

## Simulation-based learning: how can be used to prepare teacher?

Aprendizagem baseada em simulação: como pode ser usada para preparar o professor?

Sevgi Turan<sup>1</sup>

**Abstract:** Simulation is a central role especially in health science education and it is expected that it will increase as social, legal, educational and technological changes proceed. Although simulation has been used widely in health science education for a long while, it has limitedly used in teacher preparation and education. Simulated teaching environments have the potential to create experiment for teachers. In simulated environment, prospective teachers may be able to practice teaching skills. In this study, it is aimed to review the purpose and evidence for the utility of simulation in teacher education. Original articles and review articles related to simulation in training teaching skills with key words such as “simulation”, “simulation-based education”, “classroom simulation”, “teacher education”, “teacher preparation”, “prospective teachers” and “pre-service teachers” via “Academic Search Complete”, “ERIC”, and “PsycARTICLES” databases were searched. Articles, investigated training of teaching skills in undergraduate teacher education was reviewed and discussed. Most research indicates that simulations lead to significant improvements in the teaching skills of students. It was seen that there were a large body of theoretical study on the benefits of simulations in education but relatively little experimental or interventional research on the benefits or difficulty of using simulations in teaching skills.

**Keywords:** Simulation; Simulation-based education; Teacher education; Prospective teacher.

**Resumo:** A simulação é um papel central, especialmente no ensino das ciências da saúde e espera-se que ela aumente à medida que as mudanças sociais, jurídicas, educacionais e tecnológicos continuam mudando. Apesar de a simulação estar sendo amplamente utilizada no ensino das ciências da saúde, por um longo tempo, ela ainda é usada limitadamente na preparação e formação de professores. Ambientes de ensino simulados têm o potencial de criar experiência para os professores. Em ambiente simulado, os futuros professores podem ser capazes de praticar habilidades de ensino. Neste estudo, pretende-se avaliar o propósito e evidências para a utilidade da simulação na formação de professores. Artigos originais e artigos de revisão, relacionados à simulação na formação de habilidades docentes foram pesquisados nos bancos de dados da *Academic Search Complete*, *ERIC* e *PsycARTICLES*. As palavras-chave usadas foram "simulação", "educação baseada em simulação", "simulação em sala de aula", "formação de professores", "preparação de professores", "candidatos a professores" e "pré-professores em serviço". Artigos que investigaram a formação de habilidades de ensino durante a

---

<sup>1</sup> Associate Professor, Hacettepe University Faculty of Medicine Department of Medical Education and Informatics, Turquia. Endereço eletrônico: [sevgigunalaturan@gmail.com](mailto:sevgigunalaturan@gmail.com)

graduação de professores foram revistos e discutidos. A maioria das pesquisas indica que simulações levam a melhorias significativas nas habilidades de ensino dos futuros professores. Verificou-se que havia um grande corpo de estudo teórico sobre os benefícios de simulações em educação, mas relativamente pouca pesquisa experimental ou de intervenção sobre os benefícios ou dificuldades de usar simulações em habilidades de ensino.

**Palavras-chave:** Simulação; Educação baseada em simulação; Formação de professores; Professor prospectivo.

## **1. Introduction**

Academic and social activities are indisputably influenced by technology in 21st century life. In education field, technology provides possibilities for innovative and effective learning opportunities (HERRINGTON; HERRINGTON, 2006). The increasing trend of using the technology enables the educational institution to offer professional development and training beyond traditional face-to-face settings in order to facilitate more authentic and innovative teacher training (KIM; BLANKENSHIP, 2013). One of the methods used for this purpose is simulation.

Simulation is used in education to replace real experiences with guided experiences that evoke or replicate aspects of the real world. Simulation is described as an imitation of key characteristics of real events, situations or procedures (GIROD; GIROD, 2008). Simulation is a central role especially in training of airline pilots, health science professional, which allow trainees to model situations and practice skills in a risk free environment. Business and management training is other area that widely used simulation (DE JONG; LANE; SHARP, 2012).

Simulation has been proposed as a technique to close the gap between the classroom and the real environment. The key feature of simulation is that it creates real-life like environments (CRUI; CKSHANK; METCALF, 1993). Tasks, relationships, phenomenon, equipment, behavior or some cognitive activities can be simulated. Simulation is usually preferred when the real events are dangerous, expensive or potentially harmful. Simulation can provide safe opportunities for novices to practice and improve their skills (DE JONG; LANE; SHARP, 2012).

In teacher education, field experiences have been viewed as an important learning context for teachers to develop effective teaching skills (FOLEY; MCALLISTER, 2005). Most of the teacher education programs are used real classrooms to prepare teacher candidates

to work in classroom and experience teaching skills. The classroom encountered in the field experience is a vehicle for teacher candidates to learn from children and teachers. However before encounter in a real environment, teacher candidates should be prepared for it. Filmed lessons, microteaching, and simulation can be utilized for this purpose in teacher education programs. These methods provide opportunity for experience to the more complex school situations. Although simulation has been used widely in education for a long while in variety field, it has limitedly used in teacher preparation and education. But simulated teaching environments have the potential to create experiment for teachers. In simulated environment, teacher candidates may be able to practice teaching skills.

