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Development of strategies for the assessment of practical competencies in a learning environment

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Motivation and Project Objectives

The Oxford Concise Dictionary defines competence as “the ability to do something successfully or efficiently” (Stevenson & Waite, 2011). Within educational settings there is significant variance in what competency means. As Ireland’s first technological university, TU Dublin undergraduate programmes place significant emphasis on the development of practical competencies and skills in a variety of learning environments ranging from bakeries to chemistry laboratories. Therefore, in accordance with our own practices and for the purposes of this project, we define a practical competency as:

A person’s demonstrated ability to perform a valued and specific task based on standards as required for effective performance in specific contexts and at defined levels.

The requirement to assess these competencies can come from internal drivers, alignment with graduate attributes as well as from external stakeholders, accreditation and governing bodies (Muller et al, 2019). As competency-based learning becomes more prevalent across our programmes due to excellent alignment with TU Dublin graduate and workplace attributes, it is crucial that competencies are assessed correctly, fairly and effectively.

The objective of this work is to review the current practices and/or international literature in strategies for assessment of practical competencies in undergraduate learning environments i.e. ‘what is being done’. Case studies on the assessment of practical competencies from a diverse range of Schools and disciplines within TU Dublin are also presented i.e. ‘what we currently do’. Finally, this project presents a series of recommendations for the assessment of practical competencies suitable for any practical learning environment, within the unique setting of the multi-campus Technological University i.e. ‘what we should be doing’. These recommendations have been formulated after reviewing relevant literature as well as examining best practice in competency-based assessment across TU Dublin.

Part 1: What is being done

Economic, societal change, digitalisation and diversification of culture have created the continuous need to enhance and develop third level education. Globalisation, the growing increase of international interdependence and the development of new knowledge, means that students and lecturers must work together and be open to change and new opportunities in the delivery of skill and competency-based curricula (Vujko, 2017).

Competence-based teaching is a learning outcome (LO) framework within different disciplines of practical modules which is built through the context of skills, knowledge and the abilities that can be delivered in formal and informal ways of learning (NODA, 2016). McGourty et al., (1999) found that the interchangeable use and term of LO's and competencies could cause confusion between those who work or engage in third level institutes, universities and academia. Competencies can also be referred to as generic skills, key skills, learning objectives and generic attributes. These terms are widely used and respected on educational platforms and should set a 'benchmark for defining a profession' graduate attributes and career development and employability.

Competency based task forces and development agencies have been devised on national and international scales such as the European Qualifications Framework (EFQ) and the Organisation for Economic Co-operation and Development (OCED). These organisations allow a comprehensive, strategic approach and comparison of learner competencies, knowledge and skills regardless of where the qualification has been obtained (European Qualification Framework, 2018). Globally academics, diverse business leaders and governments have developed foundations and skills attributes that learners can obtain for career opportunities now and in the future (Care et al., 2018, Gordon et al., 2009, pg. 21).

Recommendations from The National Strategy for Higher Education to 2030 Report (HEA, 2011) found that:

Undergraduate curriculum needs to place more emphasis on generic skills, especially for those required for the workplace and for active citizenship. Creativity and entrepreneurship must be encouraged to a much greater extent: and institutions should facilitate reflective learning, applied knowledge, practical laboratory experience and scientific skills (p.56).

Abrahams and Reiss (2012) found that in the area of practical work, for assessments to be effective, it is necessary to know what is being assessed. Depending on the profession, it was found that there are a variety of ways to access practical competencies in higher education. In clinical medicine and science, assessments were aligned 'Millers Pyramid' which categorized observational clinical competencies and knowledge at lower and higher levels. Other medical fields such as the Environmental Protection Agency (EPA) assessed using levels and milestones to record technical and professional competence (Sahu et al, 2019). Additional influencing factors on the assessment of practical competencies were based on stakeholders and governing and accreditation bodies.

The quality of the assessment is of key importance to ensure that students obtain and understand core practical skills. Assessment should not only measure the overall outcomes of an individual but measure the student experience using 'performance indicators' or 'roadmaps' as a relevant, defined system (Vujko, 2017). Continued growth, development and strategies in third level education will ensure students understand the use and importance of practical competencies which are essential for future graduate opportunities.

