# CHAPTER 7

# The Potential of Simulation for Teacher Assessment

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## ABSTRACT

A teacher's classroom skills, attitudes, and behaviours are fundamental to excellent teaching. Assessing these qualities is a logistically difficult, costly, and at times, controversial task for teacher educators and school administrators. As a result, teacher hiring and subsequent professional development rely on indirect indicators that provide only limited evidence of a teacher's potential, strengths, and areas for improvement. Simulation techniques have been used as training and feedback tools for many years in occupations where live practice is dangerous, costly, or difficult to organize. Today's technologies are making simulations practical in new domains. In teaching they can provide practice settings, performance data, and feedback aimed at evaluating and improving a wide range of skills. Drawing from experience in medical and health education, this chapter outlines the potential for simulations to support both teacher hiring and in-service skills development, in order to support teaching excellence with new tools in the future.

*Keywords*: teacher hiring, hiring simulations, in-service skill development using simulations

## TEACHER HIRING PRACTICES IN CANADA

Schools are institutions dedicated to effective learning. A good teacher is the single most important factor in student learning, and hiring effective teachers is an essential responsibility for school leaders. When hiring, however, Canadian school administrators have little direct indication of teaching candidates' current skills or future potential for promoting student learning. Although Canada does not face US-style pressures for evidence-based educational practice, our schools could benefit from new tools for assessing and providing evidence of individual teaching abilities. If reliable, valid, and practical, these have the potential to improve both our hiring practices and our methods of evaluating teachers' abilities.

There has been little research on teacher hiring in Canada, but what does exist questions whether hiring practices lead to student learning success (Cranston, 2012b). Hiring is the responsibility of individual school districts, guided by policies and standards set by provincial governments (e.g., see Alberta Education, 1997; British Columbia Ministry of Education, 2012a; Make a Future, 2011). Each candidate must be provincially certified, either as a graduate of an accredited Canadian teacher education program or through an accepted application documenting international qualifications and experience. Certification establishes that the candidate is qualified for a teaching position. British Columbia, for example, promises that certified candidates "have

the necessary academic qualifications, teaching experience, and personal characteristics required to work with children" (British Columbia Ministry of Education, 2012b, par. 2).

A new teacher's application includes transcripts, recommendations, and practice teaching reports that give school administrators some indication of teaching experience and abilities. Aside from these documents, however, hiring appears to be largely based on interviews with individuals or teams of school administrators (Cranston, 2012b; Jang, 2011). If candidates have done their practicum at the school, administrators have some knowledge of their classroom performance; otherwise, direct assessments of classroom teaching skills are not used in the hiring process. At a time when there are so many more candidates than available positions, those who are hiring lack critical data that would help them to identify the most skilled new teachers.

Administrators' subjective judgments play a large part in hiring decisions; in studies of teacher hiring in Manitoba, eight school principals identified "fit" to the profession, school organization, culture, and existing staff as critical in new-teacher hiring (Cranston, 2012a), and interviews were seen as the most important information source (Cranston, 2012b). Issues with interviews are well-known (Cranston, 2012b; Judge, Cable, & Higgins, 2000), and "fit" can be a highly personal judgment. Cranston (2012a) questions whether hiring can be effective when it relies on criteria that may emphasize, even if subconsciously, administrators' biases and preferences rather than valid and reliable performance metrics. Other research has documented and questioned the lack of direct evidence in hiring of teaching skills and learning impact (Engel, 2013; Gargani & Strong, 2014; Maynes & Hatt, 2013; Metzger & Wu, 2008), since poor hiring diminishes schools' effectiveness. From a practitioner's perspective, Stewart (2012) agrees, arguing that a criteria-driven hiring process would help to ensure that new teachers are effective in supporting schools' future-oriented learning initiatives, such as personalized learning and new-technology integration.

A successful teacher has a combination of knowledge, attitudes, and skills including subject matter and pedagogical knowledge, supportive and caring attitudes, and skills in planning and managing classes with diverse student populations. These are often articulated as lists of specific competencies to be exhibited in planning, classroom teaching, student assessment, and relating to students. Since a teacher's classroom and relationship skills have been found to be keys to student achievement (Kane, Kerr, & Pianta, 2014; Stronge, Ward, & Grant, 2011), a process for directly evaluating these skills, rather than relying on second-hand evaluations, could provide valuable data for effective teacher hiring.

