Steelcase® EDUCATION

ACTIVE LEARNING CENTER
GRANT PROPOSAL

Please use this Microsoft® Word template to apply for the grant. We recommend that you reference the *Steelcase Education Active Learning Center Proposal Guide*, which contains helpful context and details, as you complete this form.

Register and submit your completed proposal electronically at **Steelcase.com/activelearningcenter**.

Due to the high volume of grant proposals we receive, it is not possible for us to respond to requests for feedback from individual applicants.

Submission deadline is Friday, February 2, 2018. Thank you for your interest in active learning.

EDUCATIONAL INSTITUTION: Virginia Polytechnic Institute and State University

Grades 6 – 12 ☐ College/University ☒

PRIMARY CONTACT: Timothy D. Baird

TITLE: Assistant Professor

ADDRESS: 127 Major Williams Hall, Department of Geography, Virginia Tech

CITY / STATE / ZIP: Blacksburg, VA 24061

PHONE: 540-231-5116

EMAIL: tbaird@vt.edu

Please tell us how you heard about this grant opportunity (check all that apply):

☐ Applied Previously ☐ Architect/Designer ☐ Article or Publication ☐ Colleague

☐ Professional Association ☐ Social Media ☐ Steelcase Dealership ☒ Steelcase Employee

☐ Tradeshow or Convention ☐ Other

Classroom description

Describe the classroom you will designate for the Steelcase Education Active Learning Center:

Number of students Up to 28 Grade level College

Room length 44ft. Room width 22ft. 6in. Room height 10ft. 8in.

Indicate which classroom application is most appropriate to support your educational needs. (See the four classroom descriptions on pages 11 – 15 of the *Proposal Guide*.)

☐ **Active Learning Classroom 1**
Flexible classroom encourages full participation across many modes

☒ **Active Learning Classroom 3**
Makerspace encourages exploration and problem solving

☐ **Active Learning Classroom 2**
Zoned classroom supports multiple, simultaneous activities

☐ **Active Learning Classroom 4**
Personalized classroom prioritizes large and small group work, with great breakaway options for individual work

☐ We understand that computers and monitors are not included in this classroom application

Insert photos of the current classroom space in the boxes below.
Please include a maximum of four photographs, and note that this document's file size must not exceed 10 MB (megabytes).

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Classroom description (continued)

In the space below, indicate how your educational institution will renovate the existing space, if required, to accommodate the Steelcase Education Active Learning Center.

Note: the classroom is expected to have updated floor covering, paint, lighting, etc. as part of the renovation.

The Center for Environmental Analytics and Remote Sensing (CEARS), located in room 217 Cheatham Hall was designed over 20 years ago to facilitate interdisciplinary leadership in remote sensing through formal instruction, outreach, cooperative research, and consulting. To fulfill that mission, the formal learning space was outfitted with traditional classroom furniture and computer hardware to support teaching, applied computer-based research, and public outreach functions. Over the years, CEARS has been used for formal classroom instruction in all disciplines in the College; it has hosted workshops and outreach activities for groups within and outside of the university, and has fostered the development of research projects by students, and faculty members in the College.

As can be seen by the attached photographs, the space is currently formatted in a traditional, theater style layout with 6 rows of 4 tables and a teaching station at the front of the room. The classroom supports 22 high-end computers that are used for both teaching and research activity. Each of the computers is connected to the university network through wired connections. Much of the research that is developed in this space involves the application of Geographic Information Systems, Bioinformatics, and Remote Sensing with big-data that requires high end computation.

In the current configuration of the classroom, there is little room for instructors to move through the space to interact with students and inhibits classroom community, student engagement, and active learning strategies that facilitate learning outcomes (e.g., critical thinking, collaboration, and creativity). For example, as currently configured, spacing between the tables and the row layout does not facilitate group interaction and discourages engagement with the instructor.

To accommodate the ALC we will renovate the existing space in a number of ways. First, the current projection system, which projects from a stationary workstation to a single display at the front of the room, will be replaced with a set-up that includes multiple displays on each wall via and Intel Unite collaboration display system. This will allow multiple groups working on projects to display information/ideas from multiple devices (laptops, tablets, smart phones) for others to view and respond to. Second, we will install fixed whiteboards to supplement the Steelcase's personal whiteboards, wall tracks and easel. To support this more open electronic infrastructure, we will also replace the current flooring with a new carpet tile floor covering that can accommodate the Steelcase thread power distribution system.

