

VOCATIONAL EDUCATION AND TRAINING – DRAFT LITERATURE REVIEW

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This draft literature review was prepared for an experts meeting and special session of the Programme on Educational Building (now CELE) Governing Board held in November 2008 which discussed facilities used for vocational education and training.

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1. This brief draft review of the literature relevant to facilities for vocational education and training (VET) follows from a paper presented to the Programme on Educational Building (PEB) Governing Board in November 2007, “Vocational education and training - directions for future work” [EDU/PEB(2007)11]. In the context of the Special Session of the Governing Board on 11 November 2008, this literature review aims to identify key themes of the physical learning environment and how they support student performance and users’ needs. The findings will guide future research and policy analysis. This paper briefly describes the context of current OECD work on VET, briefly touches on the complexities of VET systems, and considers the literature on the physical environment that supports VET.

Current OECD work on VET

2. This review of the literature on VET facilities is in the context of work being carried out by the OECD on national VET policies and innovation [EDU/EDPC/CERI(2007)2]. Currently, the Education and Training Policy Division at the Organisation for Economic Co-operation and Development (OECD) is conducting a thematic review of VET (www.oecd.org/edu/learningforjobs). This exercise seeks to help countries increase the responsiveness of VET systems to labour market requirements. It aims to improve the evidence base, identify a set of policy options, and develop tools to appraise VET policy initiatives. A programme of analytical work draws on evidence from all OECD countries. It includes an international questionnaire on VET systems, literature reviews of previous OECD studies and the academic literature on topics such as costs and benefits of VET, and analysis of available VET indicators.

3. Country policy reviews are being carried out in Australia, Austria, Belgium (Flanders), the Czech Republic, Germany, Hungary, Ireland, Korea, Mexico, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom (England and Wales), and the United States (South Carolina and Texas), between the end of 2007 and 2010. The results of both the analytical work and the country reviews will feed into the initial comparative report which will be available on the OECD website in 2009. The final comparative report, drawing together all the conclusions of the study will be published in 2010.

4. This work runs in parallel to an OECD study on systemic innovation in VET which is looking at innovation strategies and systems.

Complexity of VET systems: some issues

5. Although VET is used to describe a type of education and training, what constitutes VET and how it is delivered varies across countries (Grubb, 2006). Among the issues which are treated differently by countries are: definitions and status of VET, the balance between academic and practical content of VET programmes, where VET is provided - in an institution (if so, what type?) or at work, the type of training delivered or needed and the flexibility of programmes to meet market need.

6. Grubb (2006) points out that it is common to distinguish VET in terms of initial preparation and training for the labour market, upgrade training for employed individuals, retraining for those moving to different occupations, and remedial training for those who are long-term unemployed. The OECD review is concerned with initial preparation.

7. Countries also focus differently on the types of skills that VET should address and whether they should be more academic or practical (Grubb, 2006). Linked to this, the boundaries between the ‘education’ component of VET and the ‘training’ component are often imprecise. In many countries ‘training’ refers to short-term job training programs to retrain or upgrade skills, and ‘education’ is seen as a

longer duration exercise with broader implications for knowledge as well as skills. The boundary between education and training is becoming blurred further as VET may well include some 'education' component so even those training in auto-repair work and dealing with complex equipment have some broader reading and information skills to enable them to cope with the technology.

8. In some countries VET is provided in specialised institutions but in others it is offered within comprehensive institutions for example the Further Education colleges in the U.K. or community colleges in the U.S. and Canada (Grubb, 2006). Linked to this, although a separate issue, is the difference between the extent of 'school'-based and work-based learning within the countries. Countries with dual systems such as Germany and Denmark include significant work-based learning, whereas English-speaking countries have very little. But some countries such as France lie somewhere in the middle and have some work-based training.

9. This suggests that in some countries there may be facilities totally dedicated to VET while in others, there may be some spaces in buildings used for other purposes which may be used for VET. A question may be to what extent are VET dedicated buildings sufficiently flexible to meet changing demand for courses, what kinds of spaces do they have for example the extent of generic spaces such as classrooms which can be used to teach anything as compared to 'specialist' teaching space. A second question is to what extent are other kinds of institution offering VET programmes are flexible because they may have a wider range of space types?