Classroom observation is the typical way to evaluate teaching skills. However, direct teaching observation poses significant obstacles as an assessment technique for teacher hiring. A class must be found for the teaching observation, and a candidate's teaching with an unfamiliar class is not likely to duplicate performance over time. More generally, for validity and reliability, clear and valid criteria must be set, raters must be trained to produce consistent results when observing the same class situation, and ratings must be controlled for the effects of differences in student characteristics and abilities (Whitehurst, Chingos, & Lindquist, 2015). To avoid bias from an individual rater and case, more than one rater should be used (Bill & Melinda Gates Foundation, 2013). Taking into consideration the design and validation of rating instruments, rater training, and observation and analytical logistics, putting into place an effective system for direct observation, while desirable, is daunting in a high-stakes situation such as hiring.

## TEACHER ASSESSMENT FOR PROFESSIONAL DEVELOPMENT

After hiring, classroom skills assessment can provide important ongoing feedback for teachers, both in their probationary periods (before tenure is granted) and throughout their careers for professional development. The Gates Foundation MET study (Bill & Melinda Gates Foundation, 2013) found that well-implemented classroom observation contributed significantly, and equally with student perception surveys and student achievement gains, to identifying effective teachers fairly and reliably. Further, Whitehurst et al. (2015), when considering teacher evaluation in the context of US federal education policy, recommend systematic classroom observation as part of a multiple-source rating system for teacher evaluation. Driven by research and education reform legislation, regular teacher performance assessment with classroom observation is increasingly common in the US. For example, the state of Pennsylvania requires yearly evaluation of all permanent teaching professionals, with 50% of ratings from classroom observation and practice models (Pennsylvania Department of Education, 2014).

In Canada, performance assessment for working teachers, as for new teacher hiring, is the responsibility of local school boards and governed by provincial legislation and collective agreements. At least one assessment is typically done for a probationary teacher before tenure is granted, but the practice is varied for tenured teachers, ranging from discretionary reviews on the request of an employee or administrator (e.g., Regina Public Schools, 2012; Vancouver School Board, 2006, p. 57), to a regularly scheduled, provincially-mandated process with implementation issues that have led to stress and resistance among teachers (Larsen, 2009). In addition to logistical and cost obstacles, then, classroom skills assessment for employed teachers in Canada faces organizational and political complications including resistance from teachers' unions and the need to comply with established collective-agreement practices.

Simulation-based assessment for hiring or professional development would face the same challenges. While addressing these issues is beyond the scope of this paper, the following discussion outlines ways in which simulations could, in the future, reduce practical and cost challenges associated with teacher assessment in Canada, making them practical and effective tools to improve our practices in both hiring and ongoing professional development.

## SIMULATIONS FOR PRACTICE, FEEDBACK, AND ASSESSMENT

Simulations have been widely used for many years for both training and assessment purposes in high-stakes situations such as medicine, aviation, military training, business management, and large-scale investing, where skill practice in real-world situations is dangerous, costly, or logistically difficult (e.g., see Drews & Backdash, 2013; Gaba, 2007; Lu, Hallinger, & Showanasai, 2014). Rather than having the goal of winning, as in a game, simulation participants take on roles, make decisions, take action, and experience the consequences of their acts without crashing a plane, killing a patient, decimating a client's investment portfolio, or traumatizing a vulnerable student.

A simulation is a simplified but accurate, valid, and dynamic model of reality implemented as a system (Sauvé, Renaud, Kaufman, & Marquis, 2007). A simulation allows users to encounter problem situations, experience the results of their decisions and actions, and repeatedly practice and modify their decisions without risking harm from bad decisions or ineffective actions. Simulations have numerous advantages as learning and training tools, including the ability to practice repeatedly,

practice in rare or risky situations, replicate scenarios with specific learning objectives, practice for longer periods than are available in real life, and clearly measure outcomes with validated scoring systems. For skills development, a simulation's outcome measures, combined with debriefing and reflection (Crookall, 2010), serve as feedback for a formative assessment cycle of repeated performance practice and improvement (Ferry et al., 2005, Girod & Girod, 2008).