The current space contains a flexible room partition. This partition, along with a more flexible furniture layout, will afford more learning space options, including the ALC classroom or more intimate group spaces for study groups, research planning meetings, and other types of gatherings.

Lastly, our renovation will include the installation of various sensing devices including wired and wireless accelerometers, ceiling mounted video cameras, and acoustic sensors (i.e., microphones). These will transform the ALC into a cutting-edge, living laboratory. These sensors, which will be described in detail below, are integral to the research component of our proposal.

In summary, the renovation of 217 Cheatham Hall will include the following: (1) removal of current furniture and flooring; (2) installation of Steelcase thread power distribution system; (3) painting of room; (4) installation of carpet tile flooring; (5) installation of new displays throughout the room; (6) installation of Intel Unite collaboration system; (7) installation of new Steelcase furniture and whiteboards; and (8) installation of ceiling-mounted video cameras and accelerometers.

Educational philosophy

In the space below, describe the following:

- Desired teaching methods you want to achieve
- Credentials of the staff member(s) who will be responsible for the Active Learning Center Grant two-year program
- How the instructor(s) using this classroom will be selected

Maximum of 500 words

CEARS was established as a NASA Center of Excellence intended to apply remote sensing to the integration of regional and global environmental assessment. The center's computer classroom/lab space was designed for education and collaborative research. Today, core faculty members have initiated efforts that incorporate new pedagogical approaches that facilitate collaboration, nurture creativity, and improve student learning outcomes.

Desired teaching methods

The current classroom design was predicated on a traditional, lecture-based pedagogy to train students and other researchers to investigate research problems through the use of highly specialized geospatial software. This design no longer serves modern approaches to education and research, or industry workforce expectations. Advancements in these areas require interdisciplinary teams, environmental analytics, and big-data processing to address the grand challenges of environmental systems. A principal goal here is to develop competency in data analysis and computational methods, while guiding students to work in team environments on complex, real-world problems. This goal requires learning spaces that nurture collaboration and creativity.

We envisage a creative, collaborative, active-learning environment that promotes engagement, embraces design thinking, and stresses team-based computing. Successful teaching and learning in the area of advanced research computing undoubtedly requires several technological affordances, including high-speed internet connections, flexible access to cloud computing, and hard-wired computers with specialized software and data visualization tools. Furthermore, we recognize the centrality of the **learning space** as a critical element of our success. Our vision is to combine these assets with a design that maximizes form and function that facilitates creativity, collaboration, and learning.

ALC Grant staff and credentials

Several individual at Virginia Tech will come together to organize, implement, monitor, and conduct our proposed program. Dr. Timothy Baird, who serves at the primary contract for this proposal, will oversee all aspects of the project. Leslie Fuller, who serves as a systems administrator in the proposed building, will oversee classroom renovation and maintenance of data collection systems. Drs. Pablo Tarazaga (Mechanical Engineering) and Ben Knapp (Electrical and Computer Engineering), along with members of their labs, will lead the sensor installation, and data collection and processing components of the project. Drs. Baird (geography) and David Kniola (education) have expertise on intelligent infrastructure sensors, grant management, active learning, and collaboration and creativity in academic settings. Baird (Geography) and Dr. David Kniola (Education) will oversee the social data collection and lead the integration and analyses of all data. Both have been working with Steelcase and are familiar with the long-term mutual interests in creating exceptional educational spaces.

Instructor selection

Drs. Valerie Thomas (CEARS co-director) and Randy Wynne (Forestry) will oversee the selection of instructors to teach in the ALC and conventional classroom, both for the study and ongoing use of these spaces. Instruction in the room will be for graduate students and upper-level undergraduate students in environmental informatics. Our study will likely involve the course Information Technologies for Natural Resource Management (FREC 4114). This course is offered every year, with multiple sections each taught by the same instructor. This would afford multiple experiment and control groups.

Expected impact and research topic

Describe the ways you believe the Active Learning Center can have an impact on teaching and learning and support your desired teaching method, and tell us which of the following topics you plan to research – Engaged Learning Experiences, Instructor Experiences, Non-Cognitive Factors or Emerging Technology Integration. (See page 7 of the *Proposal Guide* for more information about these research topics.)