Safety is the most important reason for the dissemination of simulation usage in education. While experiencing real environment ethical problems might occur. Teacher candidates might not teach effectively and make content errors or have classroom management difficulties. But in a simulated environment teacher candidates can make mistakes without impacting real students, and they can repeat the experience (DIEKER, *et al.*, 2008). The simulated environment might be help teacher candidates to understand effective instruction without unintended negative impact on students. Besides, finding the proper schools for the teacher candidates and cooperative teachers who help the teacher candidates are challenging issues in teacher education, and reasons for preference of simulation in teacher preparation (JIYOON, 2008). On the other hand, using simulation for teacher education has some limitation such as difficulties of imitation of real educational environment and the cost of the simulation technology.

Beyond improvement of teacher candidates teaching skills, new generation is exposed to and expects that technology will be part of daily life. These expectations create a gap between those who are students in today's schools and those who teach this generation of learners (DIEKER, *et al.*, 2008). It is recommended that teachers should understand the variety of programs that students are currently using in order to partner with them effectively for meaningful and relevant instruction (KIM; BLANKENSHIP, 2013). Wider gap is also possible between higher-education professionals who are preparing future teachers to serve next generation students (DIEKER, *et al.*, 2008). Therefore using simulation technology might help to narrow the gap between today's digital natives and former generations. Accordingly, simulation in teacher training can provides experience to pre-service students in

instructional experiences, and also acquaintance with the virtual environments inhabited by today's students (KIM; BLANKENSHIP, 2013)

Simulations have been used for both instruction and assessment. Low-fidelity and high-fidelity resources have been used successfully for many years. In health science education, manikins, computer-assisted resources or simulated patients/persons might be used during to simulation. Similarly, simulations have been used in teacher preparation using films, role-playing experiences, card games, and computer based activities (GIROD; GIROD, 2006). In early years in simulation pictures, films, role playing were mostly preferred. After the development of computer technology, complex and interactive simulations of teaching and learning in virtual environment were replaced with it.

In virtual environment, the simulation is designed to serve as a "virtual practicum" that develops teacher preparation programs by supporting the development of teaching skills prior to field experience in real classrooms. The Sim-School, TeachME (Teaching in a Mixed Reality Environment) and Cook School District simulation are example of using virtual reality for development of teaching skills. Sim-School is a classroom simulation program that immerses novice teachers in some of the complexities of teaching (ZIBIT; GIBSON, 2010), which is provided a framework for students to contextualize curricular decisions, differentiate instruction, and reflect on their practice (FOLEY; MCALLISTER, 2005). Similarly, TeachME is aim to help teachers to improve their skills with virtual children (DIEKER, 2008). Another web-based simulation is the Cook School District simulation. In Cook School District teacher candidates can be practiced and received feedback regarding their progress in connecting teaching and learning using the teacher work sample methodology process (GIROD; GIROD, 2006).

Use of simulation for teachers' preparation increased and changed over time since the 1960s. Technology-driven teaching methods including simulation in teacher education are expected takes place more commonly in the future. Therefore it is important to evaluate the effectiveness of simulation in teacher education. In this study, it is aimed to review the utility of simulation in teacher preparation and seek evidence for effectiveness of using simulation in teacher preparation. The review questions were:

- How can be the simulation utilized for training teaching skills?
- What is the effectiveness of using simulation for improving teaching skills?

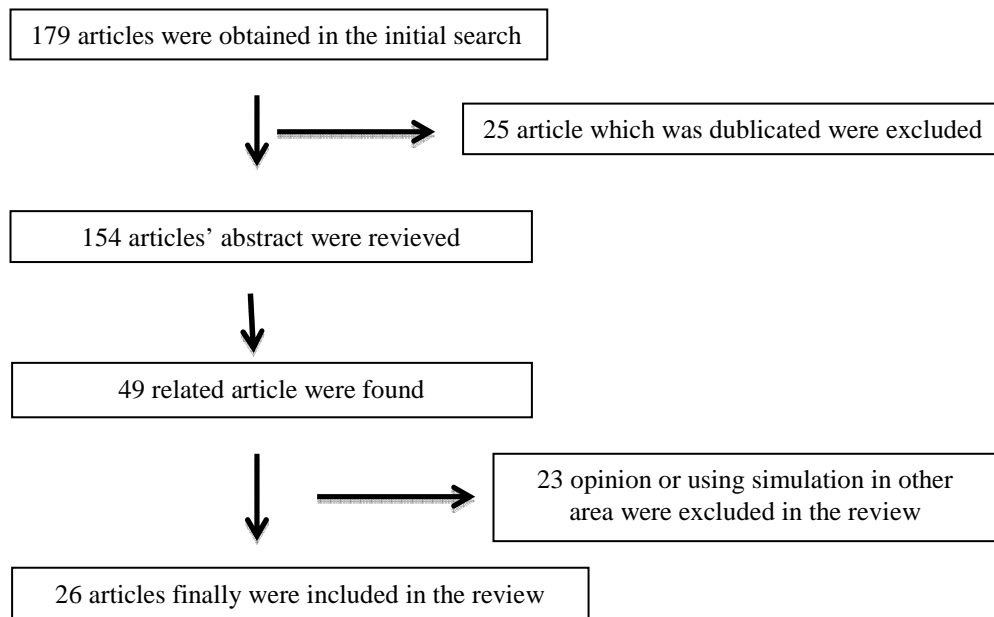
## 2. Method

A systematic review of the literature on use of simulation for training teaching skills was conducted. The search was covered three databases: “Academic Search Complete”, “ERIC”, “PsycARTICLES”. These databases were searched using the terms with search modes “subject term” or “title” in all years:

