01. General Study Information

All questions marked with a red asterisk (*) require a response. Questions without a red asterisk may or may not require a response, depending on those questions' applicability to this study.

1.1* Study Title:

PSims for Scientific Thinking

1.1.1 Full Study Title:

Using Smartphone-based Participatory Simulations to Engage Children in Scientific Thinking

1.1.2 If there are other U-M studies related to this project, enter the eResearch ID number (HUM#) or IRBMED Legacy study number. Examples of related projects include, but are not limited to:

- Projects funded under the same grant
- IRBMED Legacy study being migrated into eResearch
- Previously approved Umbrella applications (such as Center Grants or approvals for release of funding)
- Previously approved projects for which this is a follow up study

1.2* Principal Investigator:

Elliot Soloway

Note: If the user is not in the system, you may Create A New User Account...

1.3 Study Team Members:

<table>
<thead>
<tr>
<th>Study Team Member</th>
<th>Study Team Role</th>
<th>Agree to Participate</th>
<th>Conflict of Interest</th>
<th>Edit Rights</th>
<th>Accepted Role?</th>
<th>PEERRS Human Subjects?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michael Bailey</td>
<td></td>
<td>yes</td>
<td></td>
<td>N/A</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Elliot Soloway</td>
<td>PI</td>
<td>no</td>
<td>yes</td>
<td>N/A</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Joseph Krajcik</td>
<td>Co-Investigator</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

1.8* Project Summary:

An opportunity has emerged that will enable schools to more effectively engage children in scientific thinking. Finally, students will be able to use the same simulations -- augmented appropriately for learners -- that scientists use to decompose, visualize, and understand complex systems (e.g., how infectious diseases are spread, how energy uses impact the globe). Bringing that opportunity to fruition is the goal of the proof-of-concept, R&D effort, herein described.
Using two newly emerged technologies - mobile devices and cloud computing, while drawing on Learner-centered Design (LCD) guidelines and cognitive sciences’ understanding of motivation and learning, we propose developing the Participatory Simulations Software Factory (PsimSF) that will produce, automatically, Participatory Simulations (Psims) for various science processes that run on a broad range of mobile devices (iPhone, Android, Windows Phone 7, etc.).

During the two year effort, our PsimSF will produce two Psims: (1) In understanding how energy is exchanged, each student in a class of 30 will use their energyXchange PSim, synchronously, on a smartphone to explore the impact of their decisions on energy use (e.g. ride in a car, take a bus, or walk to school) has on the increase/decrease of CO2 on the planet. (2) In understanding how infectious diseases are spread, each student will use their Cooties Psim to explore the impact of their decisions on nutrition, exercise, etc. on the spread of a disease. A broad range of data will be collected and analyzed during the classroom use of these two Psims.

Because of the personal participation in the simulation, engagement should increase and result in greater time on task where a broad range of visualizations are employed, as well as real-time conversation amongst the students, which in turn should increase student achievement.

The intellectual merit of our PSims Project resides in our bringing together newly emerged technologies, cutting-edge science methodology, and inquiry-based learning to create an engaging and new mobile-device-based learning environment. In producing the Psims we, as well as the educational community, will better understand how these new technologies can be used to support active, project-based learning. Participatory simulations on mobile devices should be highly engaging for the “mobile generation” because they are require multi-player, game-like interactions. Inasmuch as mobile and cloud-based computing will become the dominant computing paradigm for the next decade, and as the use of simulations will also become a dominant science research method for the next decade, education needs to understand how to leverage these trends’ utility.

The broader impacts of our proposed PSims Project include potential commercialization and the creation of a mobile-device-based, cloud-computing infrastructure for a broad range of informal as well as formal educational applications. From the outset, our effort seeks to be scalable and sustainable so that the fruits of this effort can impact all learners in America’s schools. While our Psims Project is definitely a proof-of-concept, the specific Psims we produce should be stable, standalone mobile apps and thus distributable nationwide and usable, when accompanied by grade-level appropriate curriculum materials, by STEM students in grades 5 and up. More generally, as schools move to 1:1 (one mobile device per student) there will be a real need for a great deal of new educational software that leverages the unprecedented fact the student computing device of current decade will, invariably, be mobile and available 24/7. Developers of such educational science software should be able to learn from our K-12-tailored, mobile & cloud computing infrastructure that underlies our PSims effort.