Maximum 500 words

Expected Impact

Computer labs and computer-based learning spaces are essential in all levels of education. As demand for high-performance computing and "big data" analyses continue to grow, new spaces must not only support burgeoning technological platforms but incorporate designs and aesthetics, forms and functions, that support collaboration, creativity, and human wellbeing. With this in mind, we expect that the ALC will be both highly functional and broadly inspirational for instructors, students, and researchers.

For instructors, we expect the ALC to nudge them towards active-learning strategies and behaviors throughout the semester – and throughout their teaching going forward. Our hope is that instructors will feel supported and empowered to move around the room, to engage students, to assign group work, to encourage discussion, to have fun, to take chances and experiment, and to be reflective continually about how their strategies to leverage the ALC are working and how they could be improved.

For students, we expect the ALC to disrupt their assumptions and expectations regarding education generally and computer-based learning specifically. Over the course of the semester, we expect students to identify how their learning experiences in the ALC compare to their traditional experiences. For example, we expect students to enjoy preparing for and attending class in the ALC. We expect them to feel more comfortable engaging the instructor. We expect them to feel more confident contributing in large- and small-group settings. And we expect them to feel more relaxed and safe in the classroom community - and ready to learn and create.

Research Topic

The proposed site at Virginia Tech includes two computer labs in Cheatham Hall and affords an ideal experiment/control set-up. These labs are each used to teach undergraduate and graduate courses on the analysis of big data, especially spatial data. They include powerful desktop-computers and therefore present a unique learning-environment design challenge that characterizes many learning and working environments. One lab will be converted to a ALC and the other will remain as a control lab. In each room various sensors will be installed, including: accelerometers, cameras, and microphones.

Our research topic explores frontier concerns in the fields of education research, intelligent infrastructure, human-building interactions, and computer vision. And while our driving concern is to observe how the ALC impacts student and faculty outcomes, our project addresses several research topics listed in the ALC grant proposal guide. First, we will be developing strategies to measure, quantitatively, **Engaged Learning Experiences** using social surveys and embedded sensors. Second, we will use qualitative interviews to learn about **Instructor Experiences**. Third, our social survey will solicit information on students' **Non-Cognitive Factors**, which are known to affect learning outcomes, and therefore will be integral to understanding the net impact of the ALC. And perhaps most significantly, we will embrace **Emerging Technology Integration** by embedding various sensors in the study rooms and the furniture to collect data on patterns of movement and human behavior. Appropriate ethics approval will be obtained from Virginia Tech's Institutional Review Board (IRB).

Research method(s)

Please tell us how you will research the impact of the Active Learning Center for students and for instructors. We encourage you to use this space to describe the following:

- What qualitative and/or quantitative research methods might you use to answer your research topic?
- How do you plan to analyze the data?
- What metrics you do plan to obtain?
- Who from your institution will oversee/do this research?

Maximum 1000 words

To evaluate the impact of the ALC for students and instructors, our research project will address the following broad questions:

(RQ1) How is room type (i.e., ALC vs conventional) associated with student and instructor outcomes, controlling for other factors?

(RQ2) For each room type, how are data from various sensor technologies correlated with student and instructor behaviors and perceived outcomes, controlling for other factors?

To address these questions, we will collect and analyze mixed quantitative and qualitative social data as well as quantitative data from various sensor technologies. Active learning involves strategies to enlist students' active, rather than passive, participation in the learning process and to promote student engagement. Correspondingly, we seek to measure active learning strategies, related social outcomes, and potential sensor-derived correlates of both strategies and outcomes. In the following sections we will describe our social data collection, sensor data collection, hypotheses, and strategies for analysis.

Social Data Collection:

The table below presents the social data needs and collection plans for this project:

Data needs	Data collection plans
Active-learning events	These data will be collected in two ways: (1) instructor reports of daily activities (lecture, group work, etc.); and (2) participant observation (a teaching assistant will attend class and record notes of classroom activities including time stamps.
Student perceptions	We will administer a quantitative, standardized survey each month of the semester that asks for students' perceptions on a range of topics, including: (1) the physical classroom environment; (2) personal engagement in the course (e.g., class participation, time on homework, applying course to life, helping others, office hours, etc.); (3) perceptions of content and pedagogy (e.g., ranking pedagogical strategies and content from most to least engaging); and (4) overall learning community in the course (e.g., perceptions of belonging, safety, etc).
Student performance	We will record students' assignment and exam grades.
Control factors	We will record student characteristics, including: gender, year at VT, major, and a short series of questions to determine the "big five" personality traits. Also a unique identifier will be collected so that individuals can be tracked over the semester.

