	0.329** *(0.15)*
Task	0.223 *(0.14)*	0.240 *(0.15)*	0.210 *(0.15)*
Environment * Task			-0.124 *(0.15)*
Year = 2013	0.696** *(0.27)*	0.704** *(0.28)*	0.703** *(0.28)*
+ Skill cluster dummies		n.s.	n.s.
N	259	258	258
Pseudo R^2	0.05	0.06	0.06
LR χ^2 test	Jointly significant at 1% level	Jointly significant at 5% level	Jointly significant at 5% level

Table D5: Logit regression of probability of making the team from the squad.

Note: ** = significant at 5% level; n.s. = not significant at 10% level.

Environment	-0.047 *(0.13)*	-0.202 *(0.15)*	-0.206 *(0.16)*
Task	0.015 *(0.15)*	0.020 *(0.16)*	0.036 *(0.16)*
Environment * Task		0.472** *(0.19)*	0.467** *(0.19)*
+Year dummies	n.s.	n.s.	n.s
+ Skill cluster dummies	n.s.	n.s.	n.s.
N	186	186	186
Pseudo R^2Pseudo R^2	0.02	0.04	0.03
LR χ^2 testF-test	Not significant	Not significant	Jointly significant at 10% level

Table D6: Correlation between competitor and employer survey responses

Competitor question	Chi2 test	Cramer's V	Pearson correlation
1a. variety of situations and processes	Independent	0.338	0.021
1b. work with colleagues	Independent	0.326	0.071
1c. understand workplace goals and aims	Independent	0.387	0.020
2a. tackle complex problems	Independent	0.202	0.139
2b. use a range of skills	**Not independent**	**0.508**	0.271
2c. work with others	**Not independent**	**0.511**	0.307
2d. receive communication and feedback	Independent	0.257	0.018
3a. have mentor or coach	**Not independent**	**0.516**	-0.014
3b. access to learning resources	Independent	0.360	0.136
3c. encourage to gain qualifications	**Not independent**	**0.590**	0.401
3d. receive training	**Not independent**	**0.500**	0.251
4a. assess own performance	Independent	0.317	0.208
4b. make decisions	Independent	0.391	0.384
4c. solve problems	Independent	0.236	0.179
4d. time to reflect	**Not independent**	**0.508**	-0.064
5a. experience across company	Independent	0.482	0.084
5b. work through tasks	Independent	0.227	0.014
5c. aware of career progression	**Not independent**	**0.542**	0.412
6a. work acknowledged	Independent	0.379	0.130
6b. recognised as learner	Independent	0.344	0.169