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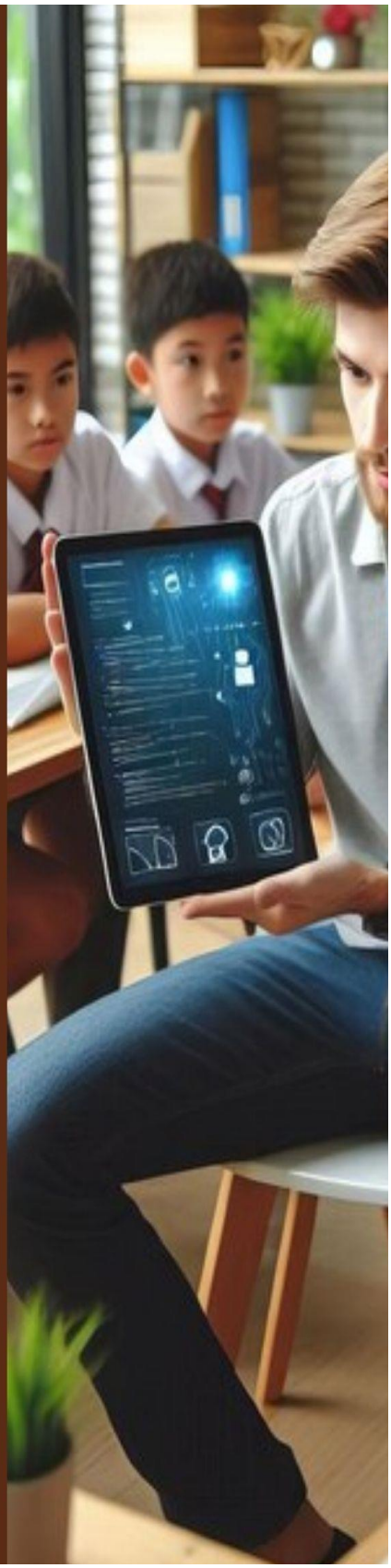

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Examining some assumptions and limitations of research on the effects of emerging technologies for teaching and learning in higher education

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Abstract

The essay delves into the attitudes and assumptions that support educational technology research. It provides a critical analysis of several methods that have been used to study the effects of technology on education. To demonstrate how unquestioned assumptions may produce dubious results, it zeroes in on comparative studies, performance comparisons, and attitude studies. Some of the assertions made on the effects of technology are cast into doubt when based on these methodologies and methods. To properly interpret results, researchers, in our opinion, should be careful to note both the limits of their methodology and any underlying assumptions.

Introduction

We need to keep evaluating the pedagogical merit of new technologies as they make their way into universities. But the outcomes we claim to have discovered are affected by how we evaluate these technologies (Oliver, 2011). Assumptions about the technology and, more importantly, about the nature of instruction and learning, form the basis of researchers' evaluation methodologies (Price & Kirkwood, in press). Discussions on the efficacy of educational technology tend to downplay these assumptions. Publications claiming to have discovered enhancements to learning seldom ever include them (Bimber, 1994; Kanuka & Rourke, 2008). This gives rise to interpretive variety. The research that researchers do is influenced by their own ideas and preconceptions. The methods used to gather evidence reveal different epistemological viewpoints. Research in the field of education, for instance, may take on the rigour and objectivity of the scientific or medical sciences. According to many sources (Hattie & Marsh, 1996; Means, Toyama, Murphy, Bakia, & Jones, 2010; Slavin, Lake, Davis, & Madden, 2011; Slavin, 2008; Tamim, Bernard, Borokhovski, Abrami, & Schmid, 2011), this demonstrates a positivist epistemology. In their pursuit of knowledge, some researchers may take a more subjective approach. They argue that the complicated social realities of educational environments, where pedagogies and epistemologies are debated, make

controlled experiments undesirable (Clegg, 2005; Elliott, 2001; Hammersley, 1997, 2007; Oakley, 2001). Therefore, research methodologies do not lack value or objectivity; rather, they mirror the epistemological stances that govern the breadth of investigations and the conclusions drawn from them.