- “Simulation-based education and “teacher education” or “prospective teachers” or “pre-service teachers” or “preservice teachers”
- Simulation-based learning and “teacher education” or “prospective teachers” or “pre-service teachers” or “preservice teachers”
- “Simulation-based teaching and “teacher education” or “prospective teachers” or “pre-service teachers” or “preservice teachers”
- “Classroom simulation” and “teacher education” or “prospective teachers” or “pre-service teachers” or “preservice teachers”.
- “Simulation” and “teacher preparation” or “teaching skills” or “prospective teachers” or “pre-service teachers” or “preservice teachers”

Search of databases resulted sum of 179 articles. Articles first were classified by their title and 25 duplicated articles were identified. After these articles excluded there were 154 articles in the study. All the abstract of articles were read and reviewed whether it was related to research questions. Studies which handled using simulation for teaching skills training or investigated using simulation methods for improving teaching skills in undergraduate teacher education were included in the study. There were 49 studies after this review step. But 23 studies were found focusing on description of a simulation trial in other subjects in teacher education or opinion of using simulation in teacher education. After excluding the opinion studies 26 articles were obtained finally.

**Figure 1 - The steps of the review**



Fonte: A autora.

### 3. Results And Discussion

There were 49 articles about teacher preparation. However 23 of these studies were found focusing on description of a simulation trial in other issues of teacher education or opinion of using simulation in teacher education. These studies were discussed the use of simulations as an educational approaches, gives some example of using simulation other than teaching skills such as special education, describe virtual environment instruments or interactive video simulation, using video simulation for teachers' self-assessment or teacher evaluation, using simulation for pre-service teacher assessment, describes the use of simulation for hiring new faculty, perceptions of pre-service teachers using games in classroom. As these articles were not focused developing teaching skills directly, they were excluded in the review.

There were 26 articles mainly focused utilize simulation for teaching skills training or investigated using simulation methods for improving teaching skills in undergraduate teacher education. The design types of the obtained studies were: 13 experimental studies, 5 design and pilot studies and 8 simulation intervention but used other types of research design (case, survey and qualitative studies) (see Table 1, Table 2 and Table 3 in attachment). There

were developmental trend in using simulation methods in parallel to technological development. Accordingly the included studies were presented and discussed in two sequences: early years in simulation and computer based simulation.

#### *Early years in simulation-based learning*

There were evidence of the use of simulation to be developed teaching skills in the 1960`s and early 1970`s (BOND, 1965; KERSH, 1966; TWELKER, 1968; GARRISON; KERSH, 1969; BEALS, 1970; LESNIAK, 1970; DOYLE; GREGORY, 1975). These studies were used printed materials, pictures, films or role-play and microteaching methods as a simulation technology. Though simulation is described as an imitation of key characteristics of real events, situations or procedures (GIROD; GIROD, 2008) it is realistic to use these instructional materials and methods to train students. Although using these material is limited in simulating real events these studies are innovative to implement the new methodologies in teacher education.

The experiment and measured variables were differed throughout the studies. But only two of six studies carried out before 1979 were reported no significant differences between the treatment groups. Both studies were investigated change in attitudes. Bond (1965) assessed educational majors' attitudes and found no significant differences between the treatment groups. Beals (1970), similarly, assessed attitude with Minnesota Teacher Attitude Inventory, and besides pre-post seminar data on response to simulated classroom situations (teaching performance) of student teachers and reported no significant differences in using simulation. All other studies carried out before 1979 were reported positive findings. Twelker (1968) found that students receiving simulation training spent more time in stimulation and management behaviors. Doyle and Gregory (1975) applied microteaching and indicated that teachers might acquire, practice, and learn to use technical teaching skills functionally through microsimulations. Kersh (1966) investigated different style of picture in simulation. In other study with Garrison (GARRISON; KERSH, 1969), they examined the effectiveness of two different forms of the Classroom Simulation Test-- based on motion picture and found difference in advantage of using supporting test data. It is seen that most of the studies carried out before 1979 were in the initial phase of using simulation and not focused training and assessment of teaching skills with simulation comprehensively.

#### *Computer-based simulation years*

Technologies used in simulation in teacher education were seen changed after 1980. Use of computers in simulation was common in these years. Virtual reality was re-placed with basic computer programs over years. There were seven experimental, seven descriptive (case studies, survey or qualitative studies) and five design and pilot studies (19 in totals) focused on simulation in teaching skills after 1980.

Similarly in earlier studies, the experiment and measured variables were differed throughout the studies. One of the first study was conducted by Strang, Landrum and Lynch (1989) and investigated task realism and clear, immediate post-teaching feedback in simulation. It was reported that task realism and clear, immediate post-teaching feedback were significant contributors to the simulation's training success. The study of Yeh (2004) focused computer simulation for teaching general critical-thinking skills and reported that this simulation is an effective vehicle for improving pre-service teachers' reflective teaching in critical-thinking instruction. In later study Yeh (2006) was investigated relationship between intrapersonal intelligence, teaching efficacy in critical-thinking and judicial thinking style in using same computer simulation. Lee and Powell (2005; 2006), studied with early childhood pre-service teachers and found that integrating technology-based simulations into pre-service teacher education programs could influence solving discipline problems in real classrooms by helping pre-service teachers construct their own beliefs and philosophy about discipline.

