IPad Mechanics Physics Instruction

2015 IITG Tier 1 Round 4 Application - up to $10,000

Prof Dan L MacIsaac

SCIE462 Buffalo State
1300 Elmwood Ave
Buffalo, NY 14222

macisadl@buffalostate.edu
O: 716 878 3802
M: 716 909 2233

Application Form

Report Fields

Proposed Project Title*

Please enter the name of your proposed project

IPad Mechanics Physics Instruction

Project Abstract*

Provide a brief (150 word) abstract of your project.

We propose to create videos and written lab instructions as useable learning objects for teachers of physics both at the HS and College level. These materials will be shared across and outside of SUNY via the SUNY Digital Learning Commons.

We will obtain and integrate 11 IPads running Vernier Software's _Vernier Physics App for iOS_ (cited in MERLOT II) into Introductory Mechanics and Teaching Introductory Mechanics courses (PHY107, 111, 510 and 620) using technology for video data collection and analysis of motion data in instructional laboratories. We will use video capture of mechanical phenomena (Eg dropped, tossed, rotating, and colliding objects) to study projectile motion, directly measure object linear and angular displacement, velocity and acceleration, fitting and selecting appropriate mathematical models to mechanics in laboratory exercises. We will develop three appropriate laboratory experiments making use of the system for kinematics - gravitation/projectile motion, momentum conservation, and rotational dynamics. We also have longer-term plans to use the iPads for additional open-ended media physics projects and investigations.

Amount Requested*

Please copy or enter the final funding request from the red box on the budget worksheet. This amount must be the same as your final worksheet calculation

$10,000.00

SUNY Campus*

Please select your home campus from the drop-down menu:

Buffalo State College

Funding Renewal

If you are seeking funds to renew an existing IITG project, please enter the title of your previously funded project.

[Unanswered]

Previous IITG Funding Amount

If you are seeking funds to renew an existing IITG project, please enter the amount previously received.

[Unanswered]

Contact Information for Person Submitting Application

Salutation*
Please select

Prof.

First Name*
Dan

Last Name*
MacIsaac

Title*
Please enter your role, e.g., "Director, Sponsored Programs" "Administrative Assistant" "Associate Professor" "Clinical Professor"

Associate Professor of Physics

Campus Email Address*
macisadl@buffalostate.edu

Phone Number*
Please enter the best number to reach you during normal business hours

1 716 878 3802

Contact Information for Principal Investigator (PI) (faculty or staff responsible for the project execution)

Salutation*
Please select a salutation

Prof.

First Name*
Dan

Last Name of Principal Investigator*
MacIsaac

PI Campus Email Address*
macisadl@buffalostate.edu

PI Phone Number (Office)*
Please enter best number to reach PI during normal business hours

1 716 878 3802

Alternate PI Phone Number (Mobile or Second Office)

Please enter alternate contact number (mobile, home office, lab, etc.)

1 716 909 2233

General Guidance regarding the IITG Online Application Form:

Character Countdown is not connected to choice of font size. The countdown operates the same as "Twitter." Some overhead has been built in to compensate for cutting and pasting text from different types of word processors.

File Upload is limited and displayed regardless of choice of file format (PDF, Word, Excel). If you need to delete a file that has been uploaded, click on Save as Draft at the bottom of the page, delete and replace with the correct file.

WARNING: It's a good idea to "save as draft" periodically at the bottom of the form. But **DO NOT "submit" until you are satisfied the application is complete,** or you may need to start from scratch!

Principal Investigator (PI) Biographical Sketch*

You may either upload a CV summary or resume (2 page limit) or enter text below as a biographical sketch. If you choose a text description, it must include your primary campus role, responsibilities and "high level" details.

(Text Calculator = 1 page / 500 words)

MacIsaac_CV_Feb2015A_2pIITG-B.pdf

Co-PI's (Collaborators and Key Stakeholders)

Please list all Co-PI's, collaborators and key stakeholders. These names will appear on the project website if your project is selected for funding. For each person, you must include:

- Name
- Title (e.g. Associate Professor, Instructional Designer, etc.)
- Affiliation (school, department name or external partner)
- Brief paragraph of why this person is key to your project.

If you choose to upload this information, it must be consolidated into a single document.

(Text Calculator = 2 pages /1,000 words)

IITG2015MacIsaacPersonnel.docx

Certification of Campus Endorsement*

You may either enter text below or upload a letter that certifies you have reviewed this proposal with your Chief Academic Officer or designee [enter name], and it has been endorsed, including any matching or in-kind resources at the campus level. If your proposal involves campus IT resources, please include a letter of support from your CIO or designee, or certify that your senior campus IT officer [name] has reviewed and supports the commitment.

(Text Calculator = 1 page / 500 words)

Optional Letter(s) of Support

You may upload an optional letter of support. (If you have multiple letters of support, you may combine them into a single document for upload.)

KOQSptLettMacIsaac IITG.pdf

Optional Letter(s) of Support

You may upload an optional letter of support.