To illustrate this point, we review some of the methods used to investigate theimpact of educational technologies on learning.We question some of the claimsmade on the basis of the approach adopted and the extent to which these can besubstantiated. This critique contributes to current debates about the appraisal ofeffective educational technologies and their role in enhancing student learning(Oliver, 2011;Oliver *et al*.,2007).

Assumptionsaboutlearningandteaching

Interpretations about teaching and learning are frequently taken for granted.However research shows considerable variations in conceptions of teaching (Kember&Kwan,2000;Prosser,Trigwell,&Taylor,1994; Samuelowicz&Bain,1992, 2001).

While some teachers have *teaching-focused* conceptions (i.e. teaching as thetransmission of information, skills and attitudes to students), others have *learning-focused* conceptions (i.e. promoting the development of the students' ownconceptual understanding).Trigwell and Prosser (1996) found that teachers'conceptions of teaching were commensurate their approaches to teaching.So,teachers with a conception that foregrounds 'the transmission of knowledge' arelikelytoadoptateacher-centredapproach,whilethosewhoconceiveteachingas 'promoting conceptual development in learners' are likely to adopt a learner-centredapproach. Teachers' conceptions of teaching have significant and interrelatedimpacts upon how they employ technology and upon students' learning.They alsoreflects attitudes aboutagencyandwhetheritis theteacherorthetechnologythatis considered to be significant (Kirkwood & Price, 2012) and this can influence howresearch is conducted and interpreted, particularly as teachers often conductresearchintotheirowninnovations(Hammersley, 1997).

Comparativestudies

This approach typically involves comparing the outcomes from teaching one group(or more) using some form of technology with those of a control group taught by amore 'conventional' method, such as classroom instruction.Apart from thetechnology, all other aspects of the educational experience are kept identical or assimilar as possible. They use the same content, pedagogical approach; they have thesame expected learning outcomes and form of assessment. This is in order toestablish whether the one factor – the technology – had caused any observedimprovements.

This remains a commonly used method in educational technology (Reeves, 2005,2011; Slavin *et al*., 2011; Slavin, 2002, 2003, 2008).Means, Toyama, Murphy, Bakia,& Jones(2010) conducted a meta-analysis of 48 studies comparing face-to-face andonline or blended learning. In a similar study, Tamim, Bernard, Borokhovski, Abramiand Schmid(2011, p. 5) conducted a meta-analysis of 25 meta-analyses in order toascertain the impact of technology on student achievement. Neither of these largemeta-analyses had any discussion about the comparative research methodsparadigm or assumptions that underpinned the design and subsequentinterpretationoffindings.

According to Oh and Reeves (2010) and Reeves 2005, 2011, one reason why comparative studies are still popular is that they seem to be an easy way to compare things using a'scientific' approach. This approach, nevertheless, is not simple. In order to see how different factors affect the dependent variable, "real" experimental comparisons account for a plethora of independent variables (Cohen, Manion, & Morrison, 2011, p. 316). The complexity of studying human learning makes this an arduous goal to achieve in practical educational settings (Hammersley, 1997, 2007). It is more common to use a quasi-experimental technique, where the experimental group receives instruction that is not just technologically improved but also enhances or transforms the instruction in some way due to the intervention's inherent characteristics. The findings may not be solely attributable to the modification of the technology, which might introduce experimental error. According to Cohen et al. (2011) and Joy & Garcia (2000), this complicates the process of establishing causation. Arbaugh et al. (2009), Means et al. (2010), Oh & Reeves (2010), Reeves (2005), 2011; Russell (2013), and the vast majority of comparison research have concluded that there is "no significant difference" in the impact of the different types of educational technology. Few studies were able to demonstrate "significant" gains in knowledge, and those that were only able to demonstrate "modest" gains, according to Means et al. (2010). According to Reeves (2011, p. 8), the reason why most comparative studies don't yield meaningful results is because they ignore important pedagogical dimensions (such as alignment of objectives with assessment, pedagogical design factors, time-on-task, learner engagement, and feedback) in favour of examining instructional delivery modes. According to Schramm (1977, p. 273), researchers often report more variation within media than between them, suggesting that the content rather than the method of transmission has a greater impact on learning. Because the educational components must be constant in order to detect the impacts of the technology, the comparative method to investigating technology's influence imposes design restrictions. So, neither the technical potential nor its exploration have progressed. "Doing things better" is the only thing these studies ever show, never "doing better things" (Reilly, 2005). Improvements in learning are often thought of as more developmental and qualitatively rich when they occur in a university setting. According to Lave and Wenger (1991), students are expected to do more than just increase their knowledge and comprehension; they should also learn to constructively react to ambiguity, become more self-directed learners, and enhance their ability to join a community of practice. Aiming to "do better things" is the goal here (Reilly, 2005). Still, a large body of research on the topic of technology-enhanced learning has shown that it just serves to replicate preexisting methods of instruction (Price & Kirkwood, in press). The method based on comparative studies