In addition to these quantitative measures, semi-structured, qualitative, individual interviews will be conducted at the end of the semester with instructors and a sample of students. The purpose here is to discuss: (1) how each room influenced teaching and learning; (2) the development of a learning community; and (3) students' academic performance and perceptions of creativity.

Sensor Data Collection:

The table below presents the sensor data needs and collection plans for this project. Sensor data collection will involve continuous collection from each sensor, during each class period. Integrated analyses of these data and social data will be conducted to address RQ2.

Data needs	Data collection plans
Active-learning events	Accelerometers: Wired and wireless accelerometers will be placed strategically in each room to measure various types of movement including macro-measures of floor vibration (3-4 wired/room) and micro measures of individually instrumented chairs (3-4 wireless/room) (see Figure 1). These data can be used as general measures of movement (instructor and student) in the classroom. Cameras: Wide angle cameras will be installed in ceiling tiles to collect data on instructor mobility in the class and individual students' spatial patterns, including measures of movement, affect and participation. These patterns may be identifiable with various computer vision techniques. Microphones: Microphones, which measure auditory vibration (not language), will be installed to measure classroom lecture/discussion patterns.
Student behaviors	Cameras: Computer vision algorithms may potentially be used to identify measures of engagement including: taking notes, raising hands, using whiteboards, student affect (e.g., open vs. closed posture), orientation towards speaker, individual vs group work, etc. (see Figure 2).

Figure 1.

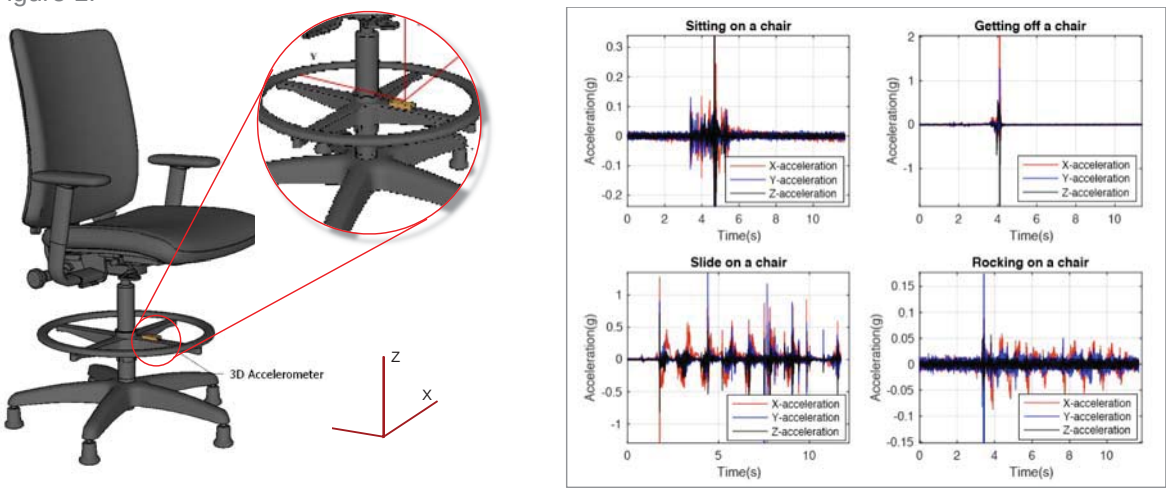


Figure 2.