MacIsaacIPadLtr.pdf

Project Information

Based upon the criteria described for a **Tier One** IITG project in the 2015 IITG RFP please upload a brief (less than two pages) description of how your proposed project will meet the program objectives. (Please note: there is a separate section to expand on the budget narrative.)

In order to make your IITG project more discoverable via website browsing, please review and select from the theme(s)* below, up to three categories that best describe your project. If your project clearly fits within a single theme, please indicate “no further selection” for your second and third choice.

*Themes reflect 2014 EDUCAUSE Learning Initiative Content Anchors

Theme 1st choice

If your theme fits within a single theme, please indicate “No further selection” for your second and third choice.

Instructional Technologies- Open educational resources (OER)

Theme 2nd choice

OPTIONAL 2nd choice -- if your project fits in more than one category, you may choose a secondtheme.

If your project fits within a single theme, please indicate "No further selection" for your second and third choice.

Instructional Technologies- Mobile Learning

Theme 3rd choice

OPTIONAL 3rd choice -- if your project fits in more than one category, you may choose a third theme.

If your project fits within a single theme, please indicate "No further selection" for your third choice.

IT Integration- Multimedia

Please provide three intended learning outcomes for your grant project. It is recommended that you consider the theme of “Access, Completion and Success” although the objectives need not map to all three of those thematic terms when forming these objectives.
Each learning objective should be less than 250 words.

First learning objective*

Project faculty will acquire experience developing, assessing, refining and iterating a set of scaleable technology-based creative commons licensed physics OER -- three introductory physics mechanics activities for students. We will produce three lab activities and support materials that have passed through at least two drafts and one set of quantitative and qualitative data collection and analysis for impact on student learning in PHY111 and 620, and make these widely available to SUNY and worldwide physics instructors.

Second learning objective*

PHY111, 510 and 620 students at Buffalo State will learn to use video data capture, digitization, scaling, equation fitting and numerical analysis to collect position, velocity and acceleration data and model these data in three introductory mechanics laboratory experiments. Students will produce graded for-credit formal physics laboratory reports for credit in their classes using iPads and Vernier Video Analysis, together with supporting software (MS Excel and Word).

Third learning objective*

Project faculty will acquire hardware, software and experience in creating simple physics media projects for use in their own instruction, and provide access and limited guidance to these resources to their Buffalo State PHY111, 510 and 620 students. The outcome will include student physics media projects disseminated by the web (YouTube, SUNY/Buffalo State Digital Commons).

Innovative Instruction Project Narrative*

Please upload a document describing your project proposal (no more than 2 pages).

IITG2015MacIsaacProjectDescription.pdf

Project Timeline Estimate*

Please either provide a text timeline estimate for the major milestones described in the project narrative or upload a 1 page document.

(Text Calculator = 1/2 page / 250 words)

IITG2015MacIsaacTimeline.docx

Budget & Administrative Support

Budget Narrative*

If awarded, please upload a document describing how the funds will be allocated if awarded (1 page or less).

Project Budget*

Download, complete, and upload the 2015IITG Budget Worksheet here. The budget narrative will "tell the story" but please use the "Brief Rationale for Line Item" (last column) to provide key words that clearly reinforce and connect the line expenditure to the narrative. Please note - you MUST use this budget worksheet, no substitutions will be accepted.

MacIsaacIITG-Budget-template-dec-2014.xlsx

Certification of Budget Deadline Understanding*

SUNY IITG awards are part of University Wide campus allocations maintained in Albany. If your project is selected for funding, you must adhere to State procurement and all local campus policies and procedures. **Any funds not expended or encumbered by June 30, 2016 will not be "rolled over" or available the following year.** All encumbrances should be cleared, and all funds expended no later than August 15, 2016.

Please enter the text "I agree" in the box below to signify that you have read and understand that any funds awarded must be expended by June 30, 2016.

I agree

Administrative Support*

Please enter the name of a departmental staff contact who will assist you with state purchase requests and any procurement questions that may arise. If you receive an award, the person named in this field will be included in future notification of when funds become available. The person named must be familiar with the SUNY University Wide accounting processes and know who to contact in the campus business office.

Administrative Support Name

Dr. David S Abbott, Physics Inst Support

Administrative Support Email*

Please enter the email address of the administrative support contact named above.

abbottds@buffalostate.edu

Assessment Plan

Assessment Plan Narrative*

Please upload a document describing how you will assess your project outcome(s). This should include how you will seek (and document) evidence of how your innovation will impact student/faculty learning. (No more than 2 pages).

IITG2015MacIsaacAssessment.docx

Communication Plan

Open sharing and communication is a paramount principle of IITG. All project collaborators are required to use the SUNY Learning Commons to document project outcomes with enough detail to replicate or build upon a success through use of a Creative Commons license.

Communications Plan Narrative*

Please upload a document (or describe in the area below) how your project outcomes will be documented and shared to enable others to replicate and build upon the project innovation. (This may include - but is not limited to - videotaped presentations uploaded to YouTube, iTunes U or another openly available video resource, and/or links to documentation of practices, and assessment documentation.)