reinforcesthisfindingastheyarenotsuitedtoinvestigatingtheimpactoftechnologyon transformationalaspects oflearning.

Clark (1983) argued that the teaching *medium* was less significant than the*pedagogic* or *teaching approach* when it came to influencing learning. However, headvanced a pervasive analogy based upon the 'no significant difference' resultsfrequentlyfound:

> The best current evidence is that media are mere vehicles that deliverinstruction but do not influence student achievement any more than thetruckthatdeliversourgroceriescauseschangesinournutrition(1983,p.445).

The 'Grocery Truck Analogy' taken out of its specific context (replication of teaching)could be interpreted as being applicable to *all* educational situations. However, theevidence had excluded contexts in which technology was used to achieve novel ordifferent learning outcomes. In other words, his generalised assertion – like that ofTamin *et al*.(2011) – could not be substantiated by the evidence available fromcomparative studies alone. Clark's purposeful use of the verb 'deliver' indicates thatthe analogy embodies a *transmissive* epistemology. Clark's view of learningconcentrates on learners acquiring the knowledge and skills necessary to perform atask through the transmission or delivery of information.This would suggest aconception of learning and teaching with technology that is predicated upon atechnologically deterministic perspective, i.e. that the technology in and of itself isthe agent of change.This conception is prevalent in assumptions underpinningcomparativestudies.

Joy and Garcia (2000) argue that the usefulness of comparative studies for predictinglearning outcomes is extremely limited due to the need to impose artificial controlsto produce results.Constructivist views of learning, aimed at developing studentunderstanding are grounded in very different assumptions and beliefs about therelative roles of instructors, learners and technologies. Such a perspective givesprominence to different research questions that need to be explored throughdifferentmethodologies(Reeves, 2011).

Performancecomparisons

Much educational technology research involves less demanding comparisonsbetween the performance of 'with technology' and 'non-technology' groups ofstudents (Liao, 1998, 2007; Rosen & Salomon, 2007; Schmid *et al*., 2009; Sipe &Curlette,1997; Timmerman&Kruepke, 2006;Torgerson&Elbourne,2002).
Performance is usually compared through normal module assessments or by meansof specifically design tests. However, expediency and pragmatism often determineshowgroupsareselected.Theymightbeconcurrentgroupswithinthesamest udentcohort, or consecutive cohorts of students taking ostensibly the same module andthiscan affectthefindingsgiventhat otherfactorsmightaffectthe results.

When comparing the performance of student groups to determine the effects of anyinnovation the comparison assumes that the inputs such as resources, learningactivities, support, etc. should be equivalent or very similar. If student groups haveactually experienced differing amounts of resource input or time spent on tasks, thecomparison might provide an indication of improved outcomes, but it cannot bepresumed that using technology was responsible for the improvement as the act ofchangingthe resourcecompromisesanyclaimsthat canbemade about causality.

'Between group' performance comparisons tends to assume that student learninggains involve a quantitative improvement, i.e. higher scores achieved reflect morelearning (Liao, 1998, 2007). Scouller (1998) has shown that different forms ofassessment influences students' perceptions of the task and their subsequentperformance.However, the nature of the assessment itself influences varyingstudent learning outcomes (Laurillard, 1978, 1979, 1984).This suggests that usingperformance as an assessment of improved student learning has methodologicalproblems.Such methods reveal nothing about whether students achieve longer-lasting gains such as acquiring qualitatively richer or deeper understandings(Dahlgren, 2005; Säljö, 1979) or progressing their intellectual development (Perry,1970).These kinds of approaches to evaluating student performance similarlyreflect what Trigwell*et al*. (1999) regard as a teacher-focused conception oftenassociatedwitha transmissiveepistemology.