Part 2: What we currently do

Across different colleges in TU Dublin, a variety of competency assessment types are currently being used for the assessment of practical work. These include continuous assessment (Andersson & Palm, 2017), demonstration of scientific theory understanding as well as more traditional practical exams at the end of the term (Gron et al., 2013). A mixture of direct and indirect assessment, as defined by Abrahams and Reiss (2015) are also used.

In the School of Biology and Health Sciences, practical skills such as pipetting, microscopy and spectrophotometry are assessed indirectly by an end of module exam using a written paper. The assessment is designed to measure the student's individual ability to obtain a specific result/demonstrate a scientific theory by performing the task and recording the result on paper rather than physically performing the experiment, referred as direct assessment (Abrahams and Reiss, 2015). Results are given as a percentage and the students must achieve the required grade in order to progress.

In the School of Culinary Arts and Food Technology, students have their core competencies (set for each module/Culinary degree) assessed by individual continuous assessment (Andersson & Palm, 2017) and a final reflective portfolio (Gron et al., 2013). The core skills to be assessed include hygiene and safety, professional conduct (timekeeping, appearance, teamwork, work plan and organisation), skills development, the finished product, reflection on the process and product. Results are given in a percentage of the overall core components of the module and the students must pass all for progression into Stage 2 of all chef programs at TU Dublin.

In the School of Food Science and Environmental Health, after completing all required practicals for a chemistry module, students need to complete a practical exam over 20 mins involving both paper and physical performance. Each group (5-6 students) has a particular time slot on the day. The practical skills (weighing, pipetting, mixing, dilution, cleaning up, etc) are assessed by the lecturer, and the theoretical competency (accuracy and unit) is assessed by the demonstrator. The students' soft skills are also assessed by this approach, including time management, pressure handling and resilient (Hadiyanto et al., 2017). Students must achieve the required pass grade (from the combined two aspects) in order to progress.

In the School of Physics and Clinical and Optometric Sciences, core competencies are defined as essential practical skills required for progression through subsequent stages of the different degree programmes, as well as for students' future careers as physicists, for example use of vernier calipers, cathode ray oscilloscope, construction of circuits, uncertainties etc. The assessments indirectly assess the student's individual ability to undertake a specific competency. Each student has two attempts during the semester to successfully complete each practical competency. Within the School, a pass/fail assessment strategy (Mbarushimana et al., 2017) is considered appropriate due to the nature of the competencies. Without successfully completing the core competency, the students cannot progress to the next stage.

Part 3: What we should be doing

Here, seven recommendations for effective and fair assessment of practical competencies within learning environments are presented i.e. ‘what we should be doing’. These recommendations have been devised based on reviewing best practice in the literature (Part 1), as well as best practice across four different Schools and disciplines currently utilizing practical assessment in TU Dublin (Part 2).

Recommendation 1: Identification of relevant competencies

- In order to assess student competencies, the competencies themselves must first be correctly identified.
- Ensure that the assessed competencies reflect the current needs of graduates, graduate employers and accreditation bodies, and that graduation standards are maintained (Muller et al., 2009).
- It is recommended that an initial survey of faculty and external stakeholders (Gordon et al., 2009) is conducted to facilitate specific identification and ranking of relevant competencies in order of importance (Kerchner et al., 2012).
- It is important to involve external stakeholders from accreditation bodies and industry at this stage, in order to ensure that the identified competencies reflect the current and future needs of graduate employers, and indeed that graduation standards are maintained.
- Through this process, a ‘shared vision’ for a faculty, department or programme can also be developed (Thompson, 2013).

Recommendation 2: Design a student ‘roadmap’ to competency

- For each competency, milestones or levels of achievement should be identified. A milestone is a behavioral descriptor that marks a level of performance for a given competency.
- Levels of competency may be introduced as described by Pittenger et al (2016). In Pittenger’s ‘5-level trust scale’, students are graded from level 1 to 5, with level 1 representing the student being observed and directly supervised in completion of a task, and level 5 representing the student themselves supervising and instructing others in the same task.
- The provision of such a roadmap at an early stage in an undergraduate programme instils students with the knowledge of what is expected of them.