10. The 'need' clearly differs from country to country and the function of any one programme might be very broad and include training on practical skills as well as education in a more general sense. On the other hand a particular programme may have a very narrow focus. The spaces needed to support this will be significantly different.

11. Grubb (2006) also raises the issue that VET teaching takes place in a variety of settings from specialised workshops to classrooms. The extent to which VET training is "hands-on" varies as it is interpreted differently between trainers. Concerns about links between VET and employers.

Planning and designing VET facilities

12. School buildings and facilities serve a variety of purposes for students and the surrounding community, most importantly to develop knowledge and skills for learners. Yet, the impact of the physical environment on learning outcomes has been insufficiently explained and examined. However, some researchers have made connections for example Jamieson, Dane and Lippman (2005) have found that curriculum and facility design are related, and their findings demonstrate that the physical learning environment has an influence on students' social and scholastic behavior. The research that has been conducted which examines the links between school infrastructure and student performance is at best unquantifiable observation (AMA, 2006). This view is confirmed by Temple (2007) in a review of the literature, demonstrating that any connections between the learning environment and educational activities lack firm evidence. Even less research is focused on space issues in vocational education and training (VET) facilities and skill attainment.

13. The educational infrastructure for VET programmes also serves a more specific purpose in that it prepares students to enter the workforce with a set of specific, technical skills. While the issues of facility planning for technical schools are not markedly different from those in other academic facilities, there are other challenges with regards to the maintenance and improvement of specialised equipment that is needed for instruction (Cutshall, 2003). Spaces for VET have distinct requirements for constructing the infrastructure, which include equipment, room size and providing resources for a range of activities, in addition to providing conventional classrooms for academic instruction (JISC, 2006). Spatial and

equipment needs vary depending on the country job market demands, curriculum requisites and programme funding and organisation.

14. This review looks at the issues of planning and designing VET facilities under five headings: learning spaces, technology, maintenance and accommodation, community links and funding schemes. It considers the layout of learning spaces; integration and management of technologies; ensuring satisfactory environmental conditions; the community relationship to the building; and the funding structure. Accompanying each of the five areas are examples of good practices in renovated or newly constructed VET facilities that exemplify the theme. The highlighted facilities may incorporate other relevant features as well. Present in each of these areas is the theme of flexibility in which spaces are capable of supporting different styles of learning and are able to physically transform in response to user needs. Buildings are often not constructed, budgeted or retained to adapt, however, to remain functional they will change and be redefined (Wolff, 2002). Since VET facilities are sizeable financial investments to construct, sustain and refurbish an element of flexibility is necessary to maximise cost-effectiveness and the buildings' educational value.

15. Another important cross-cutting theme is the link between VET and industry, both because that is the focus for the training but also because industry is an important source of funding, in particular where the costs of providing, updating and maintaining equipment used in training courses may put excess strain on the funding resources of VET providers. From a broader VET perspective, industry also can provide valuable training resources in terms of knowledge and skills needed to carry out the training.

Learning spaces

16. Spatial considerations for VET schools are not the same as conventional schools (Cutshall, 2003). In technical schools, instructional rooms and space design tend to be driven by the highly-specialised equipment, furnishings, machinery and tools needed to properly instruct students (JISC, 2006; Cutshall, 2003). However, construction and refurbishment decisions are more and more driven by administrator and teacher requests for areas that are flexible, which will allow spaces to be used for multiple purposes and different sized groups; and adaptable, to allow for building renovations or additions in a time- and cost-efficient manner. VET facility planning necessitates flexible design with consideration for the future and accompanying changes to pedagogic approaches and changes in labour market demands (Wolff, 2002; JISC, 2006). For the learning environment to be effective, the design of the space must be co-ordinated with user needs and related activities, while maintaining physical, technological and spatial flexibility. Isler and Doerig (2008) contend that architects should design spaces with little definition of function, so that spatial elements can evolve or redevelop. Indeed, Jamieson (2000) who examines space from the teacher perspective, notes that the physical environment will influence how teachers construct activities. Therefore arguably the less specific the function attributed to the space, the greater the opportunity for teachers to create different instructional settings.

