Integration of Sensors into Secondary School Classrooms

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Abstract - The University of Maine (UM), in collaboration with several Maine middle and high schools, is introducing sensors into secondary curricula to motivate students to follow science and engineering career paths. This program is supported by two National Science Foundation grants: GK-12 Sensors! and RET (Research Experience for Teachers)-Sensors! Secondary school teachers are awarded fellowships for an eight-week summer session, where they become involved in cutting-edge sensor science and engineering. During the summer, GK-12 fellows are paired with RETs who become participating teachers in the GK-12 program. RETs and GK-12 fellows have developed sensor modules and integrated sensors into a wide range of middle and high schools courses. In addition to providing a positive impact on students and teachers, the program has provided community outreach and fellows and teachers have described their interactions in conference presentations and refereed publications. Initial program evaluations indicate that student exposure to sensors encourages them to follow science and engineering career paths. The UM System Chancellor is committed to the program’s sustainability, as evidenced by a bill currently before the State Legislature to create continuing financial support for the program.

Index Terms - GK-12, High School, K-12, Middle School, Sensors.

BACKGROUND

Attracting, retaining and/or incubating high technology-based industries in a region is controlled to a large extent by the presence of a work force educated in science and/or engineering. This work force is often created by science and engineering programs at nearby universities. If more than one university is nearby, the economic effect can be dramatic, as evidenced by areas such as Silicon Valley, the Research Triangle in North Carolina, and the Route 128 area surrounding Boston. However, even a single university, though isolated, can attract, retain and incubate high technology industries if a symbiotic relationship exists between the university and the high technology industries.

The state of Maine is different from most other states in that it has a sparse population density and only one significant research university; namely, the University of Maine (UM) in Orono. Although other schools of higher learning, such as the University of Southern Maine, Colby College, Bowdoin College and Bates College, exist, they do not have the resources—particularly in the science and engineering disciplines—that are available at UM. In recent years the state of Maine has experienced the loss and/or significant downsizing of labor intensive industries such as paper companies, fishing based industries, and shoe industries. The resulting unemployment has produced an exodus of workers from the state. Efforts to reverse this trend have included providing education to the unemployed work force in Maine and focusing on the aspirations of youth currently in secondary school systems. Although providing educational training to the work force might help increase the number of available people in science and/or engineering, such a stop-gap measure will not pay dividends in the long term. In order to provide an environment conducive to high technology industry, the focus should be on Maine youth in secondary school systems.

In an attempt to increase the work force educated in high technology, UM has added world-class researchers in the areas of microbiology, microelectronics and sensors to the faculty. As a result of the university’s investment, several small companies have been incubated which employ trained scientists and engineers from the state. Some of the university’s recent and most promising graduates have chosen to pursue careers in-state, therefore decreasing the brain drain from the state. Others have strengthened small high technology businesses within the state. However, in spite of the efforts of UM, the state’s economic picture still remains bleak.

In a further attempt to improve the state’s economic picture, UM has been placing science and engineering graduate students in elementary and secondary schools, to serve as positive role models. This has been done in an effort to

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increase the aspirations of Maine youth and convince them to follow science and/or engineering career paths. Two National Science Foundation (NSF) funded multi-year programs, namely GK-12 Sensors! and Research Experience for Teachers (RET)-Sensors!, at UM, are mainstream in this initiative.

**GK-12 Sensors! Genesis**

The idea of the GK-12 Sensors! program emerged in the summer of 2001 as a result of interactions between Stephen Godsoe, head of the Bangor High School (BHS) Math Department, John Vetelino, Professor of Electrical and Computer Engineering at UM, and Constance Holden, a former high school teacher and currently an instructor in Spatial Information Science and Engineering at UM. In the summer of 2001, Stephen Godsoe was awarded a NSF RET supplemental grant giving him the opportunity to participate in cutting-edge sensor science research with Vetelino.

During the summer, Godsoe, Vetelino, and Holden also began discussing methods for encouraging Maine high school students to follow career paths in science or engineering. They realized that, while students are surrounded by sensors in their homes, schools and other places they frequent, they do not know the science or engineering that underlies sensors and sensor systems. Godsoe, Holden and Vetelino moreover recognized that this underlying science and engineering could readily be integrated into a wide variety of secondary school classes such as chemistry, physics, biology, environmental science, mathematics, computer science as well as social sciences such as civics. Furthermore, since the area of sensors is a high-profile UM research strength, it was decided that sensors should be the vehicle of choice to convince high school students to follow a science or engineering career path. As a result of these discussions, a proposal relating to the integration of sensors in Maine secondary school curricula was submitted to NSF and funded in March 2002. GK-12 Sensors! began targeting schools, and GK-12 graduate fellows were selected for the 2002-2003 academic year. The fellows were involved in sensor research and came from a number of different science and/or engineering related backgrounds. The PI and Co-PIs also selected a number of regional secondary school educators to participate in a supplemental RET program and become part of the GK-12 Sensors! program.

