Teacher Experiences with Professional Development and Virtual Labs:

A Field Study Proposal

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New Jersey City University Educational Technology Leadership Program

EDTC809: Assessment and Evaluation

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Teacher Experiences with Professional Development and Virtual Labs

Overview and Need for the Study

Laboratory experiments are keystone experiences conducive to the successful mastery of science concepts. Unfortunately, many schools struggle to secure the resources, funds, and access to facilities to conduct hands-on labs requiring teachers to use alternative methods like virtual labs (Marble, 2017). VLs are computer-generated simulations of traditional PLs that can be used when resources or access to lab facilities are unavailable (Son et al., 2016). Although, insufficient professional development has been shown to impact teachers' efficacy in incorporating educational technology in their lessons (Dolighan & Owen, 2021).

Additionally, the restrictions due to the ongoing global health crisis have limited access to labs in science courses. The lack of lab experiences can negatively impact student development of scientific skills like modeling, computational thinking, and collaboration (NRC, 2012). Research on virtual labs in the classroom indicates they are as effective as traditional physical labs (Hamed & Aljanazrah, 2020). While similar studies show the potential of VLs to improve learning (Darrah et al., 2014; Son et al., 2016), further studies are necessary to understand the impact of other factors, like instructor experience with professional development and its relationship to self-perceived efficacy (Reece & Butler, 2017).

Literature review indicates that limited professional development on new technologies, like virtual labs, is not beneficial enough for teachers to introduce technology into their lessons (Carlson & Gadio, 2002). Recent studies show that training in technology and instructional practice can positively impact the self-perceived efficacy of pre-service teachers (Joo et al., 2018). Self-perceived efficacy is a crucial factor in the successful adoption of new educational

technology. Additional studies are needed to understand further the impact of professional development on teachers' self-perceived preparedness to implement virtual labs into their lessons and the successful adoption of technology in the classroom.

Description of the Study

This study explores teachers' experiences with professional development and their self-perceived efficacy using virtual labs in the classroom. The research will investigate the impact of professional development on teacher self-perceived efficacy and familiarity with the virtual lab platform. Next, the researcher will explore the teachers' experiences with professional development on educational technology through questionnaires and interviews. Ultimately, the researcher will analyze the data acquired to identify the instructional training factors contributing to the teachers' self-perceived efficacy with the platform.

Research Questions

The following questions will help guide the researcher through the study:

RQ1 (QN): What is the impact of professional development on the teachers' self-perceived efficacy with the virtual lab platform?

RQ2 (QL): What are teachers' experiences with professional development for the virtual lab platform?

RQ3 (MM): In what ways does the interview data of teachers' experiences with professional development training explain the quantitative survey results on teachers' self-perceived efficacy using virtual labs?

Methodology

This study will use an explanatory mixed-methods design to explore the impact of professional development on teacher self-perceived effectiveness. A mixed-method study can integrate the data obtained from qualitative and quantitative methods to gain a deeper understanding of the issue (Creswell & Creswell, 2018). The researcher will evaluate the data collected in this study through a pragmatic lens by converging data collected from quantitative and qualitative designs to best answer the research questions in this study, which is more important than either choice of design alone (Patton, 2015). Similarly, identifying the procedures to collect the data in each design phase is crucial to developing the procedures and instruments (Creswell and Guetterman, 2019). Considering the purpose of this study is to examine how professional development impacts the teachers' self-efficacy, quantitative data will present the relationship between quantity and quality of professional development and self-perceived efficacy with the platform, while qualitative data will further explore teacher experiences with professional development and the virtual lab platform.

The researcher will collect qualitative through surveys and quantitative data through interviews. Creswell & Plano Clark (2018) state that explanatory designs intend to explain the results of quantitative data through further qualitative phases. Thus, the researcher will collect quantifiable data from a correlational study phase on the impact of professional development on teachers' self-efficacy. Next, the researcher will gather qualitative data from participants in the quantitative case studies, as match comparisons, of teacher experiences with professional development through interviews. Ultimately, the researcher will examine the data from both phases of the study independently. Then, the researcher will analyze the results for emergent themes and relationships to answer the research questions.