17. It is possible to identify three broad types of space in which VET instruction can take place: 1) specialised; 2) generic; and 3) informal (Worthington, 2007). Examples of specialised learning spaces include focused laboratories or workshops that require particular equipment that serve specific functions; generic spaces are generally defined as classroom spaces that can accommodate a range of activities and do not have specific infrastructure requirements; and lastly, informal learning spaces are non-classroom, open spaces which include a range of settings for a range of interactions (Worthington, 2007; Wolff, 2006). The challenge in designing for VET is to adequately incorporate these three types of spaces to maximise student performance and skill attainment.

Specialised

18. Specialised, or defined space provides a setting for students to develop critical thinking and problem solving abilities, practice pertinent skills and gain hands-on experience with industry equipment (Worthington, 2007; Wolff, 2002). This space and its related activity is critical to the education of vocational students as it supplies the foundation for their access to further education and/or job placement. Typically, this space is assigned to a specific discipline or course, examples include: laboratories and automotive workshops.

19. Practical instructional spaces need to emulate the eventual work environment that students will enter upon completion of their program. Labs and workshops that simulate actual work settings can contribute to student achievement, and it is this physical environment that will properly prepare students for employment (Cutshall, 2003). One way to accomplish this setting to organise the school by trades or subject, and place student learning areas in proximity to teacher offices. Arranging teacher offices and student learning areas in close proximity promotes collaboration, so that students can easily interact and engage with teachers (Jamieson, *et al.*, 2000). Another response is to professionally structure the building to simulate an actual workplace or business (Paglin, 2001). This type of layout engages the student body directly with their trade. Additionally, some VET programmes have an apprenticeship requirement. This learning component situates students outside of the classroom and directly into the real workplace. The apprenticeship offers learners access to equipment and tools that may not otherwise be provided by schools.

Generic

20. Generic spaces support formal teaching activities in a group setting and are focused on content rather than equipment and infrastructure requirements (Worthington, 2007; Wolff, 2002). In contrast to specialised spaces, generic spaces can be used by any department or for any course and usually used for lectures, seminars or workshops. Providing general classroom space aligns with contemporary curriculum plans to balance vocation-specific coursework with traditional coursework, such as basic literacy and numeracy skills. This space also accommodates theoretical VET studies that do not necessitate access to equipment or tools with practical training. For this academic purpose, spaces can be shared among vocational disciplines, from cosmetology to manufacturing to automotive.

Informal

21. Informal learning spaces are undefined and can be public, allowing users to socialise and make choices about their educational activities (Worthington, 2007; Wolff, 2002). The flexibility of these spaces can accommodate numerous types of studies, projects and engagements. Increasingly, contemporary technologies and student needs are demanding the integration of wireless technologies in these spaces (Lonsdale and Vavoula, 2004). The design of informal learning spaces should ideally prompt collaborative, student-oriented and group activities, and feature learning technologies.

22. Open access and informal spaces are largely overlooked in the facility planning process and viewed as expensive and inefficient for improving educational outcomes (Wolff, 2002). However, changing pedagogical theory supports the inclusion of informal spaces which can encourage various interactions among students and their peers and teachers, and likewise support a variety of learning activities from individual work to group projects (Jamieson, Dane, Lippman, 2005). Lonsdale and Vavoula (2004) also found that creative and efficient structuring of open access spaces will ensure that space is fully utilised and economical.

23. Circulation spaces can also be transformed into areas of social interaction and informal learning. Strategic planning of paths which guide student movement can further integrate learning activities in a non-disruptive way and do not require additional allocations of physical space (Wolff, 2002). The design of corridors and hallways can function as extensions of lessons, as students move from class to class and further facilitate scholarly dialogue, advance learning and provide a setting for different activities (Lippman, 2006).