Recommendation 3: Develop multiple learning tasks for each competency

- Students must be given multiple learning opportunities throughout the semester and in advance of assessment to develop their skill in each identified competency.
- Ideally, learning tasks will simultaneously address more than one competency, and allow students repeated opportunities to build competencies in different combinations and contexts (Thompson et al., 2013).
- It is important to ensure that all staff and/or students working in the laboratory are correctly trained in instruction of students for each competency (Sahu et al, 2019), and this is assessed on ongoing basis.

Recommendation 4: Use direct competency assessment methods “There is no single tool that can be used to assess all the learning objectives in terms of knowledge, skills, behaviours and attitudes. Thus, it is essential to match the assessment methods with the competencies being learned” (Liu et al., 2006).

- Direct assessment methods are preferred for practical skills (Abrahams and Reiss, 2015); if the competency is practical, then the assessment method should be practical. E.g. written examinations are not best suited to assessment of practical skills.
- Recommendation 5: Authentic competency assessment
- The necessity for authenticity of the competency assessment is important for all disciplines (Liu et al., 2006).
- The assessment should ideally mimic real situations or tasks that the students will encounter after graduation, but in a safe, risk-free environment.

Recommendation 6: Identify the right marking scheme for your competency

- Selection of an appropriate marking scheme for a competency assessment is crucial.
- There are certain practical competency assessments which students will be expected to perform unaided in the next stage of their programme, or indeed upon graduating. In these instances, a pass/fail marking scheme may be considered appropriate in order to determine ‘workforce readiness’ (Mbarushimana et al., 2017).
- In other instances, such as formative or summative practical assessments composed of multiple sub-competencies, Rubrics or Global Rating Scales may be more appropriate e.g. ‘not proficient, towards proficient, proficient’ (Moni et al., 2007).
- Levels of competency may be introduced as described in Recommendation 2.
- In addition, staff must be appropriately trained in how to evaluate/mark competencies properly through observation.

Recommendation 7: A ‘Competency Passport’

- Students may not be aware of the significance of competencies in relation to their professional development; students can view practical competency assessments as yet another test to pass, rather than a body of knowledge or skill that will be important in their future careers.
- It is important to promote student awareness and understanding regarding the importance of successful competency development. Upon completing their programme, students must reach certain milestones in each identified competency.
- To this end, each student should have a record of their competencies, sometimes referred to as a ‘Laboratory Passport’ or ‘Competency Passport’.
- This passport ideally contains a list of all competencies to be completed and is a record of the level of performance that students have attained in a given competency.

Conclusions

Assessment of practical competencies is a key component of undergraduate programs across TU Dublin. Here, seven recommendations for effective and fair assessment of practical competencies within learning environments have been presented (Part 3). These recommendations have been devised based on reviewing best practice in the literature, and across four different Schools and disciplines currently utilizing practical assessment in TU Dublin. Going forward, these recommendations will be presented and further refined via discussion with TU Dublin faculty in the relevant Schools, with a view to implementation in our programs. To assist our colleagues in the implementation of these recommendations a guideline has been produced to enable them to integrate these findings easily into their practice (Figure 1).

During the project, several areas for further research were identified. Firstly, we recommend that multiple learning tasks be developed for each competency (recommendation 3), however there is limited literature available on how best to design and structure practical learning tasks. This should be further explored by setting up a working group on designing practical competences with staff from across multiple disciplines. Secondly, it is recommended to use direct assessment methods (recommendation 4). While there is some dispute in the literature, observation is generally accepted as the only true direct assessment method (Abrahams and Reiss, 2015). Without instruction and proper training of staff, assessment via observation is flawed, open to bias and inconsistent, particularly in large student groups. Therefore, a key area for future research is the development of guidelines and training for TU Dublin staff in the assessment of practical competencies via observation.