In a summative assessment situation, the simulation must provide defensible evidence that desired learning objectives have been achieved and that assessment results predict performance in the applied environment (Andreatta & Gruppen, 2009; Mislevy, 2011; Salas, Rosen, Held, & Weismuller, 2009). If the summative assessment has a high-stakes outcome, such as professional certification or competitive hiring, it is important that the simulation has rigorous validity in the sense that it accurately measures what it is intended to measure in the context of the assessment objectives (Andreatta & Gruppen, 2009). It must also be reliable (produce consistent results) and practical in terms of cost and logistics.

There is a growing body of literature on simulations in preservice teacher education, citing their advantages for practicing skills in managing the classroom, teaching students with varying learning needs, and working with challenged learners (e.g., see Bradley & Kendall, 2014; Girod & Girod, 2008). As in other domains, reflection and repeated practice are keys to learning from simulations in teaching (Girod & Girod, 2006); simulation-based practice allows pre-service teachers to translate their theoretical knowledge into action through repeated trials (Carrington, Kervin, & Ferry, 2011) without harming vulnerable students, and it allows more practice time and variety than would be available in limited live practicum sessions (Hixon & So, 2009).

While teacher-training simulations are becoming more common, simulation use for assessment appears rare in Canadian teacher education and in school systems. However, established practices in other fields can provide us with useful examples and guidelines for simulation use in teacher assessment, and existing teaching simulation examples show potential for future development as assessment tools. The following sections outline three broad types of simulations that have great potential as assessment tools for Canadian schools, together with examples from medical and health education of how they are used for assessment.

## SITUATIONAL SIMULATIONS

Simulations have been categorized in many ways, based on their situations, tasks, disciplines, and supporting technologies (e.g., Alessi & Trollip, 2001; Bradley & Kendall, 2014; Georghiou, n.d.; Gredler, 2004; Maier & Grössler, 2000). Simulations involving role play and interpersonal interaction are called "situational simulations" by Alessi and Trollip and are particularly relevant to teacher training and assessment. As described by Lyons (2012):

> [A situational simulation] … could be a clinical scenario, a conflict situation or an emergency situation where the student makes decisions to respond to the situation and develops strategies to rectify the situation as they would do in real life contexts. The provision of a real life situation gives learners a sense of immediacy and involvement where time and the chosen response matter to the successful outcomes. (p. 4)

In medical and health education, situational simulations such as interactions with patients, crisis situations, emergency departments, and operating rooms are well established and researched as tools for training and assessment beyond technical skills. Situational simulations in teaching

often focus on planning, classroom management, or parent-teacher interaction – educational settings requiring users to exercise their knowledge, skills, and attitudes to achieve student learning or resolve conflicts.

Researchers and educators in medicine and the health professions have accumulated extensive research evidence and experience around the use of simulations for both teaching and assessment. Drawing on parallels between these domains and teaching, the following discussion builds on this evidence and experience to envision the potential for simulations as teaching assessment tools. Three broad types of situational simulations are included: scenario/ role-play simulations, standardized students, and computer-based clinical simulations.

## Scenario/ Role-play Simulations

A scenario/ role-play simulation asks the student to assume a role and perform tasks in that role, such as diagnosing an illness (as a physician) or handling a series of tasks (as a business manager). The scenario is presented on paper, in a video, or digitally on a computer, smart device, or online. The student may have enough initial knowledge to complete the tasks or may have to engage in research to gather needed information. The scenario might play out following a branching tree logic based on the user's decisions or a linear scenario in which the user simply describes sequential actions. A variation is the "in-basket" exercise (Stearns, Ronald, Greenlee, & Crespy, 2003), in which the student takes on a role where they are presented with a collection of memos, documents, and requests that require setting priorities and handling multiple tasks. This requires effective communication with others in limited time. In-basket exercises are often used in management, public-sector, and educational recruiting to test the skills of potential managers and school leaders (e.g., see Schroffel, 2012).