24. These informal, generally open spaces can serve an additional purpose for infrastructure flexibility. By remaining open and undefined, the building can be malleable and change to serve future institutional needs as they arrive (Whitaker, 2002).

- **Example:** *Stephenson College, Coalville, England, United Kingdom* is organised into units by speciality and vocational trade. Each cluster is composed of related workshops, demonstration rooms, teachers offices and a library. This composition enables easy navigation throughout the school and encourages interaction between students and teachers and commitment by the students to their vocation.
- **Example:** *Alpha High School, Gresham Oregon, USA* was built to resemble a business and not a school to develop job preparedness. The institution has replicated a professional working environment, where students are exposed to career options and gain job skills. Additionally, innovative spaces and movable furnishings allow learners to rearrange their learning environment and partake in a variety of activities in a variety of educational settings.
- **Example:** *Challenger TAFE, Australian Centre for Energy and Process Training, Fremantle Campus, Australia* is a training facility for students in the oil and gas industry designed to give students learning spaces for theory as well as practical on-the-job training. In addition to the classroom facilities, a fully operational process plant has been constructed on-site to give students a comprehensive education.

Technology

25. This section looks at technology used for training as distinct from the technology used as part of the building; this is covered in the next section.

Integration of technology for training

26. The integration of technology is an essential component to augment training programs, yet constant advances make this difficult to fund and preserve. For vocational studies, the exposure to and experience with modern and advanced technologies easily translates into marketable skills when entering the labour force. The inclusion of learning technologies will supplement the students' experience by giving direct access to broad resources, diversify skills and develop one's adaptability and creativity (JISC, 2006). Technology is divided into two categories and defined as digital (*e.g.* the Internet, wireless local area network communication, intranet) and mechanical or industry-specific (*e.g.* agricultural equipment, automotive repair tools). Both digital and mechanical technologies require that trainers and instructors remain proficient with the latest trends, methods and equipment. Spaces for learning technologies will remain more cost-efficient and better serve user purposes for longer periods if designed flexibly, rather than expressly for technologies with uncertain longevity (Temple, 2007).

27. Computer literacy and competency are becoming normative job criteria, and digital technologies need to be incorporated in VET infrastructure design to diversify and maintain skill quality. However,

provisions for information and communication technologies do not demand a large amount of physical space (Temple, 2007).

28. The increasing reliance on technology and resulting improvements do require that spaces be flexible in their design to include and allow for new technological methods and devices. To maximise infrastructure utility, appropriations for digital technology need to be organised in a way to maintain and support rapidly changing advancements and learning space needs (Lonsdale and Vavoula, 2004). To properly support digital technology systems and capitalise on their capabilities, classrooms, administrative offices, teachers offices and other parts of the institution must be fitted, which may require additional staff to provide technical support and expertise (Whitaker, 2002).

29. Rapidly changing industry technologies render equipment and machines outdated relatively quickly compared to the expense, which demands that vocational and technical schools adapt just as quickly. However, this can be costly (Cutshall, 2003). This need for hands-on exposure to the latest technologies and equipment raises the possibility of creating partnerships with local companies and businesses, which improves student access to and training with current industry technologies and consequently enhancing educational outcomes (Cutshall, 2003). Another solution to lowering operational costs and equipment management is to incorporate VET programs with universities or other schools and share space (Whitaker, 2002). Temple (2007) notes that given current scientific and technological trends toward smaller and more powerful equipment, certain activities in laboratories can be conducted in any given space. He further emphasises the need for space design to be flexible so that new scientific and pedagogic approaches can be implemented.

- **Example:** *Brewbaker Technology Magnet High School, Montgomery, Alabama, USA* is equipped with digital and mechanical technologies throughout. Industry and project-based learning are integrated into the curriculum and provide students with direct access to computers and equipment.
- **Example:** *Interactive Kitchen, Lewisham College, London, England* has fully integrated audiovisual technology into the curriculum. Students have access to video-recordings, audio commentary and digital quizzes, which allow them to review instructional material as needed.
- **Example:** *The Advanced Technology Center (ATC), Virginia Beach, Virginia, USA* was designed expressly to integrate outside businesses in career and technical training. This shared community space allows new industries and technologies to enter and finance certain programs while imparting a specific, desirable set of skills to students. The facility features technologies in teleconferences, video-conferences, satellite broadcasts and webcasts.