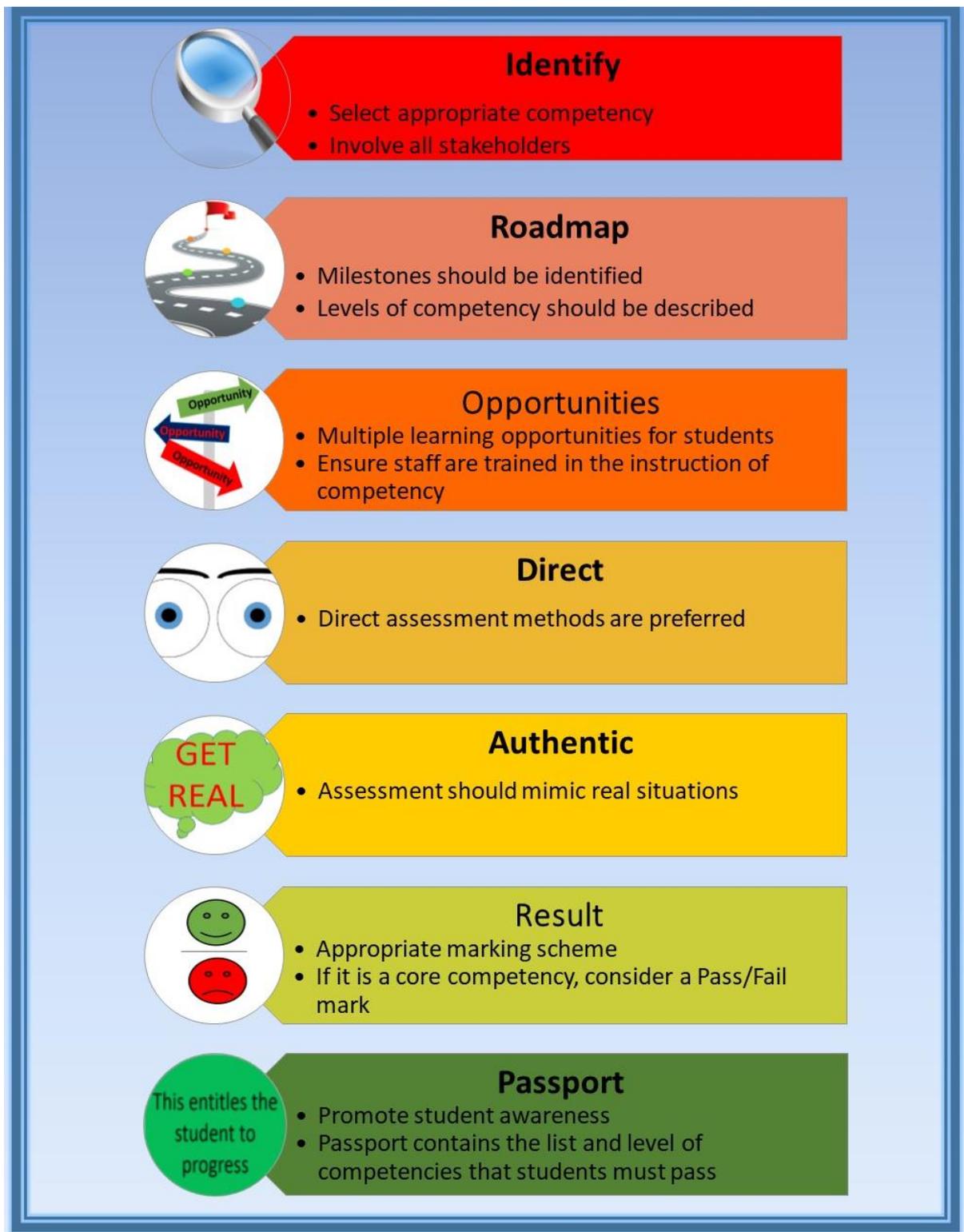


Figure 1: A guide to practical competencies. This figure illustrates the recommended steps to implement and assess practical competencies in a learning environment