In teacher education and assessment, scenario/ role-play simulations are used extensively for training but less frequently in skills assessment and hiring. Niemeyer, Johnson, & Monroe (2014), citing Mississippi Teacher Corps. (2012), argue for classroom role-plays for training alternate-route teachers (those with nontraditional training). They list 21 relevant scenarios for teachers involving single and multiple students, administrators, and parents, both inside and outside the classroom. In one hiring application, Stanford University uses an office-hour simulation to screen potential second-language teaching assistants for their language fluency and communication skills (Stanford University, 2014).

Citizen Schools (www.citizenschools.org), a US organization that provides enrichment teaching in low-income schools through trained tutors, uses "job simulation activities" (JSAs), a form of in-basket exercise, as part of a multi-stage hiring process that also includes a background review, a screening test, and interviews. JSAs introduce Teaching Fellow candidates to the organization's work environment and provide data on candidates' work styles, critical thinking skills, and overall project approaches (Citizen Schools, 2015a). For a JSA, a candidate takes on a role and prepares a lesson plan based on a scenario description, email correspondence, records of student backgrounds and learning needs, with additional feedback from hypothetical previous classroom observations (Citizen Schools, 2015b).

In medicine and health care, the main form of scenario/ role-play simulations is problem-based learning (Barrows & Tamblyn, 1980). Case-based learning is sometimes regarded as a separate approach (Srinivasan, Wilkes, Stevenson, Nguyen, & Slavin, 2007) but is included for the purposes of this discussion. There are many styles of problem-based learning, ranging from

short single-paragraph cases used in residency and continuing medical education, to long cases requiring several pages that are used in the first and second year of medical school. Depending on the instructional goals and the student's prior knowledge, the case may demand anywhere from quick judgments to in-depth, multi-stage reasoning and research. Cases that simulate actual patient problems are used for training in diagnosis and clinical reasoning, as well as for assessment by many professional bodies (e.g., in Part 2 of the Medical Council of Canada Qualifying Examination).

A variety of methods has been used for PBL assessment (Miller, 2014). These assess students in various formats, such as the triple jump format, which is effective for measuring skills in analysis, critical thinking, and problem resolution (Navazesh, Rich, Chopiuk, & Keim, 2013). In this format, the student meets with the examiner and is presented with a case. After a question and answer session with the examiner about the student's existing knowledge and planned reasoning (first jump), the student does library research for a designated time to find needed information to resolve the case (second jump), and then returns to the examiner for a final oral session presenting their solution or management plan (third jump). A variation of this method used in diagnosis cases is called the "quadruple jump," in which a fourth step is added that requires the student to consult a clinician for expert advice.

## Standardized Students

In teacher education and assessment, a type of simulation called an Objective Structured Teaching Exercise (OSTE) (Boillat, Bethune, Ohle, Razack, & Steinert, 2012; Sturpe & Schaivone, 2014) is set in a classroom with one or more people trained to play the roles of students with individual behaviours, learning characteristics, and possibly special needs. The simulated students are trained in advance to act and respond in particular ways, and the student, playing the teacher role, must manage the situation. So far used only for teacher training, the OSTE consists of a teaching scenario involving a simulated learner. Immediate feedback is given to the teacher based on a pre-determined behaviourally-based scale or assessment checklist. A natural extension of this approach would be to set up a simulated classroom with more than one student and to run a more realistic OSTE. However, due to the high cost of doing this, the simulation field has moved towards computer-based classroom simulations, described below.

In a similar approach, eduSIMS (http://edusims.syr.edu) are simulations for pre-service teachers and school leaders (Dotger, 2009; Dotger & Alger, 2012; Dotger & Smith, 2009). These simulations move scenarios out of the classroom to teach communication and management skills through simulated interactions with standardized parents, students, paraprofessionals, and community members. To quote the eduSims web site:

> Each simulation centers on a problem or issue that teachers and leaders commonly encounter in daily practice – academically struggling students, parents with concerns over discipline or curricula, teacher or leader ethical dilemmas, school bullying/harassment, drug/alcohol abuse, and fully including students with dis- abilities. The standardized individual is carefully scripted to present a distinct problem of practice, but the teacher or leader is not scripted at all, and must utilize professional knowledge and skills to address the question, concern, or issue presented within the simulation. (eduSIMS, 2015, par. 2)

Each simulated conference is captured on video and used for post-simulation feedback and debriefing.