---

**1.9* Select the appropriate IRB:**
Health Sciences and Behavioral Sciences

**1.10* Estimated Study Start Date (Not required for IRBMED):**
9/1/2011

**1.11* Estimated Duration of Study:**
Two Years

**01-1. Application Type**
1-1.1* Select the appropriate application type.

Exempt Human Subject Research

01-2. Standard Study Information

1-2.1* Who initiated this study?

Investigator

If other, please specify.

1-2.2* Are you or any students working on this project being paid from a federally funded training grant?

☐ Yes  ☐ No

1-2.3 This study is currently associated with the following department. To associate this research with a different department, click Select. If the department has defaulted to "student", click select to specify the department through which this application is being submitted.

CoE Electrical & Computer Sci

1-2.4 Will the study utilize resources from the following centers?

Select all that apply:

There are no items to display

1-2.6* Has the scientific merit of this study already been peer reviewed (i.e., reviewed by one or more recognized authorities on the subject)?

☐ Yes  ☐ No

1-2.6.1* List the peer-review organization(s).

Peer Review Organization

Other (explain below)

National Science Foundation

Study Team Detail

1.4 Team Member:

Michael Bailey

Department: CoE Electrical & Computer Sci

Preferred email: mibailey@umich.edu

Business phone 734-647-8086

Business address: Elec Engr & Comp Science 4611 CSE 48109-2121
1.5 Function with respect to project:

1.6 Allow this person to EDIT the application, including any supporting documents/stipulations requested during the review process:
yes

1.7 Include this person on all correspondences regarding this application: (Note: This will include all committee correspondence, decision outcomes, renewal notices, and adverse event submissions. Co-investigators and faculty advisors are required to receive this information.)
yes

Credentials: Required for PI, Co-Is and Faculty Advisors

Upload or update your CV, resume, or biographical sketch.

<table>
<thead>
<tr>
<th>Name</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>cv.pdf</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Conflict of Interest Detail: Required for all roles except Administrative Staff

C1 Do you, your spouse, domestic partner, or dependents have any outside interests or relationships to companies or entities related to this research that the IRB should consider?

Examples of outside interests include, but are not limited to the following:

- receiving compensation whose value could be affected by the study outcome
- IN THE AGGREGATE, expecting to receive compensation from the sponsor of the research of $10,000 or greater in the next year
- having a proprietary interest in the sponsor of the research or a product tested by this research including but not limited to, a patent, trademark, copyright, or licensing agreement, or the right to receive royalties from product commercialization
- individually or collectively, having an ownership interest (equity or stock options) in the sponsor of the research or product being tested whose value cannot be readily determined through reference to public prices
- individually or collectively, having an ownership interest (equity or stock options) in a company or product whose value could be affected by the study outcome
- IN THE AGGREGATE, having an ownership interest (equity or stock options) in the sponsor of the research that exceeds $10,000 or 1% when the sponsor is a publicly traded entity
- receiving significant payments of other sorts with an aggregate value of $10,000 or more (or payment of ANY amount to medical school or hospital employees) made directly by the sponsor of this research for unrestricted research or education, equipment, consultancy, or honorarium
- holding a position of management or leadership in company or entity related to this research including, but not limited to, officer, director, or member of an advisory board.
providing consulting services or serve on a Speaker’s Bureau, either paid or unpaid, to the financial or non-financial sponsor of this study
• when the sponsor is a publicly traded entity, having any ownership interest (equity or stock options) in the sponsor
• expecting to receive any loans, educational support, contributions of in-kind for equipment, or any other non-compensatory payment from the sponsor of the research in the next year

C2 Please provide a detailed description of the outside interest in the box below.

C2.1 Where have you submitted a disclosure of this outside interest?

C2.2 Has a management plan been formalized?