Hypotheses:

These social and senor data will allow us to test many hypotheses related to movement, engagement, community, and learning in each classroom. Here we present five core hypotheses:

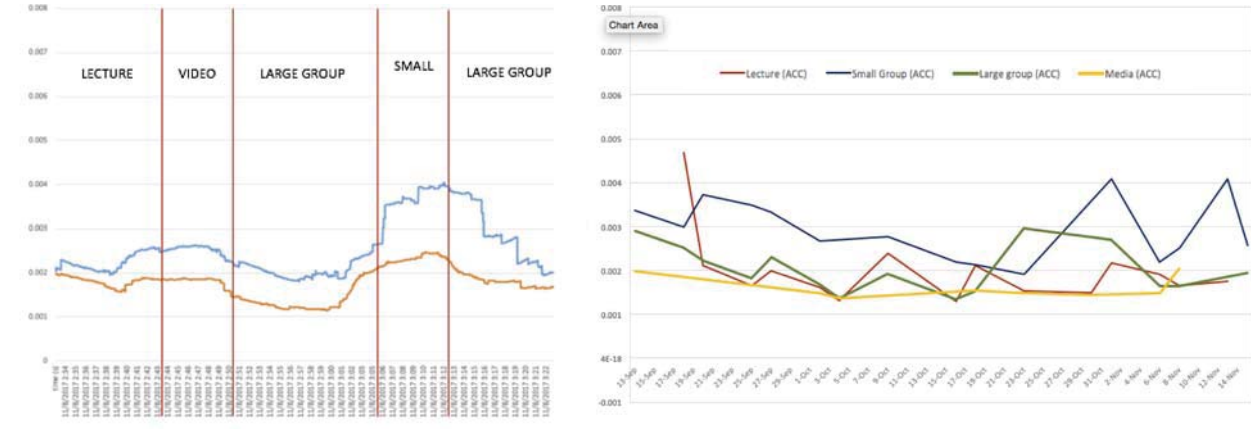
H1. Student perceptions of environment, engagement, pedagogy and learning are more positive in the ALC compared to the conventional room, controlling for other factors.
H2. Student performance is stronger in the ALC compared to the conventional room, controlling for other factors.
H3. Sensor-derived measures of active-learning events and student behaviors are greater in the ALC than in the conventional room.
H4. Differences in student perceptions between the ALC and the conventional room are correlated with differences in sensor-derived measures of student behavior.
H5. Sensor measures of movement exhibit a U-shaped relationship with student measures of perceived engagement wherein the lowest and highest measures of movement are associated with the highest levels engagement.

This last hypothesis was raised for us during pilot studies of these data collections strategies. In Figure 3, which shows camera derived bounding boxes around students' movements, a high impact practice (A) and active-learning activity (C) are each associated with higher levels of student engagement, compared to traditional lecture (B).

Figure 3.

Similarly, accelerometer data collected over 2 months (Figure 4) provides some evidence that the most engaging classroom activities, including small-group discussion (blue line, "2 months" graph) and mixed media (yellow line), yield the highest and lowest accelerometer values, respectively. Notably, daily patterns of movement for different pedagogical strategies vary considerably (see "1 day").

Figure 4.



1 day

2 months

Analyses:

To address RQ1 and RQ2, we will conduct analyses to identify ***change*** in student and faculty outcomes over a full semester AND ***difference*** in outcomes between the ALC and the control room. Here we present 3 likely analytical strategies for analysis:

(1) Standard descriptive and multivariate statistical techniques of student perceptions will be used to test **H1** and **H2**.
(2) Computer vision algorithms to identify student behaviors in both classrooms will be developed and tested against raw video. To test **H3**, significance tests of data from the two classrooms will be performed for multiple time scales.
(3) To test **H4** and **H5**, indices of student engagement that distinguish between pedagogical techniques and course content will be constructed and compared with sensor-derived data for each iteration of the social survey (4x). This will provide measures of the relationship between student perceptions and student behaviors for each classroom.

Disseminating findings and insights

Describe how your educational institution will share your research results (see the "Dissemination" section on page 6 of the *Proposal Guide*) within your institution and with external audiences throughout the two-year grant period.

Maximum 300 words

This project will explore frontier areas of teaching and research in several disciplines and we anticipate many opportunities to disseminate our results. Here, we propose a plan to engage instructors, scientists, administrators, and non-academics within VT and with external audiences.