The Objective Structured Clinical Examination, referred to as the OSCE, is used extensively

in medical and health care education for both practice and final assessment of clinical and interpersonal skills. For example, Part 2 of the Medical Council of Canada Qualifying Examination is run as an OSCE. In the OSCE, actors (professional or amateur) are used to simulate patients with certain conditions. These people are called standardized patients because several of them are trained together in advance to simulate a particular situation in a similar fashion and to respond to questions or maneuvers in the same way. At an OSCE "station," students are given a task to perform in a specific time period, such as taking a history, performing a physical examination, or giving bad news. An expert assessor is usually present with a predetermined checklist to assess the student, although this is sometimes done later using a video recording of the interaction. Shorter OSCEs (e.g., five stations) are used for training and feedback, while longer ones (12 or more stations) are typically used as part of a high stakes examination to increase validity and reliability (Kahn, Gaunt, Ramachandran, & Pushkar, 2013; Pell, Fuller, Homer, Roberts, 2010). OSCEs have also been used for admissions screening to assess candidates' interpersonal skills (Eva, Rosenfeld, Reiter, & Norman, 2004).

## Computer-based Clinical Simulations

Advancing technological capabilities have resulted in widespread computer-based simulation use in medical and health education (Issenberg, McGaghie, Petrusa, Gordon, & Scalese, 2005). With computer-based simulated patients, for example, the user works through the steps for the simulated medical case from history-taking to physical examination to laboratory tests to diagnosis. In some cases, management of the patient's condition is required. These cases might use multimedia to present the patient and allow the user to perform virtual maneuvers on the patient. They are so well developed that users receive detailed feedback on their performance, such as whether they were efficient, systematic, and cost-effective (Melnick, 1990). Computer-based simulated patients are used in a number of medical certification exams (Boulet, 2008).

Like simulated patients in medicine, computer-based classroom simulations are being used with growing success for teacher education. The Cook School District simulation, for example (http://cook.wou.edu), is designed to support pre-service teachers in their practice of connecting teaching and learning (Girod, Girod, & Denton, 2007). The simulation animates the Teacher Work Sample Methodology (TWMS) (Girod, 2002), which dates from the 1970s and models in detail connections between teacher actions and student learning. Originally used in the context of a real field experience with real students, TWMS requires a student to define and defend learning goals, pedagogical approaches and lesson plans, along with pre- and post-tests, analysis of results and student learning gains, and reflections on connections among teaching, student learning, and personal professional growth (Girod & Girod, 2006). The simulation provides a practice setting with simulated students that are based on real students (taken from the experience of former classroom teachers). Users are able to repeat and modify their teaching strategies and plans in a variety of grade levels and content areas. Interaction is in the form of choices, with feedback provided through documents and reports. Cues, prompts, and personal notes encourage reflection during and following the simulation, and feedback is provided through impact of user decisions and actions on student learning. The TWS methodology is used for assessing teacher performance at about 30 US institutions that are part of the Renaissance TWS Group (http://www.wku.edu/rtwsc/), although the simulation itself is used only for practice of TWS skills.

ClassSim, an online simulation, provides users with a place to practice lesson structure, classroom management, and responding to students, particularly those with special needs (Ferry

et al., 2004, 2005). The simulation operates through a series of virtual episodes in a kindergarten class setting with decision points for the teacher. Learning is supported with materials, online links, and a reflection space. ClassSim has been shown to contribute to the development of pre-service teachers' professional identities and to their skills in connecting theory to real-life practice (Carrington et al., 2011).