C2.2.1 If yes, attach the management plan here, as well as any other applicable conflict of interest documents.

C2.2.2 If no, describe the financial interest in sufficient detail to permit the COI Ancillary Committee and the IRB to determine if such involvement represents a potential conflict-of-interest and/or should be disclosed to potential research subjects in the informed consent form.

Study Team Detail

1.4 Team Member:
Elliot Soloway
Department: CoE Electrical & Computer Sci
Preferred email: soloway@umich.edu
Business phone 734-936-1562
Business address: Elec Engr & Comp Science 3629 CSE 48109-2121

1.5 Function with respect to project:
PI

1.6 Allow this person to EDIT the application, including any supporting documents/stipulations requested during the review process:
yes

1.7 Include this person on all correspondences regarding this application: (Note: This will include all committee correspondence, decision outcomes, renewal notices, and adverse event submissions. Co-investigators and faculty advisors are required to receive this information.)
**Credentials: Required for PI, Co-Is and Faculty Advisors**

Upload or update your CV, resume, or biographical sketch.

<table>
<thead>
<tr>
<th>Name</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bio Soloway IRB.doc</td>
<td>0.01</td>
</tr>
</tbody>
</table>

**Conflict of Interest Detail: Required for all roles except Administrative Staff**

C1 Do you, your spouse, domestic partner, or dependents have any outside interests or relationships to companies or entities related to this research that the IRB should consider?

Examples of outside interests include, but are not limited to the following:

- receiving compensation whose value could be affected by the study outcome
- IN THE AGGREGATE, expecting to receive compensation from the sponsor of the research of $10,000 or greater in the next year
- having a proprietary interest in the sponsor of the research or a product tested by this research including but not limited to, a patent, trademark, copyright, or licensing agreement, or the right to receive royalties from product commercialization
- individually or collectively, having an ownership interest (equity or stock options) in the sponsor of the research or product being tested whose value cannot be readily determined through reference to public prices
- individually or collectively, having an ownership interest (equity or stock options) in a company or product whose value could be affected by the study outcome
- IN THE AGGREGATE, having an ownership interest (equity or stock options) in the sponsor of the research that exceeds $10,000 or 1% when the sponsor is a publicly traded entity
- receiving significant payments of other sorts with an aggregate value of $10,000 or more (or payment of ANY amount to medical school or hospital employees) made directly by the sponsor of this research for unrestricted research or education, equipment, consultancy, or honorarium
- holding a position of management or leadership in company or entity related to this research including, but not limited to, officer, director, or member of an advisory board.
- providing consulting services or serve on a Speaker’s Bureau, either paid or unpaid, to the financial or non-financial sponsor of this study
- when the sponsor is a publicly traded entity, having any ownership interest (equity or stock options) in the sponsor
- expecting to receive any loans, educational support, contributions of in-kind for equipment, or any other non-compensatory payment from the sponsor of the research in the next year

no

C2 Please provide a detailed description of the outside interest in the box below.

C2.1 Where have you submitted a disclosure of this outside interest?

C2.2 Has a management plan been formalized?
C2.2.1 If yes, attach the management plan here, as well as any other applicable conflict of interest documents.

<table>
<thead>
<tr>
<th>Name</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There are no items to display

C2.2.2 If no, describe the financial interest in sufficient detail to permit the COI Ancillary Committee and the IRB to determine if such involvement represents a potential conflict-of-interest and/or should be disclosed to potential research subjects in the informed consent form.

Study Team Detail

1.4 Team Member:

Joseph Krajcik
Department: Other
Preferred email: krajcik@umich.edu
Business phone: 734-647-0597
Business address: School Of Education 1323 SEB 48109-1259

1.5 Function with respect to project:

Co-Investigator

1.6 Allow this person to EDIT the application, including any supporting documents/stipulations requested during the review process:

yes

1.7 Include this person on all correspondences regarding this application: (Note: This will include all committee correspondence, decision outcomes, renewal notices, and adverse event submissions. Co-investigators and faculty advisors are required to receive this information.)

yes

Credentials: Required for PI, Co-Is and Faculty Advisors

Upload or update your CV, resume, or biographical sketch.