Passig and Moshe (2008) investigated effectiveness of virtual reality technology on the level of awareness of test-anxiety and found difference in favor of 3D immersive simulation group. Girod and Girod (2006) tested a web-based simulation -Cook School District- and stated the efficacy of the simulation to improve field-based lesson teaching performance, and affect users' perceptions of their skillfulness. They also piloted Cook School District for investigating simulation users' abilities to analyze hypothetical teaching scenarios, interviews, and reflective writing. They indicated that simulation help candidates become more aware of, and able to perform, several critical skills necessary to effectively connect teacher actions to the learning of each student (GIROD; GIROD, 2008).

The Sim-School which is a classroom based simulation that integrates an interactive website in which pre-service teachers become faculty members in a K-12 low-income diverse school were also investigated. In this simulation, students experience pre-service education courses through a hands-on approach in which they must apply to a school, receive a classroom with simple profiles of their students, and then complete a series of assignments as



a member of a grade level team and school faculty (FOLEY; MCALLISTER, 2005). McPherson, Tyler-Wood, McEnturff and Peak (2011) were examined effectiveness of SimSchool- and found that students who participated in the teaching simulation scored higher on the teacher preparation survey and valued simulations.

In other design research Ferry and Kervin (2006) trailed an online simulation and reported that online simulation provides pre-service teachers with time to think critically about complex classroom situations. Recent researches on simulation designed and piloted simulation created with Second Life (MAHON, *et al.*, 2010; BROWN, DAVIS; KULM, 2011; GREGORY; MASTERS 2012). These studies were indicated that the students found the simulation to be a useful learning experience and could provide rich settings for teacher development.

There were also qualitative and case studies that investigated utility of the simulation in teaching skills. All of these studies were reported positive aspects of using simulation in training teaching skills: in providing learning context to struggle with key questions around working with students from diverse linguistic and cultural backgrounds (FOLEY; MCALLISTER, 2005), enjoyment of participants (LOPER, 1985), enhanced the professional identity (CARRINGTON, KERVIN; FERRY, 2011), in training teachers to work on a collaborative team (MASON, 2011) and emphasize the importance of simulation on teachers being able to self-regulate their emotions as a professional responsibility (DE JONG; LANE; SHARP, 2012)

#### **4. Conclusion**

Teacher education faculties are working hard to design learning experiences to assist teacher candidates (GIROD; GIROD, 2006). Despite these efforts to create teaching experiences, most pre-service teachers complained that they inadequately prepared. Simulation as a pedagogy was proposed that it might be a powerful tool in this regard. Simulation provides an opportunity to demonstrate links between theory and practice to pre-service teachers and prepare them to the practice.

In this review study, it was seen that pictures, films, role playing mostly preferred in early years in simulation and complex and interactive simulations of teaching and learning in virtual environment replaced with it after the development of computer technology. Most

research indicates that simulations lead to significant improvements in the teaching skills of students. However, as Teoh (2011; 2012) stated although there is a large body of theoretical study on the benefits of simulations in education but relatively little experimental or interventional research on the benefits of using simulations in teaching skills. There is also the lack of consistency in the terms used among researchers in the field.

Simulation can provide opportunities to train and assess pre-service teachers' professional ability. An adaptation of microteaching with simulation widely has been used in health science education (MOTOLA, 2013). However there was any study in discussing using this method in supporting teacher candidates teaching skills. There is need to investigate further on effectiveness of using variety of simulation methods in teacher preparation.

## REFERENCES

BEALS, P. E. **Classroom simulation as a substitute for live pre-student-teaching laboratory experiences.** Paper presented at the annual meeting of the American Educational Research Association, Minneapolis, March 1970. (ERIC Number ED 037401). Retrieved from <http://eric.ed.gov/?id=ED037401>.

BOND, J.H. Using simulation techniques to change attitudes of education majors toward professional course objectives. Oregon State System of Higher Education, Monmouth. **Teaching Research Div.** 1965. (ERIC Number ED 037401).

BROWN, I. A., DAVIS, T. J., KULM, G. Pre-Service teachers' knowledge for teaching algebra for equity in the middle grades: a preliminary report. **Journal of Negro Education**, v. 80, n. 3, 2011. p.266-283.

CARRINGTON, L., KERVIN, L., FERRY, B. Enhancing the development of pre-service teacher professional identity via an online classroom simulation. **Journal of Technology and Teacher Education**, v. 19, n. 3, 2011. p. 351-368.

CRUICKSHANK D.R; METCALF K.K. Improving preservice teacher assessment through on-campus laboratory experiences. **Theory into Practice.** v. 32, n. 2, 1993. p. 86-92.

DE JONG, T., LANE, J.; SHARP, S. The efficacy of simulation as a pedagogy in facilitating pre-service teachers' learning about emotional self-regulation and its relevance to the teaching profession. **Australian Journal of Teacher Education**, v. 37, n. 3, 2012. Article 4.

DIEKER, L. HYNES, M. HUGHES, C.; SMITH, E. **Implications of Mixed Reality and simulation technologies on special education and teacher preparation. Focus on Exceptional Children.** 2008 Retrieved from <http://www.highbeam.com/doc/1G1-191479838.html>.

DOTGER, S., DOTGER, B.H.; TILLOTSON, J. Examining how preservice science teachers navigate simulated parent–teacher conversations on evolution and intelligent design. **Science Teacher Education**, 94, 2010. p. 552-570.

DOYLE J.; GREGORY, J. W.A. **Cluster of technical teaching skills—acquisition through microsimulation and evaluation through microteaching.** Florida University, Gainesville. Inst. for Development of Human Resources. 1975.