More recent simulations attempt to reproduce the experience of working in a classroom setting more fully. Probably the most fully developed fully-computerized classroom simulation, simSchool, is a web-based simulation designed to offer practice experiences for pre-service teachers (Badiee & Kaufman, 2014; Christensen, Knezek, Tyler-Wood, & Gibson, 2011; Gibson, 2007). SimSchool uses screen shots of a classroom seen from the teacher's position at the front of the room. The class is populated by up to 20 students represented as cartoon characters, with a vast range of possible appearances (randomly generated), cognitive abilities, and personalities, including ESL and autistic; based on a model of cognition, personality and communication theory, the simulation dynamically generates learner behaviours in response to teacher actions chosen from lists of possibilities. Although it is relatively low-fidelity on the surface, evaluation results have shown it to be valid for pre-service teachers to practice instructional activities (Deale & Pastore, 2014). Gibson & Halverson (2004) documented initial research on its suitability for pre-service teacher assessment.

Rather than attempt to reproduce a classroom fully in virtual reality, TLE TeachLivE (http://teachlive.org) uses a "mixed reality environment" that blends real and synthetic content. Because suspension of disbelief (i.e., belief that the simulated environment is in some sense "real") is important for learner engagement in a simulation (Dede, 2009), users teach in a physical classroom environment (the TLE TeachLivE Lab) or using a mobile TV cart, and the simulated students are avatars operated as puppets by a trained human (Dieker, Rodruiguez, Lignugaris/ Kraft, Hynes, & Hughes, 2014). Classroom scenarios can be set up to teach specific skills and behaviours, and the system enables repeated practice. It is now in use at 48 US universities; in addition to teaching a wide range of general classroom management skills, it has been successfully used to train teachers of special-needs learners including severely autistic students (Dieker et al., 2014). The puppetry approach allows a wider range of learner behaviours to be modeled without the need for full psychometric computational models.

## LOOKING INTO THE FUTURE

The above examples reflect current simulation technologies, but rapid advances give us glimpses into additional possibilities. For example, Gibson (2013) suggests assessment using cloud-based simulations on mobile devices, offering new ways of reaching users, modeling student behaviours, and conducting large-scale data collection and analysis. The recently announced Microsoft HoloLens, a VR headset supporting augmented reality (Bailey, 2015) suggests the idea of realistic student avatars in any classroom or office setting. TLE TeachLivE researchers envision highly personalized simulation environments, making simulated teaching environments ever more individual, believable, and immersive (Dieker et al., 2014).

## MOVING FROM TEACHING TO ASSESSMENT

These examples show that simulations are becoming well established as tools for pre-

service and practicing teachers to augment practicum experience; practice and develop new classroom, management, and interpersonal skills; and in some cases assess existing skills and attitudes in support of candidate screening or hiring. Formative assessment through a cycle of practice, feedback, reflection, and repeated practice is a common aspect of these simulations.

Experience in medical and health education, shows the hurdles to be overcome in order for simulation-based teaching assessment to be widely accepted. Extending simulation to summative assessment requires defining the skills to be measured, choosing appropriate simulation tasks, developing appropriate metrics, assessing the reliability of test scores, and providing evidence to support the validity of test score inferences (Boulet, 2008). Each of these demands rigorous research and analysis when the consequences of decisions based on simulation data are important, as for medical licensing. Implementing assessment simulations also requires extensive training and strong administrative practices to ensure assessment consistency and validity (Furman, Smee, & Wilson, 2010). For technical and practical reasons, high-stakes teacher assessment is clearly not likely to arrive overnight.

As mentioned earlier, political considerations can add additional difficulties for implementing high-stakes simulation-based assessment. Any new form of assessment is likely to encounter resistance when it changes existing norms or appears to challenge existing power structures; this is a significant issue in the Canadian education system, where collective agreements largely govern current practice. In addition, the decentralized nature of our school systems makes it more difficult to implement widespread changes in existing practices.

Still, the potential of simulations to strengthen our school hiring and teacher development shows promise. Future research, as well as practical initiatives, are geared toward improving our teacher hiring and continued development. Perhaps the most practical suggestion, from the Bill & Melinda Gates Foundation (2013), is to use multiple sources for teaching quality assessment. Simulations could then become one in a set of tools contributing to school improvement by providing better evidence for assessing teachers' competencies and their impact on student learning.

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