(Text Calculator = 1 page / 500 words)

IITG2015MacIsaacComms.docx

File Attachment Summary

Applicant File Uploads

- MacIsaac_CV_Feb2015A_2pIITG-B.pdf
- IITG2015MacIsaacPersonnel.docx
- KOQSptLettMacIsaac IITG.pdf
- MacIsaacIPadLtr.pdf
- IITG2015MacIsaacProjectDescription.pdf
- IITG2015MacIsaacTimeline.docx
- MacIsaacIITG-Budget-template-dec-2014.xlsx
- IITG2015MacIsaacAssessment.docx
- IITG2015MacIsaacComms.docx

IITG 2p Curriculum Vita of Daniel Lawrence MacIsaac

Department of Physics State University of New York (SUNY) College at Buffalo
462SCIE Bldg, 1300 Elmwood Ave, Buffalo NY 14222
+1 (716) 878 - 3802 (O); +1 (716) 909 - 2233 (cell); +1 (716) 878 - 4421 (FAX)
macisadl@buffalostate.edu http://PhysicsEd.BuffaloState.Edu/danowner

EDUCATION:

Ph.D. (1994). Education: Curriculum and Instruction: Purdue University, West Lafayette IN USA. Dissertation: Curricular Reformation in Computer-Based Undergraduate Physics Laboratories via Action Research.

M.S. (1994). Physics; Purdue University -- Non-thesis option.

M.A. (1991). Science Education; University of British Columbia, BC Canada. Dissertation: The Design and Implementation of Microcomputer-Based Laboratory Instrumentation in the British Columbia High School Chemistry Curriculum.

B.Ed. (1986). Science and Mathematics Methods; Mount Allison University, Sackville NB Canada.

B.Sc. (1983). Physics; Mount Allison University.

PROFESSIONAL ACADEMIC EXPERIENCE:

Jan 2011 - present **Adjunct Associate Professor of Physics**, *Department of Physics, SUNY University at Buffalo, Buffalo, NY*. Unsalaried courtesy appointment to nearest Carnegie R1 institution to support collaboration in scholarship, service and education initiatives with SUNY Buffalo (UB) faculty from Departments of Physics, Engineering, Chemistry, and Learning and Instruction.

Aug 2005 - present **Associate Professor of Physics,** *Department of Physics, SUNY--Buffalo State College, Buffalo, NY*. Tenured faculty teaching graduate physics education courses, also undergraduate physics courses. Acting Physics Department Chair for Summer & Fall semesters of 2008. I have advised or advise over 100 masters level physics teacher certification candidates. My research is in physics teacher preparation and physics learning. My contractual teaching load at Buffalo State is 9cr for 10months (two semesters) but I typically carry 10-13cr during the fall and spring and another 6-9cr summer semesters.

Aug 02 - Aug 05 **tenure track Assistant Professor of Physics,** *Department of Physics, SUNY Buffalo State College, Buffalo, NY*.

Aug 96 - Aug 02 **tenure track Assistant Professor of Physics and Astronomy**, *Department of Physics & Astronomy, Northern Arizona University, Flagstaff AZ 86011-6010*.

Jan 95 - Aug 96 **Visiting Assistant Professor of Physics**, *Department of Physics, Purdue University*.

Sept 86 - June 88 **Full-time Teacher,** *Ebb and Flow School, Ebb & Flow Indian Reserve #52, Frontier School Division #48, Manitoba Canada*.

PROFESSIONAL LICENSES:

Permanent level five teacher certification (HS Science and Mathematics) in the Canadian provinces of NB, NS, and MB. Interim teacher certification in BC (expired). Eligible for high school science and mathematics teaching certification in many US states.

SCHOLARLY ACTIVITIES: REFEREED JOURNAL PUBLICATIONS (14) SELECTED EXAMPLES:

MacIsaac, D.L., Falconer, K.A. & Wu, W. (2013). Improving Your Classroom Teaching via RTOP------Taking Physics Teaching as an Example. *Educational Measurement and Evaluation*. 2013.2, 4-9.

Saeli, S. & MacIsaac, D.L. (2007). Using gravitational analogies to introduce elementary electrical field theory concepts. *The Physics Teacher*, 45(2), 104-108.

Lui, X. & MacIsaac, D.L. (2005). An investigation of factors affecting the degree of naïve impetus theory application. *Journal of Science Education & Technology*, 14(1), 101-116.

MacIsaac, D.L., Henry, D., Zawicki, J.L. Beery, D. & Falconer, K. (2004). A new model alternative certification program for high school physics teachers: New pathways to physics teacher certification at SUNY-Buffalo State College. *Journal of Physics Teacher Education Online,* 2(2), 10-16.

MacIsaac, D.L. & Hämäläinen, A. (2002). Physics, behavior and pedagogy of ultrasonic SONAR systems. *The Physics Teacher*. 40 (1), 39-46.

MacIsaac, D.L. & Falconer, K.A. (2002). Reform your teaching via the Reform Teaching Observation Protocol (RTOP). *The Physics Teacher*. 40(8), 479-486.

MacIsaac, D.L., Cole, R.P. & Cole, D.M. (2002). Standardized testing in physics via the world wide web. *The Electronic Journal of Science Education*. 6(3). <http://unr.edu/homepage/jcannon/ejse/ejse.html>

MacIsaac, D.L. (2000). PHYS-L: A community of online physics educators. *The Physics Teacher*, 38(4).