Population and Sample

The target population for this study is secondary science teachers in public and private schools in New Jersey. The choice of secondary science teachers will allow teachers in various grades to participate in the study. The researcher will contact district science supervisors and building administrators to request information on their teacher's usage of virtual labs. Once potential schools are identified to fit the criteria, the researcher will request teacher emails from school administrators. The research will select an equal number of potential participants from each county to participate in the study. Potential participants will be contacted through email to explain the importance of the study and request their participation by responding to the survey attached.

The researcher will use convenience sampling for the quantitative phase of the study and the qualitative phase. After analyzing the data from the quantitative phase, the researcher will group the potential participants into two categories: teachers with the highest and teachers with the lowest. The researcher will aim to select an equal number of participants from each group to interview for the qualitative phase of the study. This study will use a convenience sample to select up to 30 participants, or until saturation is reached, that completed the questionnaire to participate in the qualitative phase of the study. Research shows that a range between five (5) and fifty (50) participants is sufficient to reach saturation, the point at which no new information is collected from additional participants (Charmaz, 2006). The potential participants will be contacted for follow-up interviews to explore their experiences with professional development.

As with any research, there are various concerns for potential issues with the population sample. Suppose supervisors and administrators do not respond to emails. In that case, the researcher will have to seek information from other administrators in the district and research the

publicly available science curriculums in each district. Similarly, if teacher contact information is not provided, the researcher will have to search individual school websites for publicly available emails of science teachers. Additionally, if quantitative data is not enough for proportional representation in each county, the researcher will have to seek additional participants or note the study's limitations.

Instrumentation

This mixed-method study will combine data from quantitative and qualitative phases in the research. The quantitative data will be collected through a survey including biographical questions, professional development quantity, quality questions, and Likert scale questions on their self-perceived efficacy with virtual lab platforms. The survey questions were created following applicable item categories like self-efficacy, usefulness, and intention to use from the metacognitive awareness survey developed by Joo et al. (2018). The researcher created the questions to collect nominal data for correlating the impact of professional development on teachers' self-perceived efficacy using the VL platform (Appendix D). The qualitative phase of the study will seek to explore deeply into the teacher experiences with professional development for the virtual lab platform using semi-structured interviews. The questions were developed to further understand teacher experiences with professional development and how it impacted their use of VLs in their classrooms (Appendix E). The instruments will be evaluated for relevance and alignment with the attributes in the study by experts in the education field and piloted with teachers outside of the study. Sample questions can be found after the IRB application (Appendix A). The online survey, including the participant consent form, can be accessed at the following site: https://njcu.co1.qualtrics.com/jfe/form/SV_2ggb5HCLRtFfRoW

References

Carlson, S., and Gadio, C.T. (2002). Chapter 8: Teacher professional development in the use of technology. In W.D. Haddad and A. Draxler (Eds), *Technologies for education: Potentials, parameters, and prospects*. Paris and Washington, DC. UNESCO

Charmaz, K. (2006). Constructing Grounded Theory: A Practical Guide Through Qualitative Analysis. United Kingdom: SAGE Publications.

Creswell, J. W., & Clark, V. L. (2018). *Designing and conducting mixed methods research*. SAGE Publications.

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.

Creswell, J. W., & Guetterman, T.C. (2019). Educational research: Planning, conducting, and evaluating quantitative and qualitative research (6th ed.). Pearson.

Darrah, M., Humbert, R., Finstein, J., Simon, M., & Hopkins, J. (2014). Are virtual labs as effective as hands-on labs for undergraduate physics? A comparative study at two major universities. *Journal of Science Education and Technology, 23*(6), 803-814. https://doi.org/10.1007/s10956-014-9513-9

-Dolighan, T., & Owen, M. (2021). Teacher efficacy for online teaching during the COVID-19 pandemic. *Brock Education Journal*, *30*(1), 95. doi.org/10.26522/brocked.v30i1.851

-Hamed, G., & Aljanazrah, A. (2020). The effectiveness of using virtual experiments on students' learning in the general physics lab. *Journal of Information Technology Education: Research*, *19*, 977-996. https://doi.org/10.28945/4668

Joo, Y. J., Park, S., & Lim, E. (2018). Factors Influencing Preservice Teachers' Intention to Use Technology: TPACK, Teacher Self-efficacy, and Technology Acceptance Model. Educational Technology & Society, 21(3), 48–59.

-Marble, J. (2017). *A Comparison of Traditional and Virtual Labs in Physics* (10744612) [Doctoral dissertation]. ProQuest Dissertations and Theses Global.