FERRY B.; KERVIN L. Applying synchronous methods during the development of an online classroom-based simulation. **Campus-Wide Information Systems**, v. 23, n. 3, 2006. p. 149-158.

FOLEY, J.A.; MCALLISTER, G. Making it real: Sim-school© a backdrop for Contextualizing Teacher Preparation. **AACE (Association for the Advancement of Computing In Education Journal) Journal**, v. 13, n. 2, 2005. p159-177.

GARRISON, J. H.; KERSH, B. Y. **The comparison of two forms of a classroom simulation test designed to enhance future teachers' self-definition and teaching style.** Final Report. Oregon Coll. of Education, Monmouth. Office of Education (DHEW), Washington, D.C. Bureau of Research. BP-9-I, 033Oct 690EG-9-9470033002127p. 1969.

GIROD M.; GIROD G. Exploring the efficacy of the Cook School District Simulation. **Journal of Teacher Education**, v. 57, n. 5, 2006. p. 481-497.

GIROD, M. ;GIROD, G.R. Simulation and the need for practice in teacher preparation. **Journal of Technology and Teacher Education**, v. 16, n. 3, 2008. p. 307-337.

GREGORY S. ; MASTERS Y. (). Real thinking with virtual hats: A role-playing activity for pre-service teachers in *Second Life*. **Australasian Journal of Educational Technology**, v. 28 (Special issue), n. 3, 2012. p.420-440.

HERRINGTON, T.; HERRINGTON, J. **Authentic learning environments in higher education.** Information Science Publishing. Australia. 2006.

JIYOON, Y. Cyber practicum: A future practicum classroom. **British Journal of Educational Technology**, v. 39, n. 1, 2008. p. 163-165.

KERSH, B. Y. **Classroom simulation--a new dimension in teacher education. Final report, National defense education act of 1958.** Oregon State System of Higher Education, Monmouth. (Project number 886). 1966.

KIM D.; BLANKENSHIP R.J. Using *second life* as a virtual collaborative tool for preservice teachers seeking English for speakers of other languages endorsement. **Journal of Educational Computing Research**, v. 48, n. 1, 2013. p.19-43.

LEE S. ; POWELL J.V. Using computer-based technology to determine emergent classroom discipline styles in preservice teacher education. **Journal of Educational Technology Systems**, v. 34, n. 1, 2005-2006. p.83-110.

LESNIAK, R.J. **A method for the selection and diagnosis of fifth year urban teaching interns**. Pennsylvania State University. 1970. (ERIC Number ED 039187). Retrieved from <http://eric.ed.gov/?id=ED039187>.

LOPER, A. B., STRANG H.R., RICHARDS F.; BADT K. Use of a microcomputer-based simulation to enrich teacher training. **Educational Technology**, v. 25, n. 12, 1985. p. 36-37.

MAHON J., BRYANT B, BROWN B.;KIM M. Using Second Life to enhance classroom management practice in teacher education. **Educational Media International**, v. 47, n. 2, 2010. p. 121–134.

MASON, L. L. **A functional assessment of the use of virtual simulations to train distance preservice special education teachers to conduct individualized education program team meetings**. Ph.D. Dissertation, Utah State University, 2011.

MCPHERSON, R., TYLER-WOOD, T., MCENTURFF E.A.;PEAK, P. Using a computerized classroom simulation to prepare pre-service teachers. **Journal of Technology and Teacher Education**, v. 19, n. 1, 2011. p. 93-110.

MOTOLA, I., DEVINE, L.A., CHUNG, H.S., SULLIVAN, J.E.; ISSENBERG S.B. Simulation in healthcare education: a best evidence practical guide. AMEE Guide n. 82. **Medical Teacher**, v. 35, n. 10, 2013. p. 1511-30.

NELSON, M. M. **Approximations of practice in the preparation of prospective elementary science teachers**. Dissertation, University of Michigan. 2011.

PASSIG D.; MOSHE R. Enhancing pre-service teachers' Awareness to pupils' test-anxiety with 3D immersive simulation. **Journal of Educational Computing Research**, v. 38, n. 3, 2008. p. 255-278.

SMITH, D., MCLAUGHLIN, T.; BROWN, I. 3-D computer animation vs. live-action video: Differences in viewers' response to instructional vignettes. **Contemporary Issues in Technology and Teacher Education**, v. 12, n. 1, 2012. p. 41-54.

SMITH, P. **Instructional simulation: research, theory, and a case study**. Paper presented at the Annual Convention of the Association for Educational Communications and Technology, Las Vegas, NV, January 16-21, 1986.

STRANG, H. R., LANDRUM M.S.; LYNCH K.A. Talking with the computer: a simulation for training basic teaching skills. **Teaching and Teacher Education**, v. 5, n. 2, 1989. p. 143-53.

TEOH, J. Pre-service teachers in Second Life: Potentials of simulations. **Journal of Educational Technology Systems**, v. 40, n. 4, 2011-2012. p. 415-441.

TWELKER, P. A. **Interaction analysis and classroom simulation as adjunct instruction in teacher education**, 1968. Retrieved from <http://www.eric.ed.gov/contentdelivery/servlet/ERICServlet?accno=ED021780> .

YEH, Yu-Chu. Nurturing reflective teaching during critical-thinking instruction in a computer simulation program. **Computers and Education**, 42, 2004. p. 181-194.