Bodner, G., MacIsaac, D. & White, S. (1999). Action research: Overcoming the sports mentality approach to assessment / evaluation. *University Chemistry Education*, 3(1), 31-36.

REFEREED CONFERENCE PROCEEDINGS (15);
UN-REFEREED PRESENTATIONS AND PROCEEDINGS OF RESEARCH CONFERENCES (156);
PAPERS IN NON-REFEREED JOURNALS, UN-REFEREED COLUMNS, OCCASIONAL PAPERS, REPORTS (128) -- including over 100 ***WebSights*** monthly columns since 2002 on technology use in physics pedagogy in ***The Physics Teacher*** (the leading English language journal for introductory physics pedagogy; masthead at http://scitation.aip.org/content/aapt/journal/tpt).
FIVE (5) UN-REFEREED VIDEO VIGNETTES for physics teacher preparation. SELECTED EXAMPLES:

MacIsaac, D.L., & Falconer, K.A. (2014). An Introduction To Research On Physics Teacher Preparation For Teachers. INVITED presentation to Institut für Physik und ihre Didaktik, Mathematisch-Naturwissenschaftliche Fakultät. Universitat zu Koln, Cologne, Germany, 7 December 2014.

Falconer, K.A. & MacIsaac, D.L. (2014). W04: Workshop on the Reformed Teaching Observation Protocol. National Meeting of the American Association of Physics Teachers in Orlando, FL, January 2014.

MacIsaac, D.L., Abbott, D.S., Falconer, K.A. & Gomez, L.S. (2012). Invited Paper*: Integrating Lab and Lecture in Graduate Physics Courses for Teachers*. National Meeting of the American Association of Physics Teachers in Philadelphia, PA, July-Aug 2012. Available from http://physicsed.buffalostate.edu/pubs/AAPTmtgs/AAPT2012Sum/.

Falconer, K.A. & MacIsaac, D.L. (2004) (Authors & Producers; SUNY-BSC Production). *Reformed Teaching Methods: Think Pair Share*. [QuickTime Web Streamed Video 12:02]. Buffalo, NY: Authors. Retrieved February 20, 2014, from <http://physicsed.buffalostate.edu/rtop/videos/TPS/TPS.mov>.

INTERNAL GRANT PROPOSALS (22); EXTERNAL PROPOSALS (55) SELECTED EXAMPLES:

Gardella, J.A., Sykes, D., Liu, X., Cartwright, A.N., & MacIsaac, D.L. (2010). *NSF DUE 1102998: The University at Buffalo/Buffalo Public Schools (UB/BPS) Interdisciplinary Science and Engineering Partnership*. Unpublished SUNY-UB proposal to Targeted MSP program for $10,000,000 over five years. Available from the authors. A*ctive project*.

Gomez, L., MacIsaac, D.L., Wilson, D., Cushman, J., Harris, R.L., Henry, D., Lange, C. & Zawicki, J. (2010). *NSF DUE 1035360: WNY Noyce Scholars Partnership Phase II: An NSF Noyce Phase II Scholarship & Stipend (S&S) Project*. Unpublished proposal for $750,000 / 5 years. Available from the authors; *MacIsaac lead writer*, *active project*.

Chambers, L., MacIsaac, D., Carbonara, J., Lange, C., Williams, K., Higgins, P., Henry, D., Ackerman, S., Sabata, J. & Zawicki, J. (2009). *Students and Teachers Using Data from Investigations in Earth Systems (STUDIES)*. NASA Proposal 09-EPOESS09-0038 awarded $654,000 over four years. Available from the authors. *Funded and completed*.

Zawicki, J., MacIsaac, D.L., Henry, D., McMillen, S. & Wilson, D.C. (2004). *NSF-0434103: NSF-Noyce Western New York Partnership for New Science and Mathematics Teachers*. Unpublished proposal to the NSF Noyce Scholarship program awarded $462,000 over four years. Available from the authors; *MacIsaac lead writer*. *Funded and completed*.

MacIsaac, D.L., Henry, D., Plumb, M.F., & Josef, C.K. (2003). *DUE-0302097: The Physics Teaching Pathways Coalition: Alternative Pathways To Physics And General Science Teaching Certification*. Unpublished proposal to the National Science Foundation Science Technology, Engineering and Mathematics Teacher Preparation (STEMTP) program awarded $503,000 over four years. Available from the authors. *Funded and completed, established alternative certification program at Buffalo State*.

SCHOLARLY SUPERVISION ACTIVITIES:
From 2002-present at SUNY-Buffalo State College I have taught PHY 103, 104, 107, 108, 111, 112, 213, 304, 308, 324W, 485, 500, 502, 518, 520, 525, 590, 594, 620, 622, 690 and 721. I proposed, revised, developed and/or initially taught many of these courses.
External examiner for 2 Ph.D. candidates and 130+ Masters' projects in Physics / Physical Science Education (over 20 published in peer-reviewed literature). SELECTED EXAMPLES:

Sears, P. (2009). (PHY690) [Web] Physlet Based Peer Teaching for Regent Physics Review. *STANYS The Science Teachers' Bulletin,* Fall 2009 73(1), 22-29.