<table>
<thead>
<tr>
<th>Name</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resume Krajcik</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Conflicts of Interest Detail: Required for all roles except Administrative Staff
C1  Do you, your spouse, domestic partner, or dependents have any outside interests or relationships to companies or entities related to this research that the IRB should consider?

Examples of outside interests include, but are not limited to the following:

- receiving compensation whose value could be affected by the study outcome
- IN THE AGGREGATE, expecting to receive compensation from the sponsor of the research of $10,000 or greater in the next year
- having a proprietary interest in the sponsor of the research or a product tested by this research including but not limited to, a patent, trademark, copyright, or licensing agreement, or the right to receive royalties from product commercialization
- individually or collectively, having an ownership interest (equity or stock options) in the sponsor of the research or product being tested whose value cannot be readily determined through reference to public prices
- individually or collectively, having an ownership interest (equity or stock options) in a company or product whose value could be affected by the study outcome
- IN THE AGGREGATE, having an ownership interest (equity or stock options) in the sponsor of the research that exceeds $10,000 or 1% when the sponsor is a publicly traded entity
- receiving significant payments of other sorts with an aggregate value of $10,000 or more (or payment of ANY amount to medical school or hospital employees) made directly by the sponsor of this research for unrestricted research or education, equipment, consultancy, or honorarium
- holding a position of management or leadership in company or entity related to this research including, but not limited to, officer, director, or member of an advisory board.
- providing consulting services or serve on a Speaker’s Bureau, either paid or unpaid, to the financial or non-financial sponsor of this study
- when the sponsor is a publicly traded entity, having any ownership interest (equity or stock options) in the sponsor
- expecting to receive any loans, educational support, contributions of in-kind for equipment, or any other non-compensatory payment from the sponsor of the research in the next year

no

C2  Please provide a detailed description of the outside interest in the box below.

C2.1  Where have you submitted a disclosure of this outside interest?

C2.2  Has a management plan been formalized?

C2.2.1  If yes, attach the management plan here, as well as any other applicable conflict of interest documents.

Name

<table>
<thead>
<tr>
<th>Name</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There are no items to display

C2.2.2  If no, describe the financial interest in sufficient detail to permit the COI Ancillary Committee and the IRB to determine if such involvement represents a potential conflict-of-interest and/or should be disclosed to potential research subjects in the informed consent form.

02. Sponsor/Support Information
The following sections request details about the current or pending sponsorship/support of this study. Consider all of the choices below and complete the appropriate sections.

* Note: At least one of the following sections must be answered. Multiple sponsors or sources of support must be added one at a time.

### 2.1 External Sponsor(s)/Support:

<table>
<thead>
<tr>
<th>Type</th>
<th>Name</th>
<th>Other Direct Sponsor/Support Type</th>
<th>Has PAF?</th>
</tr>
</thead>
<tbody>
<tr>
<td>View</td>
<td>Government - Federal without Stimulus Plan (American Recovery and Reinvestment Act) funding</td>
<td>National Science Foundation</td>
<td>Financial</td>
</tr>
</tbody>
</table>

### 2.5 Internal UM Sponsor(s)/Support: [Including department or PI discretionary funding]

Type | Department Sponsor | Support Type
There are no items to display

### 2.8 Check here if the proposed study does not require external or internal sponsorship or support:

- [ ]

#### External Sponsor Detail

#### 2.2* Direct Sponsor/Support:

If the Direct Sponsor/Support does not appear in the Select list, enter the name of the Direct Sponsor/Support below:

National Science Foundation

#### 2.2.1* Sponsor Type:

Government - Federal without Stimulus Plan (American Recovery and Reinvestment Act) funding

**If other, please specify:**

#### 2.2.2* Support Type:

Financial

#### 2.2.3* Is the support confirmed?

- [ ] Yes
  - [ ] No

#### 2.2.4* Is there an existing Proposal Approval Form (PAF) for this IRB Application
2.2.5* Please select the PAF(s) associated with this study. Clicking the Add button will allow for the selection of a PAF based on selected criteria. After the PAF(s) has been associated with the human subjects research application, clicking on the PAF link will access the Proposal Management system and will display the current PAF information. Access to the PAF is based on account information in the Proposal Management system.