YEH, Yu-Chu. The interactive effects of personal traits and guided practices on preservice teachers' changes in personal teaching efficacy. **British Journal of Educational Technology**, v. 37, n. 4, 2006. p. 513-526.

ZIBIT, M.;GIBSON, D. SimSchool: The game of teaching. **Innovate: Journal of Online Education**, v. 1, n. 6, 2010. p. 7.

## ATTACHMENTS

Table 1. Experimental studies included in the review

Article	Research design	Subject group	Intervention	Measurement	Results
<b>1979 and before</b>					
Bond, J. H. (1965)	Experimental study	Education majors. The experimental group consisted of 20 students. The control group consisted of 15 students	Classroom simulator. Variety of problem sequences was employed to teach a specific principle or skill. Each sequence was used repeatedly until the testee achieved the established level of performance. After each presentation of the problem and feedback sequence, the experimenter and the testee discussed the experience in preparation for the next experience.	Attitude instrument	There were no significant differences between the treatment groups.
Kersh, B. Y. (1966)	Experimental study	Preservice education of elementary school teachers. 40 students, divided into 4 groups: (1) large motion pictures, the most realistic, (2) small motion pictures, intermediate, (3) large stills, intermediate, and (4) small stills, least realistic.	A single sixth-grade classroom was simulated through the use of films and printed materials	The students were asked to make an appropriate response to each situation and the experimenter projected an appropriate feedback sequence.	Difference in favor of the small stills, the least realistic.
Twelker, P. A. (1968)	Experimental study: 2-factor design	Ninety-two student teachers	Two types of training: interaction analysis and/or simulation training or neither	Simulation tests, classroom performance records, course grades, Minnesota Teacher Attitude Inventory, Edwards Personal Preference Schedule, and Educational Testing Service Cognitive Test	Students receiving only simulation training spent more time than others in stimulation and management behaviors, would benefit from interaction analysis training was not supported.
Garrison J. H. and Kersh. B. Y. (1969)	Experimental study	Ninety prospective teacher-elementary education majors	Three groups of elementary education majors were involved in the experiment, the immediate objective of which was to test the effectiveness of two different forms of the Classroom Simulation Test -a test based on motion picture sequences of classroom problems and students' responses to these. Objective form in one group, projective form in the other was used. The control group interviews were conducted without any supporting test data.	Classroom Simulation Test, Edwards Personal Preference Schedule and the 16 Personality Factors test.	Results support the effectiveness of the testing-interviewing technique: (1) There is a distinct advantage to using supporting test data in the interviews as contrasted with interviewing without the use of test data. (2) It may not matter which form of the Classroom Simulation Test (objective or projective) is used. (3) Learning effects are not limited to a single instructor personality.
Beals, P. E. (1970)	Experimental study: randomly assigned to three groups pre-post-test design.	Seventy-five student teachers	Two weeks of observation and participation in an elementary classroom and one of simulated classroom experiences; and one week of simulated classroom experiences. Simulation groups used Program II of "Mr. Land's Sixth Grade" in which students respond to 20 simulated classroom situations (on 16mm film) as if they were the teacher in the actual classroom.	Minnesota Teacher Attitude Inventory, and pre-post seminar data on response to simulated classroom situations (teaching performance)	No significant differences
Doyle J. and Gregory, J. W.A. (1975)	Experimental study	Twelve preservice social studies teachers	Microsimulation and then used under microteaching conditions. The practice moves include the following: (a) structuring moves, which provide a context within which discussion is to be focused; (b) conditional moves, involving a given premise and a following consequence; (c) wait-time moves, involving teacher utilization of silence; and (d) indicative moves, involving teacher responses which relate directly to student utterances.	Social science observation record, Conditional movie coding protocols, Indicative movie coding protocols. Data for first microsimulation used for as a pretest, data for microteaching were used as a posttest.	Preservice teachers teaching skills were changed significantly from pretest to posttest. The results indicated that teachers may acquire, practice, and learn to use a cluster of technical teaching skills functionally through microsimulations of teaching.