-National Research Council. (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas*. The National Academies Press.

Patton, M. Q. (2015). Qualitative research & evaluation methods (4th ed.). SAGE.

Reece, A., & Butler, M. (2017). Research and teaching: Virtually the same: A comparison of STEM students' content knowledge, course performance, and motivation to learn in virtual and face-to-face introductory biology laboratories. *Journal of College Science Teaching*, *046*(03). https://doi.org/10.2505/4/jcst17_046_03_83

-Son, J. Y., Narguizian, P., Beltz, D., & Desharnais, R. A. (2016). Comparing physical, virtual, and hybrid flipped labs for general education biology. *Online Learning*, *20*(3). https://doi.org/10.24059/olj.v20i3.687

APPENDIX A

NJCU Institutional Review Board Application for Review of Research Project

Email all materials in one word document to: kresch@njcu.edu.

Date of Submission: 12/14/2021

Name (PI)/Sponsor Submitting Application: Dr. Christopher Carnahan

Application Type: ☒Original ☐ Previously Approved

Proposal Title	Teacher Experiences with Professional Development and Virtual Labs
Proposed Start Date	8/1/2022
Anticipated Duration of Research	6 months
CITI Certification by all researchers (Certificates must be attached.)	Yes

Type of Research

☒ Student/Classroom project
☐ Faculty research project
☐ Staff research project
☐ External researcher project (All external researchers must have an NJCU faculty/staff sponsor.)

NJCU Investigators (Please list additional investigators as necessary)

Name: Giancarlo Perez-Flores
Department: Educational Technology
Telephone number: 201-555-5555
Email address: gperezflores@njcu.edu

Data Sources

1. Number of participants: 250

2. How was this number determined (e.g., power analysis)?

Through literature review on Mixed Method studies. Creswell recommends 200-300 participants. Potential number of science teachers in the North New Jersey area.

3. Does this project require the collection of new data? ☒ Yes ☐ No

3A. If yes, how will participants be selected or recruited (<4-5 sentences)?

The potential participants' email information will be collected from each of their school' official website. The researcher will contact all high school and middle school teachers in the North New Jersey area. The researcher will contact teachers through email to explain the importance of the study and request their participation and consent by responding to the survey attached.

3B. Will subjects participate on a fully voluntary basis? ☒ Yes ☐ No

3C. Will subjects be compensated for their participation? ☐ Yes ☒ No

3D. If yes, please briefly describe the compensation:

4. Does this project make use of human tissue or cell lines: ☐ Yes ☒ No

5. Briefly describe the research methodology(ies) to be used in this study (e.g., focus group, participant observation, survey, experiment). (<4-5 sentences)

This study will use a Mixed Methods approach. An explanatory mixed method design uses qualitative data to further explain the findings of the quantitative phase. The quantitative phase will collect data through online surveys to be analyzed for correlations. Next, data collected from semi-structured interviews with selected participants will be coded and analyzed. The researcher will analyze the quantitative and qualitative data collected to answer the research questions.

6. Does this project use data that have already been collected for a non-research purpose or by another researcher? ☐ Yes ☒ No

6A. If yes, what is the source of the data? (3-4 sentences)

6B. Are the data accessible in the public domain? ☐ Yes ☒ No

6C. If no, does the data include information that would allow identification of individuals, either directly or indirectly? ☐ Yes ☒ No

6D. If yes, please explain briefly how participant confidentiality will be safeguarded. (3-4 sentences)

Participant Risks

7. Will participants be exposed to any stresses (e.g., anxiety, pain, etc.) or physical harm (e.g., injury infection, etc.) in connection with this research? ☐ Yes ☒ No

7A. If yes, please briefly explain what risks may be involved in the research, what specific steps will be taken to minimize and monitor the risk, and what will be done to compensate and/or treat participants who are harmed by the research. (4-5 sentences)

8. Does the research design require that participants be deceived? ☐ Yes ☒ No

If yes, please briefly explain why deception is necessary and what steps will be taken to reduce potential harm from this deception. (<3-5 sentences)

Potentially Vulnerable

9. Human Research Subject Populations – Please check if your research involves vulnerable populations:

Physically/Mentally Challenged Individuals:	☐ Yes ☒ No
Young children (ages 0 – 13):	☐ Yes ☒ No
Older children (ages 14 – 17):	☐ Yes ☒ No
Senior Citizens (over age 65):	☐ Yes ☒ No
Pregnant women:	☐ Yes ☒ No
Prisoners:	☐ Yes ☒ No

9A. If anything in Question #9 is checked **yes**, please briefly explain how the rights of this (these) population(s) will be protected. (<4-5 sentences)

Informed Consent (Please attach your consent form(s).)