Proposal ID
11-PAF03586

2.3* Is this a subcontract to UM?

- Yes
- No

03. UM Study Functions

3.1* Indicate all functions that will be performed at University of Michigan locations.

Select all that apply:
- Recruitment (including screening)
- Primary or secondary analysis (data/specimen)
- Storage (data/specimen)
- If other, please specify.

5-3. Research Design - Exempt Project

Completion of this section is required based on the response provided to question 1-1.1

5-3.1 Upload scientific protocol if one is available.

Name
Version

There are no items to display

5-3.2* Describe the objective and specific aims of the project. If included in the attached protocol, please indicate the section.

In order to enhance science learning through the use of science participatory simulations, this 2-year project will:

- Design and build the (1) Psim Software Factory and the (2) Cloud Platform for Education (CPE), the two backbone software applications for the effort.
- Input a PsimML definition of Cooties and a PsimML definition of energyXchange into the Psim Software Factory, which in turn will output a participatory simulation in the domain of energy exchange (energyXchange) and a participatory simulation in the domain of infectious diseases (Cooties), respectively.
- Test the two Psims, the output of the Psim Software Factory, in 5th grade classrooms, using appropriate RSSs running over the CPE (Figure 1)

we identify relevant research questions for this proof-of-concept effort:
RQ1 for Domain Scientists: What features should a PsimML have in order to make the task of defining a Psim for a domain expert a relatively straightforward one? Domain scientists are accustomed to complex, sophisticated simulations so we need to help domain scientists understand how to construct a Psim for a 5th grader. Also, a Psim, as described in Section 3.1, is based around a student’s choices/decisions. Again, that abstraction is not necessarily how a domain scientist conceptualizes a simulation of a sophisticated, complex system.

RQ2 for Software Development: How general (i.e., domain independent) can we make Psims? Our plan is to have the Psim Software Factory (PsimSF) take as input a PsimML description produced by a domain expert, and output a complete, runnable, mobile application, initially for the Android OS (but see Footnote 2). As described briefly in Section 3.1, a Psim has two parts (1) an interface through which a student inputs his/her choices (e.g., walk to school in energyXchange, and eat a nutritious meal in Cooties), and (2) a suite of visualization tools to support the student in understanding the events in the simulation. The challenge, it seems to us, is not in the initial specification of choices, but rather in defining visualization tools that are common to various domains.

To the extent that the visualization tools are independent of the science domain, the output of the PsimSF is more or less complete. However, if each domain requires that we craft new visualization tools, then the cost of generating Psims goes up – potentially significantly. Realistically, some visualization tools will be independent of the science domain and thus can be built automatically via the PsimSF, while there will most likely be some domain-specific visualization tools that will be need to be built for each domain. The ratio of custom software to generic software will be one of the issues we explore in this project.

RQ3 for Teachers: What materials make it relatively easy for a teacher to integrate Psims into his/her classroom? It goes without saying that professional development and curricular materials are critically important for the effective use of Psims by teachers. We will iterate on the design and development of these resources over the two years of the project.

RQ4 for Teachers: What evaluation techniques should teacher use to assess the impact of the Psims on student understanding? Besides providing the teachers with instructional strategies for using the Psims in the classroom, we need to provide teachers with strategies for formative and summative evaluations of the impact of the Psims on student understanding.

RQ5 for Students: To what extent are Psims engaging for students - and why? The assumption of this project is that Psims are engaging to students which in turn will result in increased time spent using the Psims which in turn will lead to increased understanding. While, as we have argued, there is good reason to believe that the Psims will be engaging, we need to assess the veracity of this claim. And we need to understand why or why not since the veracity may well vary from student to student.

RQ6 for Students: What interface elements (scaffolds, visualization tools) do students need in order to effectively use Psims? Inasmuch as this is a proof-of-concept effort, we readily admit that we will need to iterate on the design of the interface and the visualization tools in order to create the most effective elements as possible.