References

- Abrahams, I. & Reiss, M. (2012) Practical work: its effectiveness in primary and secondary schools in England. *Journal of Research in Science Teaching*, 49(8), 1035-1055.
- Abrahams, I., & Reiss, M. (2015). The assessment of practical skills. *The School Science Review*, 96, 40-44.
- Andersson, C., & Palm, T. (2017). The impact of formative assessment on student achievement: A study of the effects of changes to classroom practice after a comprehensive professional development programme. *Learning and Instruction*, 49, 92-102.
- Care, E., Griffin, P., Wilson, M. (2018). *Assessment and Teaching of 21st Century Skills: Research and Applications*. Switzerland: Springer International Publishing.
- Gordon, J., Halasz, G., Krawczyk, M., Leney, T., Michel, A., Pepper, D., Putkiewicz E., Wisniewski, J. (2009). Key competences in Europe: opening doors for life-long learners across the school curriculum and teacher education. Retrieved from CASE-Center for Social and Economic Research, Warsaw, Poland
- Gron, L. U., Bradley, S. B., McKenzie, J. R., Shinn, S. E., & Teague, M. W. (2013). How to recognize success and failure: practical assessment of an evolving, first-semester laboratory program using simple, outcome-based tools. *Journal of Chemical Education*, 90(6), 694-699.
- Hadiyanto, H., Nofer, N., Moehaimin, & Yuliusman. (2017). Assessing students and graduates soft skills, hard skills and competitiveness. *PEOPLE: International Journal of Social Sciences*, 3, 1885-1906.
- Kerchner, M., Hardwick, J., & Thornton, J. (2012). Identifying and using 'core competencies' to help design and assess undergraduate neuroscience curricula. *Journal of Undergraduate Neuroscience Education: JUNE: a Publication of FUN, Faculty for Undergraduate Neuroscience*, 11, A27-A37.
- Liu, M., Huang, Y.-S., & Liu, K.-M. (2006). Assessing core clinical competencies required of medical graduates in Taiwan. *The Kaohsiung Journal of Medical Sciences*, 22(10), 475-483.
- McGourty, J., Besterfield-Sacre, M., Shuman, L. (1999). ABET's eleven student learning outcomes (a-k): have we considered implications? [online] Retrieved from: http://www.engr.pitt.edu/~ec2000/grant_papers/McGourty+ASEE-99.PDF
- Mbarushimana, N., Role, E., & Allida, V. (2017). Competency-based curriculum in tourism and hospitality: a practical model for Rwanda. *Journal of Research Innovation and Implications in Education*, 1, 96-109.
- Moni, R., Hryciw, D., Poronnik, P., Bryan-Lluka, L., & Moni, K. (2007). Assessing core manipulative skills in a large, first-year laboratory. *Advances in Physiology Education*, 31, 266-269.
- Müller, K., Vanleeuwen, D., Mandabach, K., & Harrington, R. (2009). The effectiveness of culinary curricula: A case study. *International Journal of Contemporary Hospitality Management*, 21.
- NODA. (2016). The NODA Core Competencies. [online] Retrieved from: <http://cdn.ymaws.com/www.nodaweb.org/resources/resmgr/doc/competenciesbooklet.pdf>
- Pittenger, A. L., Chapman, S. A., Frail, C. K., Moon, J. Y., Undeberg, M. R., & Orzoff, J. H. (2016). Entrustable professional activities for pharmacy practice. *American Journal of Pharmaceutical Education*, 80(4), 57-57.

- Sahu, P., Chattu, V. K., Rewatkar, A., & Sakhamuri, S. (2019). Best practices to impart clinical skills during pre-clinical years of medical curriculum. *Journal of Education and Health Promotion*, 8, 57.
- Stevenson, A., & Waite, M. (2011). *Concise Oxford English dictionary*. Oxford University Press.
- The European Qualifications Framework. (2018). *The European Qualifications Framework: supporting learning, work and cross-border mobility*. [online] Retrieved from: http://www.ehea.info/Upload/TPG_A_QF_RO_MK_1_EQF_Brochure.pdf
- The Higher Education Authority. (2011). *National Strategy for Higher Education to 2030 – Report of the Strategy Group*, p.56. [online] Retrieved from: <https://hea.ie/assets/uploads/2017/06/National-Strategy-for-Higher-Education-2030.pdf>
- Thompson, K., Chmielewski, J., Gaines, M., Hrycyna, C., & Lacourse, W. (2013). Competency-based reforms of the undergraduate biology curriculum: integrating the physical and biological sciences. *CBE Life Sciences Education*, 12, 162-169.
- Vujko, A. (2017). The British Council: The importance of practical learning. [online] Retrieved from: <http://www.britishcouncil.org/education/skills-employability/what-we-do/vocational-education-exchange-online-magazine/april-2017/importance-of-practical-learning>