Our plan begins with news stories and press releases written by various Offices of Communication at VT. These will be professional journalistic pieces for university-wide communication and adoption by external media outlets. Relatedly, we will propose a story to the editor of the *Virginia Tech Magazine*, which has a quarterly mailing list of approximately 231,000. We will also submit a proposal to the newly created VT Active Learning Curation Program, which has the mission of creating physical and digital exhibits to promote active learning environments and strategies. These types of dissemination will be promoted on several university websites. Our work will immediately inform teaching and research strategies in three other instrumented buildings/classrooms at VT. And the ALC will serve as a focal point for K-12 groups that visit the College of Natural Resources (in Cheatham Hall) each year.

To broaden our dissemination of this work we will reach out to external audiences in several ways. First, we will submit an article proposal to the editor of *About Campus*, a highly influential industry journal about the student learning experience. Notably, the editor is a Vice-President at Virginia Tech. We will also submit an article proposal to editors at *theconversation.com*. This organization, which Baird has worked with, pairs academics with journalists to write for general audiences. It is a good way to create engagement on social-networking channels like Facebook, Twitter, and LinkedIn.

Lastly, we will also pursue conventional academic means of dissemination through conference presentations (e.g., T-Summit, Conference of Higher Education Pedagogy, AAC&U) and academic journal articles in education and engineering.

Project timeline

Provide a timeline indicating the chronological order in which the required activities of the grant will be undertaken, including the lead person responsible for each activity. (Activities include: Administration of the Steelcase Education Learning Environment Evaluation measurement tool, your own impact measurement activities, research schedule, dissemination of findings and insights, writing an annual report each year.)

One page maximum

Summer 2018
1. Setup ALC space in Cheatham Hall (Fuller will lead)
2. Install sensors in ALC and control room (Tarazaga and Knapp will lead)
3. Develop/refine social data collection tools (Baird and Kniola will lead)
4. Proposal to VT Active Learning Curation Program to document study (Baird to lead)

Fall 2018
5: Teach in ALC and control rooms (Thomas and Wynne will lead)
6: Sensor data collections (Tarazaga, Knapp, and Fuller will lead)
7: Social data collections (Baird and Kniola will lead)
8: Administration of the Steelcase measurement tool (Baird and Kniola)

Spring & Summer 2019
9: Analysis of social and sensor data (Baird, Kniola, Tarazaga and Knapp will lead)
10. Qualitative interviews with select students and instructors (Baird and Kniola will lead)

Fall 2019
11. Apply to spring conferences (CHEP, T-Summit, AAC&U) (Baird and Kniola to lead)
12. Proposals to VT Magazine, About Campus, (Baird and Kniola to lead)
13. VT press releases and features on VT websites, (Baird and Kniola to lead)
14. Begin drafting academic paper (Baird and Kniola to lead)

Spring 2020
15. Present at various conferences (Baird and Kniola to lead)
16. Submit academic paper to journal (Baird and Kniola to lead)
17. Proposal to theconversation.com (Baird and Kniola to lead)

Grant writing team

In the space below, please provide the names of those within or outside of your institution who helped write, consult, or complete this grant proposal.

Timothy Baird, PhD, Department of Geography, VT
David Kniola, PhD, School of Education, VT
Pablo Tarazaga, PhD, Department of Mechanical Engineering, VT
R. Benjamin Knapp, PhD, Electrical and Computer Engineering, VT
Valerie Thomas, PhD, Department of Forest Resources and Environmental Conservation, VT
Randy Wynne, PhD, Department of Forest Resources and Environmental Conservation, VT
Leslie Fuller, Systems Administrator, College of Natural Resources and Environment, VT

Commitments of grant recipient

(confirmed in three-party agreement)

We understand that the Active Learning Center Grant classroom options have been carefully developed by Steelcase Education, and that no major furniture substitutions will be allowed. However, minor changes for best use and fit in a specific classroom will be discussed with each grant recipient.

We have reviewed, understand and agree to all the commitments of a grant recipient as described in the Active Learning Center Grant Proposal Guide.

Name of school representative:	Linda R. Bucy
Signature:	Lauren P. Maguire for
Title:	Assistant Vice President and Interim Director for Sponsored Programs
Date:	February 1, 2018

☐ Steelcase Education has my permission to use images of my classroom for any purposes in connection with promoting the Steelcase Education Active Learning Center Grant and its activities, which may include advertising, promotion and marketing. No institution names will be used in these promotions or activities.

☐ Our institution would like to be contacted by a Steelcase Education representative to speak about products, insights or research as it relates to our learning spaces.