Environmental technology

30. In order for VET institutions to operate safely and efficiently, heating, lighting, ventilation, acoustics and area have unavoidable implications on design. Unlike traditional schools, vocational schools or programs require the installation of complex systems to meet the needs of the curriculum and be in accordance with local, regional or national regulations. Management of sound, heat and student activity presents a specific challenge to spatial flexibility and to support pedagogic approaches (JISC, 2006). Additionally, the variety of equipment, tools and machines make it necessary to provide access to utilities such as fume exhaust systems, compressed air, dust collection systems, electrical connections and storage containers (Indiana Technology Education, 2000). Environmental conditions, industry machinery and technical equipment all place constraints on space, influence its design and limit how the space can be employed and changed in the future.

Maintenance and accommodation

31. The architecture and appearance of the technical facility can positively affect student engagement and convey a message of high-quality education (Ostroff, 2005). Providing the right environment and infrastructure can attract students to vocational careers and specific industries (RIBA, 2006). Drawing in and maintaining a body of vocational students and future workers is critical to fulfilling economic, labour, and industry demands. For vocational education programmes to successfully recruit students, the building must be both functional and visually pleasing. Temple (2007) establishes a connection between maintaining environmental conditions (temperature, noise control, lighting, ventilation) and students commitment to learning.

- **Example:** *Culinary Arts Demonstration Kitchen Lab and Lecture Theatre, Humber College, Toronto Ontario, Canada* recent remodelling is increasing enrolment to its dynamic learning programme. In order to create a safe and appealing instructional space, architects attenuated design to specific attributes of lighting, kitchen exhaust and ventilation, noise levels and unobstructed visibility in the lab. The culinary demonstration theatre and labs utilise energy saving features and ecologically sustainable technologies.
- **Example:** *Da Vinci College, Education Park, Dordrecht, the Netherlands* was conceptualised to integrate education and commerce for providing the necessary founding for vocational training. Constructed with a variety of building materials, each vocation is located in its specific ‘training house’, with each one having a unique identity and thus emanates a sense of pride for the craftsmanship.
- **Example:** *Automotive Centre of Excellence, Kagan Batman TAFE, Victoria, Australia* was funded by the Office of Training and Tertiary Education (OTTE) as an investment in modern technology and training. The school efficiently uses compact space to incorporate the latest automotive technology and equipment into the training program.

Community

32. In order to maximise space efficiency and cost benefits, facility and space planning must include the surrounding community. Whether or not the school can be used beyond school hours and how this additional usage will affect space design are necessary questions when constructing or renovating vocational education structures (Vermont Department of Buildings and General Services, 2001).

33. In this capacity, utilisation of the facility after regular school time contributes to regional and state workforce development (Vermont Department of Buildings and General Services, 2001). Correspondingly, operating the building for workforce development can stimulate economic and industrial growth by advancing current employees (Paglin, 2001). Additionally, training and the built environment can be structured in response to industry needs and labour market demands to continually serve the community. In Portugal, for example, there is a financial incentive to structure courses on local labour and market needs. Vocational schools that adapt their curriculum are then eligible for public funds depending on the course relevance (CEDEFOP, 2007).

34. ‘Architectural transparency’ as advocated by Isler and Doerig (2008) connects the school to the surrounding community. This lucidity serves two purposes. First, it permits students to access the non-academic world and gain real life experiences with other people and professionals. Second, it establishes a link with the public and becomes a public area, rather than an isolated institution. This allows outside viewers to not only observe the learning activities of the students, but engage with the building and spaces, too.