10. Consent form must contain the following in lay terms:

The voluntary nature of their participation and the freedom to withdraw without penalty at any time:	☒ Yes ☐ No
The purposes and procedures of the research:	☒ Yes ☐ No

Any reasonably foreseeable risks or discomfort:	☒ Yes ☐ No
Any benefits to them or to others from the research:	☒ Yes ☐ No
The extent to which confidentiality will be maintained:	☒ Yes ☐ No
Whom to contact for information about the research participants' rights and any research-related injury:	☒ Yes ☐ No

10A. If the answer to anything in Question 10 was checked no, please briefly explain why the research requires an alteration of the standard elements of informed consent.

11. How will participants' informed consent be documented? Please check all that apply.

☐Signature on a written consent document

☐ Signature on a document to be read to the participants and witnessed by another party

☒ E-signature on an electronic form/survey

☐ Written documentation of informed consent will not be obtained because one of more of the following criteria is satisfied (check all that apply):

- ☐ The only link between the subject and the research would be the informed consent documentation and the primary risk is loss of confidentiality.
- ☐ The risks to participate, including risks associated with the loss of privacy, are no greater than those ordinarily encountered in daily life and the research involves no procedure for which written consent is normally required outside of the research context.

12. Who will obtain the informed consent from the participants?

☐ Principal Investigator
☒ Co-Investigator
☒ Sponsor (in cases where the Principal Investigator is not affiliated with NJCU)
☐ Other
☐ Not applicable

13. Please include your protocol summary (5-page maximum) and your recruitment materials (as applicable). You are provided space to do this at the end of this application. Please see **APPENDIX B.** *Protocol Summary.*

External Reviews and Funding

14. Has this protocol been reviewed by an Institutional Review Board or Human Subjects Review Committee at any other institution(s)? ☐ Yes ☒ No

If yes, at what institution(s)?

15. What is its status? ☐ Approved ☐ Rejected ☐ Pending (or provisionally approved)

Has this protocol been submitted for federal funding? ☐ Yes ☒ No

16A. If yes, list the agency or organization:

Submission Date: Click here to enter a date.
Funding Start Date: Click here to enter a date. ☐ Anticipated ☐ Actual
Contact Person: Click here to enter Contact Person.

Contact's Telephone Number: Click here to enter Contact's Telephone #.
Has this protocol been submitted for any other types of funding: ☐ Yes ☒ No

17A: If yes, list the agency or organization:

Proof of CITI Certification

Please provide documentation of current CITI certification in human subjects research for **all** researchers involved in this project.

Certificate of Agreement

The signatures* of all researchers involved in this project must be provided.

I/We certify that I/we agree to comply with the requirements of both NJCU and the Office for Human Research Protection (OHRP) of the United States Department of Health and Human Services as described in 45 CFR §46.

X _____ X _____

Principal Investigator Co-Principal Investigator

***Instructions for signatures**: First, save your application file and then open it. Sign the document by right clicking on the signature line and selecting "Sign." **DO NOT SAVE** the file, **simply CLOSE IT**. The signature will be automatically saved. If applicable, send the file as an email attachment to the next signatory. Every subsequent signatory must also follow these instructions.

Please submit the completed application, checklist, and accompanying documents as one word document to kresch@njcu.edu.

All applications must be submitted by the NJCU faculty or staff member serving as the Principal Investigator. Neither students nor external researchers may submit an application.

APPENDIX B

Protocol Summary

Please note: The protocol summary (5-page maximum) should only include the central elements of the project such as the rationale, objectives, methods, populations, and period.

The purpose of this explanatory sequential mixed methods study is to explore the teacher experiences with professional development and the impact to their self-perceived efficacy using virtual labs. The researcher will analyze the data acquired from the quantitative and qualitative phase to answer the following research questions:

RQ1 (Quantitative): What is the impact of professional development on the teachers' self-perceived efficacy with the virtual lab platform?