Yap, J. & MacIsaac, D.L. (2006, August). Instructional use of the Johnson electric motor. *Physics Education,* 41(5).

Bochicchio, S. M. (2005). PHY690: Post Use Review of School Island: An online test and remedial tool for New York State Regents physics students. *STANYS The Science Teachers Bulletin*, Fall 2005, 35-40.

SERVICE: Extensive national service mainly via the *American Association of Physics Teachers (AAPT)* on editorial and review boards and committees. International collaboration including travel and publications with physics teacher preparation faculty in China (Hubei U), Finland (U Helsinki), and Germany (Uni Koeln). Past acting Physics Department Chair and Buffalo State College Senator. College committee service includes College Senate Curriculum Committee (3 years).
Organizer: Western NY Physics Teachers' Alliance, WNY STEM Hub, and STANYS (Science Teachers' Association of New York State) Western Section Physics SAR (Subject Area Representative).
Scholarly peer review experience for *US National Science Foundation, Social Sciences and Humanities Research Council of Canada*, *The Physics Teacher*, *Physical Review Special Topics: Physics Education Research*, and IoP (UK) *Physics Education*. In the past: *Journal of Physics Teacher Education Online*, *Journal of College Science Teaching*.

Personnel: IITG 2015 MacIsaac iPad Mechanics Physics Instruction

Dr. Dan MacIsaac, Associate Professor of Physics, Department of Physics, Buffalo State

Dr. MacIsaac will be PI. He is PI and co-I on two other NSF supported projects at Buffalo State. He regularly teaches both introductory mechanics courses for physics majors and non-majors, and graduate courses for physics teachers combining physics pedagogy and content. He will be lead author of the mechanics lab experiments and require the use of these experiments in his own mechanics and pedagogy of mechanics instruction. He will also encourage and direct the use of the iPads for physics media development in required student projects, using insights from similar University of Cologne physics education practices.

Dr. David S Abbott, Instructional Support Specialist, Department of Physics, Buffalo State

Dr. Abbott has a PhD in Physics Education, supports instruction of all PHY courses at Buffalo State, teaches PHY103 and itinerantly PHY104. He maintains all department instructional equipment and often co-teaches or leads lab activities with instructors. Curriculum development and course pre and post testing for introductory courses (including intro mechanics) are in his job description. He also supports undergraduate and graduate physics students completing projects. He will work with MacIsaac to develop and refine the three mechanics labs, with the pre- and post- testing and data interpretation, and he will store and maintain the iPads with other Physics department apparatus. He will also load the laboratory handouts, instructions and video data files to the SUNY Digital Commons.

Ms. Kathleen Falconer, MS, Part-Time Lecturer, Department of Mathematics, Buffalo State

Ms. Falconer has an M.S. in Physics and M.S.Ed. in Physics Education, and acts as evaluator on two current NSF-funded projects in Physics Education Research at Buffalo State. She regularly prepares IRBs, collects, analyzes and presents data from projects at national conferences. She will handle IRBs, collect, analyze, report and present data. She will be the only paid personnel for this project.

Dr. David Ettestad, Associate Professor of Physics, Department of Physics, Buffalo State

Dr. Ettestad is Instructor of record for most calculus-based mechanics courses at Buffalo State. He will allow us access to his PHY111 laboratory students, lab time and evaluation opportunities and proffer feedback and guidance in developing three mechanics labs, and require their use for at least one offering of PHY111.

Dr. David Henry, Associate Professor of Elementary Education and Reading and Adjunct Professor of Physics, Departments of EER and Physics, Buffalo State

Dr Henry is a past HS physics teacher who regularly instructs physics for pre-service and in-service teachers summer in PHY510. He will allow us access to his PHY510 laboratory students, lab time and evaluation opportunities and proffer feedback and guidance in developing three mechanics labs, and require their use for at least one offering of PHY510. He will also encourage his students to complete a media project during their required projects.

Mr. Brad Gearhart, MSEd (Physics Education), physics teacher at Math Science and Technology Preparatory Academy PS#197, Buffalo Public Schools; and Summer Adjunct Instructor, Department of Physics, Buffalo State

Mr. Brad Gearhart is an alumnus of Buffalo State physics education who is employed summers on one of our NSF-funded projects. He will help with a high school adaptation and testing of the iPad mechanics labs, and help use them with local pre-service and in-service K-12 STEM teachers as appropriate. We hope to get permission to share video or stills of some of his students completing versions of the lab activities, which will require extensive negotiation with BPS and the Buffalo State IRB office.

BUFFALO STATE
The State University of New York

SCHOOL OF NATURAL AND SOCIAL SCIENCES

February 26, 2015

Dear Sir or Madam:

I am pleased to write in support of the proposal submitted by Dr. Dan MacIsaac and his colleagues entitled *iPad Mechanics Physics Instruction*. Dr. MacIsaac is well qualified to coordinate and lead this effort, and his team from the School of Natural and Social Sciences is equally well prepared to conduct the project. This IITG proposal is comprehensive, with emphasis first on faculty development to enable them to acquire experience creating, assessing, and refining three introductory physics mechanics activities that will be made available to SUNY and worldwide physics instructors via creative commons license.