- **Example:** *Lamar Institute of Technology, Beaumont, Texas, USA* has built industry specific facilities in response to petrochemical plants and oil refineries which structure the economy. The school accommodates the industry's needs for skilled workers with specialised labs and classrooms.
- **Example:** *Institut de Tourisme d'hôtellerie du Quebec, Montreal, Quebec, Canada* wanted to integrate its program into the city and regional tourism and make student activities and projects more transparent to the community. The building achieved these aims by incorporating glass into the design and thus permitted community the public to see what was happening inside the school.
- **Example:** *Reece Community High School, Devonport, Tasmania, Australia* was designed with input from teachers, students, parents, local community residents, business owners and education department officials so that school would encourage interaction between students and the community at large. The school maintains an open access policy so that the public and students can take full advantage of technology facilities and other academic resources.
- **Example:** *The Music Box, Stevenson College, Edinburgh, UK* has opened its facilities to the public to facilitate interaction between students and the community. The school offers a programme of evening and weekend courses open to the public extending the use of the recording, rehearsal and performance facilities.

Procurement and ownership

35. One of the greatest challenges in constructing a VET facility is balancing aesthetics and practicality given limited funding (Ostroff, 2005). Additionally, it has been noted that VET spaces have largely been sidelined, as money is disproportionately expended on traditional, academic-oriented secondary and further education programs (JISC, 2006). This challenge is more difficult as specialised school buildings and labs become outdated. Revisions in technology and shifts in the job market require funding to implement innovative space changes and equipment renewals for specialist trades, such as welding and computer technology. Cost considerations for machines and training equipment need to be weighed against the utility, usability and flexibility of current and future purchases, and must also take into account the cost of maintenance and replacement fees (Indiana Technology Education, 2000; Kenny, 2008). Across countries, there is no common plan for establishing and maintaining VET programmes. Various financial arrangements and responsibilities exist to deliver effective vocational education and training. Transnational comparisons demonstrate that funding schemes for vocational training vary greatly from country to country.

36. One determinant of funding for VET programmes is whether the institution is public or private. Sources of financial support can come from private-public partnerships, companies and enterprises sponsorships, local, regional or national governments, student tuition fees or shared by a combination of those suppliers. These funding arrangements further complicate the budget for and manner in which VET-specific facilities are constructed, equipped and maintained. Additionally, sources of funding are determined by the curriculum, and the inclusion of an apprenticeship component and/or general education instruction. In the UK, schools are autonomous and thus are responsible for acquiring funding for operational costs, including equipment and new technologies (both digital and industrial). As a result, VET institutions make arrangements with local industries and cultural organisations to guarantee students' access to machinery and trade tools either through donations or equipment sharing (Kenny, 2008). Another cost-efficient way is to lease items or purchase previously owned equipment. However, if equipment purchases are compatible with national policy interests, capital support can appear in the form of government grants (Kenny, 2008). In France, the Ministry of Education is responsible for funding the human capital, however, regional authorities are responsible for the operating and maintenance costs of the

infrastructure and equipment (CEDEFOP, 2007). By contrast, in Austria, the Federal Ministry for Economy and Employment funds upper secondary VET facilities (CEDEFOP, 2007).

- **Example:** *Centro de Capacitación Chrysler, Mexico City, Mexico* has an arrangement with Chrysler to receive automobile and related parts to be used for instructional purposes. Students work with and on the latest models and learn the newest innovations in manufacturing, production and repair. This programme provides recruitment opportunities and potential employment for students once requirements have been fulfilled.

Conclusion

37. Educational facilities are long-term and expensive investments. Future user needs present particular challenges for designing VET spaces. This is especially important to consider during the facility planning process as well as throughout the use of VET buildings. It is essential that construction of the learning environment remains flexible and able to respond and adapt to changes in technology, labour markets, user needs and a range of different learning activities. For all levels and disciplines, the flexibility in the design is key to preserving a cost-efficient vocational education and training programme. School planners and designers are expected to arrange spaces that will continually change and convert and be upgraded and reorganised (Kenny, 2008).

38. The objective of any school building is to support educational activities. For VET, the design of the spaces needs to support learners academic requirements and provide tangible skills that can be transferred to employment in their discipline or provide access to further education. An effective design is important to produce productive and skilful learners. The infrastructure should reflect the institutions educational vision and be responsive to, inclusive and supportive of its users and their needs (JISC, 2006).

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