## Simulation-based learning: how can be used to prepare teacher?

1980 and after					
Strang, H.R., Landrum M.S. and Lynch K.A. (1989)	Experimental study	Sixty-one preservice teachers	Computer-based teaching simulation. During three 13-minute lessons, preservice teachers individually conducted a spelling lesson with 16 computer-defined pupils—pupils who could both emit voice-synthesized replies and visually respond to a teacher's comment or touch.	Questionnaire, observation	Preservice teachers quickly acquired both effective teaching and behavior intervention skills.
Yeh, Yu-Chu (2004)	Experimental study: A pretest–posttest control group design	One-hundreds forty-nine (149) preservice teachers	A computer simulation program (the Computer Simulation for Teaching General Critical-Thinking Skills -CS-TGCTS)	Computer Simulation for Teaching General Critical-Thinking Skills (CS-TGCTS), Questionnaire of Professional Knowledge for Critical-thinking Instruction (QPK-CTI), The Checklist for Teacher Behaviors in Critical-thinking Instruction, CTB-CTI	CS-TGCTS simulation is an effective vehicle for improving preservice teachers' reflective teaching in critical-thinking instruction.
Lee S. and Powell J.V. (2005-2006)	Experimental study: Mixed method before–after design	Twenty-five preservice teachers- early childhood education	Computerized simulation used as an integrated component of a curriculum course. The simulation includes discipline issues with certain situations as one of six categories of emphasis.	Rating of simulation on discipline before–after field experience	Integrating technology-based simulations into preservice teacher education programs can potentially and effectively influence solving discipline problems in real classrooms by helping preservice teachers construct their own beliefs and philosophy about discipline. Emergent themes and direct quotes from preservice early childhood teachers are shown on the aspect of discipline.
Girod M. and Girod G. (2006)	Quasi experimental research	Participants were drawn from the population of master's of arts in teaching (MAT) teacher candidates	Cook School District, a web-based simulation designed to allow teacher candidates an opportunity to explore connections between their actions as teachers and the learning and engagement of simulated students. The simulation provides a setting in which to practice the processes inherent in teacher work sample methodology.	Pre- and postmeasures of perceived skillfulness in connecting teaching and learning and perceived value of these same skills. Teacher candidates were asked to rate themselves on a 5-point scale indicating the degree to which they felt skillful in adapting instruction to ensure that all students learned to the best of their ability. Teacher work sample scores and lesson evaluation scores were examined both before and after working in the Cook simulation	The efficacy of the simulation to (a) improve scores on a real teacher work sample, (b) improve field-based lesson teaching performance, and (c) affect users' perceptions of their skillfulness and valuing of concepts underlying teacher work sample methodology.
Passig D. and Moshe R. (2008)	Experimental study: Control group-posttest design	Ninety pre-service teachers	The experimental group experienced a 3D immersive simulation which made tangible the cognitive aspect of anxiety. One control group watched a TV film on the subject of test anxiety, while the second control group read statements by pupils who suffer from that syndrome. The level of awareness was tested four times: two weeks before the 3D experience, one week before it, immediately after the experience, and two weeks thereafter.	Awareness of Test Anxiety Questionnaire	Virtual reality technology is effective in raising the level of awareness of test-anxiety.
McPherson, R., Tyler-Wood, T., McEnturff E.A. and Peak, P. (2011)	Quasi-experimental design	One hundred fifty-one pre-service and in-service special education students	Web-based simulated classroom, Simschool	The effective inclusion instrument and teacher preparation survey	Students who participated in the teaching simulation scored higher on the teacher preparation survey and valued simulations and computer games more.
Smith, D., McLaughlin, T., and Brown, I. (2012)	Experimental study (Posttest design)	Preservice teachers (n= 55) were randomly assigned to watch the video or an animated vignette and to complete a questionnaire	The focus of the research was to determine if the embedded behavioral information perceived in a <u>live-action</u> video version of classroom management situations was the same as a 3-D computer animation version of the same content. <u>Preservice</u> teachers were randomly assigned to watch a live-action video or animated vignette. The selected vignette depicting a student cheating on an exam was shown to each group and followed up with a checklist to identify the behaviors viewed in the video or animated versions.	A researcher-developed instrument to examine the perceptions of video characters' behaviors by <u>preservice</u> teachers with regard to their viewed vignette.	There were no differences between the groups in identifying the critical behaviors.

Table 2. Other types of studies (case, qualitative and survey) included in the review

Article	Research design	Subject group	Intervention	Measurement	Results
<b>1979 and before</b>					
Lesniak, R.J. (1970)	?	Twenty students enrolled in the urban teacher preparation program	Classroom behavior task- a ten minute classroom simulation (role-play)	Classroom Behavior Observation Form, after program, and during summer, fall and spring semester of an urban teaching internship	Significant correlation between in the classroom behavior task and summer classroom performance, others not related.
<b>1980 and after</b>					
Loper, A. B., Strang H R., Richards F. and Badt K. (1985)	?	Twenty-two teacher-trainees	Microcomputer-based simulation of classroom. In the first module, trainees were encouraged to inform pupils whether their content-based answers to spelling questions were correct or not. In the second module, trainees were encouraged to adjust the pace of their questioning on the basis of whether they were introducing or reviewing content-related material.	Questionnaire on reaction of teacher-trainees, students anecdotal expression	All participants reported enjoying the post-session debriefing and performance appraisal by a counselor.
Foley, J.A. and McAllister, G. (2005)	Qualitative	Forty-nine secondary students and 77 elementary teacher preparation programs' students	Sim-School® simulation-A fictitious scenario	Reflections on students experiences with the simulation throughout the scenario. The elementary students also maintained a reflection journal that provided some insights into their experiences with the Sim-school, as well as verification of the various themes found in the reflections.	Four themes revealed: teacher identity, decision making, complexity of diversity, fostering a positive school ethos. Teacher educators have found that the simulation has provided an important learning context to struggle with key questions around working with students from diverse linguistic and cultural backgrounds; fostering a collegial ethos; and making effective instructional decisions.
Yeh Yu-Chu (2006)	?	One-hundreds seventy-eight preservice teachers	A computer simulation program (the Computer Simulation for Teaching General Critical-Thinking Skills)	Inventory of Personal Teaching Efficacy in Critical Thinking, the Questionnaire of Intrapersonal Intelligence, the Inventory of Critical Thinking Dispositions and the Inventory of Thinking Styles	Intrapersonal intelligence, critical-thinking dispositions and a judicial thinking style are related to self-awareness, analytical learning and reflective thinking and these personal qualities seemingly interacted with guided practices, which resulted in reflective teaching and mastery experience.
Carrington, L., Kervin, L., Ferry, B. (2011)	Comparative case study	Seventeen first and final year pre-service teachers enrolled in a bachelor of education.	Online classroom simulation	Semi-structured interviews, observation, the collection and analysis of artefacts.	The simulation enhanced the professional identity of the participants.
Mason, L.L. (2011)	Case study analysis	Seven pre-service special education teachers enrolled in a mild/moderate distance degree and licensure program	Virtual simulations	Observation, recording, semi-structured interviews	Virtual simulations served a variety of functions for training teachers to work on a collaborative team, including increased practice opportunities and self-efficacy to collaborate with parents in the future. Although teacher trainees had difficulty generating complete verbal statements to govern future behaviors, each was able to identify discrete antecedents, behaviors, and consequences responsible for controlling their actions throughout the simulations.
Nelson, M. M. (2011)	Qualitative research	Four prospective teachers (elementary teacher)	Approximations of practice (practice in the form of simulated teaching experiences), students' instructional approaches, ideas about, and confidence in teaching elementary science investigation lessons.	Prospective teachers' perceptions of the utility of approximations of practice in learning to teach elementary science.	Approximations of practice supported prospective elementary teachers' development of instructional approaches, ideas, and confidence for teaching investigation lessons earlier than anticipated.
de Jong, T., Lane, J. and Sharp, S. (2012)	Quantitative (survey) and qualitative study	One-hundred sixty first year pre-service teachers enrolled in a Bachelor of Education unit on learning and development	A simulated 'critical incident' was used in a lecture	Survey and tutorial data were collected through five tutorials (n = 20 students per tutorial)	Simulation pedagogy has the potential to: <ul style="list-style-type: none"> <li>1. Emphasize the importance of teachers being able to self-regulate their emotions as a professional responsibility and be good role models for their students.</li> <li>2. Underscore the importance of being professionally aware that emotions can impair judgment and diminish personal capacity to respond objectively to an emotive situation.</li> <li>3. Elicit amongst students empathy for children who are witness to a critical incident</li> <li>4. Demonstrate that learning is a multi-modal process, which integrates the physical, cognitive, social, emotional dimensions.</li> <li>5. Actively engage students through the affective domain to be a powerful facilitator of personal and professional knowledge acquisition, creation, and application.</li> <li>6. Be diminished in its efficacy if it were used inappropriately and indiscriminately.</li> </ul>