RQ7 for Students: What is the impact of using Psims on student understanding? As described in Section 4, we will collect a broad range of data from each student in order to better under the types of impacts using Psims has on their understanding.

5-3.3* Describe the scientific design of the project. If included in the attached protocol, please indicate the section.

Year 1: The overarching goal of this first year of the effort is to produce the software necessary for
a classroom-based user test of one Psim (e.g., Cooties). Thus, during Year 1 we will design and
develop the Psim Software Factory (PsimSF) and use it, along with the PsimML definition of the
infectious disease simulation to produce a mobile app, Cooties, one of the two Psims promised in
this project. We will also generate curriculum materials that will support the use of the Cooties in
the classroom.

In the design of the Psims, we will draw on our experience in using “Learner-Centered Design”
(LCD) techniques. The LCD design principles provide guidance in creating interface elements and
scaffolds that aid the learner in using software and gaining value from its use. We have used LCD
to design several well-received science education software applications, e..g, Model-It (a single-
user systems dynamics modeling program), University of Michigan Digital Library (an information
search environment), eChem (a 3-D molecule construction kit), and a mobile app, Chemation (a 2-
D molecule construction kit). A colleague, Chris Quintana, has used LCD to produce a number of
also well-received applications.

In the design of the science curricula, we will draw on our extensive experience in developing
project-based science materials (refs). Krajcik is a co-author on the Project-based Investigation
Science (PBIS) series, a project-based middles science curriculum, being distributed by Its About
Time Publishers. He is also the PI on a NSF middle school science curriculum called Investigating
and Questioning our World through Science Technology (IQWST). IQWST (Krajcik, Reiser,
Sutherland & Fortus, 2010) is a project-based, carefully sequenced, coherent middle school
curriculum that promotes student understanding of key scientific ideas and practices by
coordinating instruction across units within each grade level, and across 6th, 7th, and 8th grades.
We are currently negotiation with a publishing company to distribute IQWST. IQWST or PBIS units
promote student learning and engagement in science.

Finally, in our evaluation activities, we will draw on our experiences with other educational
software, e.g., Model-It, Chemation, University of Michigan Digital Library, eChem, etc. Also, our
model of evaluation is informed by the work of Salmon, Globerston, and Perkins (1991) where they
identified the following two types of impact:
- Effects with technology: Here we analyze how a student uses the technology, e.g., what
difficulties does a student have, what activities can a student now do because of the technology,
etc.
- Effects of technology: Here we analyze the learning residue, e.g., what science understanding
does the learner have as a result of using technology.

Inasmuch as this is a 2-year, proof-of-concept effort, our focus will be on the studying the “effects
with” rather than on a more summative, “effects of” evaluation. In particular, in the initial use of
Cooties in the classroom, our intent is to under its “usability characteristics” and answer the
following questions:
- What are the challenges in using Cooties by the students in the classroom? Here we are looking
at interface issues. Inasmuch as our Psims will be on the “complex” end of the spectrum for
“mobile apps” interface issues, e.g., ease of use, appropriate visualizations, etc. are a prime issue
that we must explicitly address.
- What are the challenges in using Cooties by the teachers? How do we need to (re)structure the
curricular materials to make the use of Cooties easier and more effective?
The above “usability questions” are specific issues in research questions RQ5, RQ6, RQ7.

We plan on using Cooties in at least three 5th grade classrooms during the Winter semester of Year
1. Soloway and Krajcik have, over the years, built up solid relationships with school districts all
over the United States who are actively engaged in mobile learning activities. The choice of the
specific school district, schools and teachers will be made at the outset of the grant activities. The
use of Cooties in multiple schools will provide the grist for our iterative design strategy.