A second outcome is that PHY 111, PHY 510 and PHY 620 students at Buffalo State will learn to use video data capture, digitization, scaling, equation fitting and numerical analysis to collect data on position, velocity and acceleration, then model the data they have collected in three introductory mechanics laboratory experiments. Students will produce formal physics laboratory reports for credit in their classes using iPads and Vernier Video Analysis, along with supporting software (Microsoft Excel and Word). An important long-term goal is to equip high school teachers with the skills to engage learners and involve them in rigorous computing activities.

The School of Natural and Social Sciences is strongly supportive of the scholarship of teaching and learning. The proposal by Dr. MacIsaac and his colleagues is an excellent example of IITG's vision to "support, monitor and embrace research on pedagogical practices to continually improve the instructional practices of SUNY faculty." I give it my full endorsement and support.

Sincerely,

Karen O'Quin

Karen O'Quin, Ph.D.
Associate Dean
School of Natural and Social Sciences

Buffalo State
State University of New York

1300 Elmwood Avenue
Buffalo, NY 14222-1095
www.buffalostate.edu

February 26, 2015

Dear Sir or Madame:

I am writing to express my support for Dr. MacIsaac's *iPad Mechanics Physics* project proposal to the SUNY 2015 *Innovate Instruct Technology Grant* competition.

This project builds on Buffalo State Physics commitment to quality undergraduate mechanics instruction and graduate teacher preparation courses by encouraging the use of video capture technology laboratories to capture, digitize, model and analyze motion data in three labs: one each for kinematics, momentum conservation and rotational motion. The investigative team includes Drs. MacIsaac, Abbott, Ettestad, and Henry who will develop and refine these activities in PHY111, 510 and 620 during 2015-16 and I expect they will proffer these activities to other department faculty, and share them to other SUNY institutions and beyond. I am also aware of and support limited involvement from Ms. Kathleen Falconer and Mr. Brad Gearhart, both Buffalo State adjunct instructors who will undertake IRB, assessment and HS classroom adaptation activity for this project.

The physics department is committed to housing, maintaining and providing access to the iPads as part of our standard instructional equipment, and to supporting activity development data collection and analysis in PHY111, 510 and 620, as long as these activities do not disrupt regular instruction of those courses.

Sincerely,

Dermot Coffey

Dr. Dermot Coffey
Chair of Physics

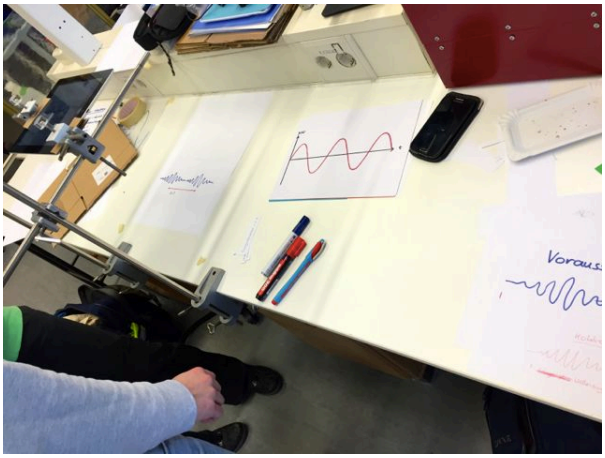
IITG2015MacIsaac: iPad Physics Mechanics Project Description

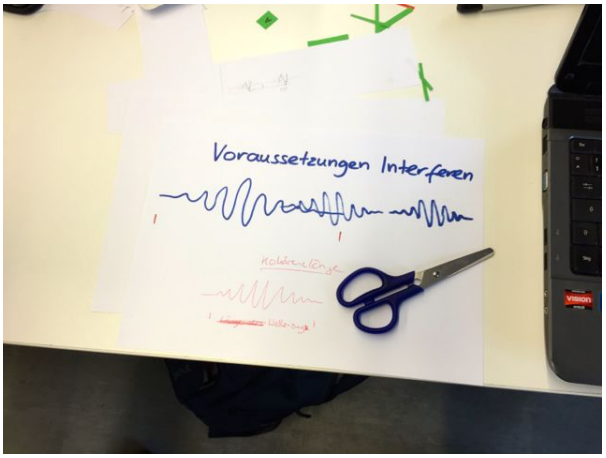
Our primary focus is to make use of integrated video and computing technology to readily collect and analyze mechanics experiment data in introductory physics labs for HS and college students, and teachers of these students. Currently, there is one developer known as Vernier Software who has developed a product known as *Vernier Video Physics for iOS*. This $5 software is reviewed in *MERLOT II* and further described in the product database at http://www.vernier.com/products/software/video-physics/ and a very early beta version is described in a 3min YouTube video https://www.youtube.com/watch?v=ugfWRPORSNg

