

The validity of virtual labs for assessing science practical skills

Conference Abstract

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There are various methods to assess science practical skills at secondary school level, each of which may have a different impact on teaching and learning. Literature has addressed the distinction between direct and indirect assessment of practical skills (Abrahams & Reiss, 2015), and questions have been raised about the validity of indirect assessment methods which could promote undesired practices such as teaching to the test.

Direct assessment of science practical skills, for example through physical lab work, is not always possible for schools around the world to achieve. The logistics and resources required to set up laboratories for assessment purposes can be difficult in practice, and there are also regional variations. In some regions, there are restrictions on what chemicals or reagents can be imported.

Alternative to practical exams, where students do a written paper instead, are an option. However, such written exams do not require students to do any manipulation of equipment during the assessment. The washback of these kinds of assessments is questionable. They are intended to promote physical practicals during teaching as a form of preparation, however, this is not a guarantee, and anecdotal evidence suggests that teaching to the test is a possible response.

This research study, which took the form of a critical literature review (Thomas, Zairina, & George, 2020), explores another potential means to assess science practical skills, which is through virtual labs. The development of computer software creates new opportunities for teaching, learning and assessment of practical skills. Virtual labs can take many forms but they are essentially computer simulations that attempt to allow students to replicate an experiment on a computer program (Reyes, Isleta, Regala, & Bialba, 2024). Virtual labs in various forms are known for their use in teaching and learning, but their potential in assessment has not received much attention in the literature.

In our review, we focused on exploring the potential validity of virtual labs for the summative assessment of science practical skills. Using the Crooks, Kane, and Cohen (1996) chain model as a theoretical framework, we elucidate threats, benefits and opportunities for the validity of virtual labs in summative assessment in comparison with physical labs and written alternative to practical exams. A key aspect of the chain model is that it includes the impact of the assessment as the final link in the chain, which highlights the impact on teaching and learning. Our review used relevant literature obtained through database searches (including Google Scholar, Scopus and Eric) using specific relevant keywords. Literature was screened and included or excluded based on our criteria, and was coded using MAXQDA software.

Overall, our review argues that virtual labs have the potential to assess a subset of science practical skills, and because they require manipulation of equipment (albeit virtually), they potentially represent an improvement over written examination. However, there are several threats to validity that we identified that would need to be carefully considered. A key factor is the quality and design of the software, which needs to be designed to mimic physical practical assessment as closely as possible. Poor quality software design can lead to linear rather than open ended experiences, which can restrict the constructs being assessed. The impact on physical practical skills also needs considering, for example, whether the use of virtual labs in assessment would reduce the amount of real physical experimentation in the

classroom. There is also the question as to whether certain practicals might be more suited to virtual labs than others, and whether this might influence the curriculum.

Our review has informed the design of a subsequent planned research project to map different practicals to different skills, and assess their relative suitability for virtual assessment. We also propose an exploration of currently available virtual lab software to assess functionality, and how this may or may not support summative assessment of science practical skills internationally.

References

- Abrahams, I., & Reiss, M. (2015). The assessment of practical skills. *School Science Review*, 357, 40-44. Retrieved from <https://discovery.ucl.ac.uk/id/eprint/1493238>
- Crooks, T. J., Kane, M. T., & Cohen, A. S. (1996). Threats to the valid use of assessments. *Assessment in Education: Principles, Policy & Practice*, 3(3), 265-286. doi:10.1080/0969594960030302
- Reyes, R. L., Isleta, K. P., Regala, J. D., & Bialba, D. M. R. (2024). Enhancing experiential science learning with virtual labs: A narrative account of merits, challenges, and implementation strategies. *Journal of Computer Assisted Learning*, 40(6), 3167–3186. doi:10.1111/jcal.13061
- Thomas, D., Zairina, E., & George, J. (2020). Methodological approaches to literature review. In *Encyclopedia of Evidence in Pharmaceutical Public Health and Health Services Research in Pharmacy* (pp. 1-15). Cham: Springer International Publishing. doi:10.1007/978-3-030-50247-8_57-1