Year 2: During the 2nd year of the project, our overarching goal is to establish a “proof-of-concept”
– that the educational value of Psims can effectively engage students in scientific thinking, as well
as explore the other research questions presented in Section 2. We will deploy two Psims (Cooties

https://eresearch.umich.edu/eresearch/ResourceAdministration/Projec...Info=False&PrintPageBreak=False&PrintLogo=True&showHiddenData=False Page 12 of 15
and energyXchange) in at least two 5th grade classrooms. It would be best if the same classroom could use both Psims since we might well be able to observe some cumulative effects of using Psims (e.g., easier to learn to use the second Psim; easier for the student to know how to abstract value from interacting with a Psim).

During Year 2 we will collect and analyze the data identified below:
- Student and teacher think-aloud interviews during Psim use
- Domain scientist think-aloud interviews during PsimML use
- Pre- and Post-Student interviews
- Pre- and post- student survey on beliefs on the nature of science
- In-class observations, including observations of Psim use
- Pre- and post- teacher interviews
- Activity logs and artifacts of student work using Psims
- Observations, surveys, and teacher feedback from professional development
- Interviews with teachers about their use of Psims

We will work with middle school 6 teachers from 3 districts in Southeastern. We have connections with Detroit, Flint and Airport Community Schools.

5-3.4* Describe the subject population for the project.
We will work with 6 middle school teachers from 3 districts in Southeastern. We have connections with Detroit, Flint and Airport Community Schools. For each teacher we will collect data from 2 classes. Each class has 25 to 30 students. This will give us a total population of 150 to 180 students.

5-3.5* Will the study involve recruitment and/or participation of subjects in order to produce new data (e.g., surveys, interaction, intervention)?
- Yes
- No

5-3.6* How will the study team interact with human subjects?
We will make classroom observations, interview students and teachers, and collect pre and post tests.

5-3.7* How will the study team be recruiting subjects?
We will work with administrators from the school districts to recruit teachers and their students.

5-3.8* Describe the setting for the research.
We will work in middle school classrooms in southeastern Michigan.

5-3.9* Indicate which of the following established subject pools, if any, will be used for recruitment.
Select all that apply:
- N/A

Provide Related UM IRB Project Number or Subject Pool Description:
5-3.10* Indicate which methods will be used for recruitment?

Check all that apply:

- Face-to-face contact (e.g. during a health care visit or an interview at a home address, etc.)
- Email
- Telephone

If Other, please indicate below:

5-3.11* Risk Level

Click "Add" to enter the risk level associated with this study.

Level Of Risk

View No more than minimal risk

5-3.12* Will the research involve the access, collection, use, maintenance, or disclosure of University of Michigan protected health information (PHI)? PHI is:

- information about a subject's past, present, or future physical or mental health, the provision of healthcare to a subject, or payment for the provision of healthcare to a subject; AND
- that is maintained by a University of Michigan school, department, division, or other unit that is part of the University's HIPAA-covered component (e.g. healthcare provider, healthcare plan, or healthcare clearinghouse).

Yes ☐ No ☒

5-3.13* Will subjects receive payment or other incentives for their participation in the study?

Yes ☐ No ☒

5-3.11.1* What is the level of risk of harm to the subjects resulting from this research?

No more than minimal risk

12. Exemption Category

Completion of this section is required based on the response provided to question 1-1.1.

12.1* Which of the following exemption criteria applies to the study?

EXEMPTION #1 of the 45 CFR 46.101.(b):
Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

12-1. Exempt Category 1 - Investigational Strategies in Educational Setting
Completion of this section is required based on the response provided to question 12.1.

12-1.1* Is the research conducted in an established or commonly accepted educational setting?

Yes  No

12-1.1.1* Describe the educational setting.
Middle school science classrooms in southeastern Michigan

12-1.2* Does the research involve normal educational practices such as research on regular and special educational instruction strategies, or research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods?

Yes  No

12-1.2.1* Explain how the research fits the definition of normal educational practice.
Students will learn important science ideas through use of participatory simulations. This is like doing any interactive activity in a classroom except that portable technology will drive the process.

12-1.3* Upload tests, surveys and/or interview questions.

<table>
<thead>
<tr>
<th>Name</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Questions.docx</td>
<td>0.01</td>
</tr>
</tbody>
</table>

45. End of Application

The form was successfully submitted. Click 'Exit' or 'Finish' to leave the form.