Hence, we will actually be experimenting with *appropriate deployment of an off-the-shelf highly scalable low cost commercial app* in SUNY physics courses, and we will create a set of *Creative Commons* licensed *Open Educational Resources*: three laboratory lessons, handouts, rubrics and some sample videos for use in introductory physics classes. These will be evaluated, iterated and refined, then shared via *Digital Commons* spaces at SUNY and Buffalo State, as well as documented in a short article for the journal *The Physics Teacher*. We expect many other introductory physics instructors throughout SUNY and beyond will make use of these resources. We believe that we can influence Vernier's software development by recommending features as appropriate, and we will use PHY111, 510 and 620 at Buffalo State as our test bed, with some observations taken from a local HS physics class as well. Finally, we expect student content creation and sharing of appropriately analyzable videos of mechanics phenomena of particular interest to and generated by students as part of the experiments and extension projects.

We have seen the Vernier video laboratory software used by a local area physics classroom teacher discussed at a meeting of the *WNY Physics Teachers Alliance*, and during a recent invited visit observing the physics teacher preparation program at the *University of Cologne (Uni-Koeln)* in Germany. Several stills showing the use of the iPad to capture mechanics lab data can be viewed at: http://physicsed.buffalostate.edu/danmac/Family/KolnMedia/ In the photo below, note the use of a meter stick against the brick wall to scale a pixel count to known linear distance; the blonde woman student on the left with the iPad is video recording trajectories of both a thrown and dropped soccer ball for analysis in her class laboratory with her group.

Uni-Koeln also is using iPads with their STEM pre- service teachers to prepare short media presentations both for and with HS students using iPads, and an example stop-action animation student project video being prepared to show wave packet interference is visible in photos at http://physicsed.buffalostate.edu/danmac/Family/KoelnMedia1/ --the iPad is clamped over a table photographing a cartoon series. We have experimented with much more time intensive media production using traditional expensive equipment (for both pedagogical methods and student physics projects) but not yet with iPads.





Example traditional Buffalo State media project on physics teaching pedagogy:
https://www.youtube.com/watch?v=T1fPl5DFDK0
Student-generated and edited PHY111 physics project report video (Bengal Space Launch):
https://www.youtube.com/watch?v=8dSq9uXoCuE

Hence, as a secondary focus, we would like to start offering regular opportunities for *student physics media projects* in PHY courses, requiring such in PHY510, 620 and 622, but making this an option for other courses as well. We intend to do so with guidance from our German collaborators and this newly available to us technology. We will also make these videos available via *YouTube* and *SUNY / Buffalo State Digital Commons*.

We anticipate that the iPads and activities will become part of the regular laboratory instructional suite at Buffalo State physics, and become part of the materials maintained by the department (though the department can't afford acquisition of 11 iPads, maintenance and gradual replacement / renewal is within department budgetary ability if the project is successful). These technologies are also highly appropriate for instructing future physics teachers who are often called upon to use technology in physics instruction or even to act as technology resources in their own schools and STEM departments. For instance, *The Physics Teacher* journal now itinerantly presents a column called *iPhysics Labs* making use of smartphone and tablet sensors for capturing and analyzing data in the form of sound, high speed video, light, GPS position, acceleration, orientation, magnetic field, air pressure etc. These technologies are having a strong impact on introductory physics laboratories, and we do not want to be left behind. See http://scitation.aip.org/content/aapt/journal/tpt/browse

Timeline: MacIsaac IITG2015 iPad physics proposal

Summer 2015
Award announced early May prior to CIT

- IRB written and filed (Falconer)
- 3 lab handouts started (MacIsaac and Abbott)
- prototype kinematics lab tested in PHY510 with physics teachers using loaned iPads (early July; w/Henry)

Fall 2015
Intended funds release early Sept

- All equipment ordered; Falconer paid half funds for IRB
- October: Initial poster presented to Faculty/Staff Research and Creativity Forum day at Buffalo State
- first drafts of 3 labs: kinematics/projectile motion; momentum conservation and rotational motion tested in PHY111 with pre and post-testing and user/learner observations. HS version started.
- December: First drafts uploaded to SUNY Digital Commons.

Spring 2016
Second drafts of 3 labs: kinematics/projectile motion; momentum conservation and rotational motion tested in PHY111 with pre and post testing and user/learner observations. Labs offered to PHY107 instructors. HS versions tested (Gearhart).
May: First drafts uploaded to SUNY Digital Commons (Abbott).
May: CIT Conference presentation (travel)
May: Falconer paid off; all final orders made

Summer 2016
Close of funds date: June 30, 2016

Third draft of 3 labs tested in PHY510 and PHY620 with teachers (July-Aug)
Draft short article for *The Physics Teacher* on iPad labs prepared and submitted.

Afterwards:
- October 2016 : Final poster presented to Faculty/Staff Research and Creativity Forum day at Buffalo State

Reports submitted; all artifacts uploaded to SUNY Digital Commons

Innovative Instruction Technology Grant Application
Proposed Project Budget

Complete grey-shaded cells only; be sure budget narrative fully describes planned expenses and campus match.