## Simulation-based learning: how can be used to prepare teacher?

**Table 3. Design and/or pilot studies included in the review**

Article	Research design	Subject group	Intervention	Measurement	Results
<b>1980 and after</b>					
Ferry B. and Kervin L. (2006)	Design research-design experiment	Two-hundred twenty pre-service teachers studying bachelor of teaching degree	Trials (online simulation) were conducted with five iterations of the software.	Researchers field notes and focus group, individual interviews before and after using simulation.	Online simulation provides pre-service teachers with time to think critically about complex classroom situations which rely on the teacher's ability to respond to children's experiences, engage with them in meaningful dialogue and negotiation as well as utilize a range of indirect instructions such as questioning, modeling and prompting.
Girod, M., Girod, G.R. (2008)	Pilot study (Quasi experimental)	Teacher candidates (masters of arts in teaching). Treatment group (Cook simulation users) 31, comparison group (non-Cook users) 33.	A web-based simulation called Cook School District was designed to allow teacher candidates to practice the skills necessary to connect their teaching to the learning of all children employing the framework of teacher work samples (TWS)	Simulation users' abilities to analyze hypothetical teaching scenarios, interviews, and reflective writing in real work samples.	Simulation plays a role in helping candidates become more aware of, and able to perform, several critical skills necessary to effectively connect teacher actions to the learning of each student.
Mahon J., Bryant B, Brown B and Kim M. (2010)	A mixed method (Design and pilot study)	Twenty undergraduate pre-service teachers enrolled in teacher education course.	Educational simulation created within Second Life in order to assist pre-service teachers in gaining more experience managing student behavior.	A questionnaire designed to capture student assessment of the simulation	Students found the simulation to be a useful learning experience and put them in situations that forced them to think on their feet.
Brown, I. A., Davis, T. J. and Kulm, G. (2011)	Pilot study	Twenty-five pre-service teacher students	Second Life (software) simulations	The Mathematics Teacher Efficacy, Beliefs Instrument, The Knowledge for Teaching Algebra for Equity	Second Life (software) simulations can provide rich settings for teacher development on specific mathematics teaching skills and challenge them to apply their ideas about diversity.
Gregory S. and Masters Y. (2012)	Pilot study (quantitative and qualitative survey data)	Ninety-six pre-service teachers enrolled in a teaching and learning unit as part their first year in UNE's four-year Bachelor of Education (Primary) program	A 3D virtual classroom and playground were created in Second Life. A project that involved preservice teachers carrying out role-plays based on de Bono's Six Thinking Hats framework is presented. A pilot study was carried out over two years with on-campus students, who performed the role-plays both in a real-life, physical setting and within the virtual world of Second Life. The activity has since been extended to off-campus students exclusively using Second Life	Observation, surveys and online dialogue recordings designed to target each of the three forms of engagement outlined earlier: affective, behavioral and cognitive.	Real world role-plays can be simulated or replicated in a virtual world, and its outcomes suggest that de Bono's Six Thinking Hats framework can be taught to off-campus students through engagement in such learning activities within a virtual world. Students have a preference for real-life, face-to-face learning activities; however, the participants in the study were on-campus students, who, unlike those who are studying at a distance, actually have the privilege of access to this mode of learning.