Self-reportquestionnairesandattitudescales

Often researchers try to determine what particular effects innovations have had onlearners. For example, how students had used the technology; what types of activitythey found most valuable, and what advantages/disadvantages the innovationpresented for their study experience, or students attitudes to a particulartechnological intervention (Cooner, 2010; Copley, 2007; Cramer, Collins, Snider, &Fawcett, 2007; Dalgarno, Bishop, Adlong, & Bedgood Jr, 2009; Elgort, Smith, &Toland, 2008; Evans, 2008; Fernandez, Simo, & Sallan, 2009; Hakkarainen,Saarelainen, &Ruokamo, 2007; Hui, Hu, Clark, Tam, & Milton, 2007; 2008; Sim &Hew,2010;Sorensen,Twidle,Childs,&Godwin,2007;Stephenson,Brown,&Griffin,2008; Tormey & Henchy, 2008; Tynan & Colbran, 2006; Wheeler & Wheeler, 2009;Woo *et al*., 2008; Wyatt *et al*., 2010). While such an approach can provide usefulinformation, the outcomes do not of themselves demonstrate that a technologicalinnovationhasimprovedthe studentlearningperformance orexperience

Evans (2008, p. 496) conducted a study into the use of podcasts in learning. Thequestionnaire collected data reflecting students' experiences and attitudes towardsusingpodcasts.Unfortunatelylittle informationwasprovided regardingany improvements in student's learning.Cramer *et al*. (2007, p. 111) conducted a similarstudy into whether students' perceived that a Virtual Lecture Hall would enhancetheir learning.Again, this provided no information about enhancements in learning.While students' attitudes and opinions are important, other forms of evidence needto be presented in order to conclude whether learning has *actually* improved. Thesestudieshaveunderlyingassumptionsinthatstudents'expressionsofattitudescan

be equated with learning 'enhancement'.This is a dubious interpretation,particularlygiventhatthenatureoftheenhancement wasnotspecified.

When designing and interpreting the findings from self-report questionnaires, it iseasy to assume that all parties share a common understanding. However'learning'and 'teaching' are not interpreted in the same way; research has shownconsiderable variations in interpretation among students and teachers(Kember,2001;Marton&Säljö,2005;Trigwell&Prosser,1996).

The widely used four-level evaluation model proposed by Kirkpatrick (1994) arguesthat the effectiveness of education or training is best evaluated at four progressivelychallenging levels: *Reaction*, *Learning*, *Behaviour* and *Results.* In a critique of the 4-level model, Holton (1996) argues that learner *reactions* are far less important thanthe other levels. So while findings suggest that learners value additional flexibilityand access of online supplementary resources, research and evaluation studies mustgofurtherandinvestigateanyquantitativeorqualitativechangesinstudentlearning associated with an intervention. Whatever the researcher's epistemological positionortheir conceptionoflearning,it isinappropriatetoconflatestudents' attitudeswith theirlearningdevelopment.

Conclusions

In this article we critically appraise methods frequently used in educational research.We are not arguing that particular methods are inherently 'good' or 'bad'. Ourconcern has been to expose the often-implicit assumptions and limitationsunderpinning methods and to question the extent to which some conclusions aresupported by appropriate evidence. Whatever methods researchers employ theyshould be aware of the underpinning assumptions and limitations of their approachboth in relation to the design of the study and in any conclusions that can be drawnfrom the findings. Interpretations of research need to be cautious as researchmethods are not epistemologically neutral.Consideration must be given to theextent to which the findings and the design of the study may have been inherentlyinfluenced bytheresearchmethod.

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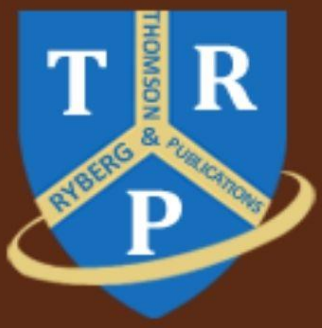

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