**** Campus Match: examples are included in RFP with Tier 2 and Tier 3 award descriptions.**

Line Item	Description	Type: *Faculty, Staff or Student*	Effort *(Est. FTE or hours)*	IITG Grant Funding Request	Campus Match** *Required for Tier 2 & 3*
Personal Service/Personnel (indicate name, role & campus if known)					
1.	Kathleen Falconer, adjunct lecturer, Mathematics: IRB, Evaluation data coll and an	Adjunct Faculty	24hrs	600	0
2.	(Buffalo State)		0.0	0	0
3.			0.0	0	0
4.			0.0	0	0
5.			0.0	0	0
6.			0.0	0	0
7.			0.0	0	0
8.			0.0	0	0
9.			0.0	0	0
10.			0.0	0	0
11.			0.0	0	0
12.			0.0	0	0
13.			0.0	0	0
	Community Colleges Only: Fringe Benefit Expense (may be funding request OR campus match)			0	0
			Subtotal, Personnel Expense	**$600**	**$0**
Other-than-Personal Service/Personnel (OTPS)					
Supplies & Materials Items:		**Purpose** (if not obvious)		*$0*	*$0*
14.				0	0
15.				0	0
16.				0	0
17.				0	0
18.				0	0
Travel (list trips; OK to group trips for like purpose)		**Purpose** (if not obvious)		*$1,006*	*$0*
19.	Travel to CIT Conference for up to 2 project personnel in May 2016 to present on			1,006	0
20.				0	0
21.				0	0
22.				0	0
23.				0	0
Services (provide vendor name if known):		**Purpose** (if not obvious)		*$50*	*$0*
19.	2 posters for presentation at Faculty Staff Creativity Days			50	0
20.				0	0
21.				0	0
22.				0	0
23.				0	0
24.				*0*	*0*
25.				*0*	*0*
26.				*0*	*0*
Equipment (hardware, software & other equipment here):		**Purpose** (if not obvious)		*$8,344*	*$0*
27.	11 iPad Air tablets (64Gb)			6,171	0
28.	cases for above			858	0
29.	tripods and stands for above			500	0
30.	*secured storage locker +charger + networked sync for above*			760	0
31.	*software (Vernier video analysis)*			55	0
			Subtotal, OTPS Expense	**$9,400**	**$0**
GRAND TOTAL				**$10,000**	**$0**

IITG2015MacIsaac iPad Physics Mechanics: Assessment Plan

We will assess the use of iPads in mechanics laboratory instruction in a variety of ways. Dr. Abbott currently pre- and post-tests conceptual understanding of mechanics using a variety of standardized Physics Education Research instruments (either Hestenes' *Force Concept Inventory or FCI,* or Thornton and Sokoloff's *Force Motion Concept Evaluation or FMCE)* and statistically analyzes and reports scores and gains every semester as department policy for lower division courses, and for graduate mechanics pedagogy courses such as PHY510 and 620. So we will review the impact of these new iPad labs on student conceptual gain scores in at least PHY111 and 620 and we can compare to about 10 years of baseline data from multiple instructors. To this mix we will add the Beichner *Test of Graphical Understanding in Kinematics (TUG-K)* instrument as a pre and post test to see if the new experiments have an impact on student learning conceptual of graphical interpretation. More importantly, we will observe the student user experience via direct observation, videos and field notes, and conduct opportunistic focus groups with self-selected student users and collect their thoughts, comments and suggestions for refinement of the activities. Kathleen Falconer has considerable expertise in collecting and analyzing similar classroom physics observational data for related NSF projects http://physicsed.buffalostate.edu/pubs/TPT/TPTNov02RTOP/TPTNov02RTOPcorrected.pdf and will conduct this research.

MacIsaac, Abbott and Falconer will produce a short assessment report, poster and publication article on the relevant findings, with comments for instructors wishing to adopt these kinds of activities in their own introductory physics laboratories.

IITG2015MacIsaac iPad Physics Mechanics: Communication Plan

We plan to produce a video of students conducting the mechanics activities and share all experiment resources electronically via the SUNY and Buffalo State Digital Commons as *Creative Commons* licensed *Open Educational Resources.*

We will report project activities in at least one poster presentation at the October 2016 *Buffalo State Faculty/Staff Research and Creativity Forum* (also the Oct 2015 forum if funds are made available in a timely fashion, otherwise only in 2016).

We will report a final project poster to the annual *SUNY CIT conference* in May 2016.

We will present the same poster to a National Meeting of the *American Association of Physics Teachers* and the *Western NY Physics Teacher's Alliance.*

We will prepare a short manuscript for publication submission to the *iPhysics Labs* column of *The Physics Teacher* journal, and as a backup publish access and retrieval information for the OERs in MacIsaac's *WebSights* column in *The Physics Teacher*. We will also ask Vernier scientific Corp. to advertise our OER materials in their *Vernier's Caliper* newsletter to introductory physics teachers.

We will approach Mary Durlak, staff writer for *Buffalo State College Relations* regarding a possible short informational blurb on this project for placement on the *college website*, in out Alumni magazine *1300 Elmwood* etc. She has been very supportive of such for physics, physics education and physics teacher preparation efforts in the past.