RQ2 (Qualitative): What are teachers' experiences with professional development for the virtual lab platform?

RQ3 (MM): In what ways does the interview data of teachers' experiences with professional development training explain the quantitative survey results on teachers' self-perceived efficacy using virtual labs?

Participants will be contacted through their district-provided email addresses found in each of their school's website. The potential participants will first be sent an email introducing the study and requesting their participation and consent by following the attached link to the Qualtrics survey. The consent form indicates that participation is fully voluntary and that participants have the right to withdraw at any time. The data collected including responses and biographical information will be kept anonymous and confidential throughout the study by the researcher.

APPENDIX C

NJCU CITI Certificate

CITI PROGRAM

Completion Date 20-Oct-2021
Expiration Date 19-Oct-2024
Record ID 45721989

This is to certify that:

Giancarlo Perez-Flores

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

Social & Behavioral Research - Basic/Refresher
(Curriculum Group)
Social & Behavioral Research
(Course Learner Group)
1 - Basic Course
(Stage)

Under requirements set by:

New Jersey City University

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w5a648eaf-9769-4722-ad3a-88e93c4f9733-45721989

APPENDIX D

Survey Instrument

Consent Form

Consent Form I agree to participate in this study entitled "Teacher Experiences with Professional Development and Virtual Labs," which will be conducted by Mr. Giancarlo Perez of the New Jersey City University's Educational Technology Department. The purpose of this study is to explore teachers' responses during COVID closures. The data collected in this study will be combined with data from previous studies and will be submitted for publication in a research journal.

I understand that I will be required to answer questions, and I will be assigned to work either individually or as part of a group. My participation in the study should not exceed one hour.

I understand that my responses will be anonymous and that all data gathered will be confidential. I agree that any information obtained from this study may be used in any way thought best for publication or education provided that I am in no way identified and my name is not used.

I understand that there are no physical or psychological risks involved in this study and that I am free to withdraw my participation at any time without penalty.

I understand that my participation does not imply employment with the state of New Jersey, New Jersey City University, the principal investigator, or any other project facilitator.

If I have any questions or problems concerning this study, I may contact Dr. Meriem Bendaoud, interim chair of the NJCU Institutional Review Board, at 201-200-2400 or mbendaoud@njcu.edu.

- ○ Yes, I consent to participate in the study mentioned above (1)
- ○ No, I do not consent to participate in the study mentioned above (2)

Q1 How many years have you been teaching?

▼ 1 to 2 years (77) ... 20+ years (81)

Q2 How often do you use virtual labs in your lessons?

- ○ Once a month (1)
- ○ twice a month (2)
- ○ three times a month (3)
- ○ four or more times a month (4)

Q3 How many professional development sessions have you received on virtual labs?

- ○ one (1)
- ○ two (2)
- ○ three or more (3)
- ○ none (4)

Q4 How much would you agree with the following statements?

	Strongly Agree (1)	Agree (2)	Neither Agree Nor Disagree (3)	Disagree (4)	Strongly Disagree (5)
I am comfortable learning from the district-mandated professional development	○	○	○	○	○
The professional development covered all basic features of the program	○	○	○	○	○
I can align virtual labs to state standards	○	○	○	○	○
I can efficiently implement virtual labs in my lesson	○	○	○	○	○
I consider myself tech savvy	○	○	○	○	○
I feel comfortable using technology in the classroom	○	○	○	○	○

Q5 How would you rank your confidence with the following?
Definitely true being the most confident, and definitely false being the least confident.

	Definitely false (65)	Probably false (66)	Neither true nor false (67)	Probably true (68)	Definitely true (69)
I am confident using all the virtual lab tools (5)	○	○	○	○	○
I am confident using virtual labs in your lesson (1)	○	○	○	○	○
I am confident explaining virtual lab features to your students (2)	○	○	○	○	○
I am confident using virtual labs to model complex scientific concepts (3)	○	○	○	○	○

APPENDIX E

Semi-structured Interview Questions

1. What were your experiences, whether positive or negative, with professional development on virtual lab platforms?
2. How would you describe the depth of information and applicability of the trainings you attended?
3. How would you describe your understanding and familiarity with the platform before and after the trainings?
4. In which ways to feel that the professional development improved your instructional practices and ability to use the platform in your lessons?
5. How would you describe your use of technology in your lessons?