**Program Organization**

GK-12 Sensors! consists of a Principal investigator (PI) (John Vetelino), two co-PIs (Stephen Godsoe and Constance Holden), a program manager (Joe Arsenault), fifteen fellows and more than two dozen teachers in participating middle and high schools. Each fellow is assigned to a teacher, with whom s/he works, generally one-to-one throughout the school year. Each fellow spends ten hours per week with his/her teacher developing learning modules that integrate sensors into the curriculum and participating in classroom teaching. Fellows maintain journals and report activities to the program manager, who reports to the PI. Teachers interact informally with the PI, Co-PIs and the program manager. Informal workshop-seminars are held in the fall and spring for fellows and teachers. A program evaluator from UM works with the PI, co-PIs, fellows and others to develop appropriate instruments for measuring program effectiveness for students, fellows, teachers, and participating institutions.

**2002-2005 Operations and Activities**

1. Spring 2002-Summer 2003: Start-Up & Academic Year

In the 2002 spring, UM graduate students working in sensors were made aware of the opportunity to become GK-12 fellows through the GK-12 Sensors! program. Each applicant submitted a written statement expressing his or her career objectives, two references and a grade transcript. Selection was based on a personal interview, references, academic promise, performance in sensor research, and interest in participating in the project.

Two high schools were targeted for the program’s first year: Bangor High School (BHS) and John Bapst Memorial High School (JBMHS), both located in Bangor. One reason motivating these choices was the fact that Bangor is reasonably close to UM, minimizing travel time for the GK-12 fellows. Two other critical factors leading to selecting BHS were that Co-PI Steve Godsoe provided a direct link to BHS, and BHS is the largest public high school in Maine, offering a diversity of high quality programs to students. JBMHS was selected because one of its teachers, Scott Burgess, participated in the summer 2002 supplemental-RET program and expressed great interest in the GK-12 Sensors! program.

Fifteen BHS teachers and Scott Burgess participated in a one-week workshop, held in August 2002. Teacher selection was based on interest in the program and courses taught. In this workshop teachers presented material covered in their respective high school courses. Individual topics such as fluid sensors, air quality sensors, medical sensors, biological sensors, automotive sensors, agriculture sensors and the use of sensors in everyday life were targeted for module development. Teacher and fellow teams were formed and the team was asked to create a module for an individual topic. These teams worked together in the schools throughout the 2002-2003 academic year, creating model curricula based on the application of sensors that could be disseminated state-wide and nationally. For example, BHS chemistry teacher Cary James and GK-12 Sensors! fellow Andrea Martin, formed a team and developed, implemented and assessed a number of air-quality projects in James’s chemistry classrooms during the 2002-2003 year. Their introductory project used Schönbein ozone sensors made by painting a potassium iodide/cornstarch solution onto a filter paper strip placed on an overhead transparency, providing an inexpensive, simple method for detecting ground level ozone. The pair first introduced students to sensors and air quality, and then worked with students to construct their own Schönbein ozone sensors. A series of six air quality projects were designed that
progressively involved students more deeply in active-learning situations. At year’s end, students presented analyses of sensor-generated air-quality data to the BHS science faculty and peers. The air-quality projects were designed to align with appropriate Maine Learning Results educational standards, American Association for the Advancement of Science benchmarks, and North American Association for Environmental Education’s learning guidelines.

II. Spring 2003: GK-12 Supplemental Grants

(i) Social Science and RET Supplements: A social science supplement funded by NSF in the 2003 spring enabled the addition of Kevin Boyle, a UM professor of Economics, as program evaluator. The supplement also provided a two-year social science graduate fellowship, which was awarded to Brad Neumann. The RET portion of the supplement expanded the GK-12 Sensors! program into four rural Maine high schools: Dexter High School (DHS) in Dexter, ME, Lee Academy (LA) in Lee, ME, Jonesport-Beals High School (JBHS) in Jonesport, ME, and Sumner Memorial High School (SMHS) in East Sullivan, ME. These schools were chosen due to the low percentage of students from these schools going on to post-secondary education. One teacher from each of these schools was selected to participate in the 2003 summer under a RET supplement. These teachers came to UM and took part in research projects with research scientists forming bonds with the GK-12 fellows. These bonds served as links when the 2003-2004 academic year began, and made it easy for the fellows to become established in these schools in the fall.

(ii) International Interactions in Italy and Germany: A second program supplement resulted in international interaction with European sensor researchers. Through research connections, Vetelino became aware research activities at the University of Brescia in Brescia, Italy and at the Otto-von-Guericke University in Magdeburg, Germany that could benefit GK-12 Sensors!. These activities included research relating to air quality, water quality, oil quality, landfill and food monitoring. In addition to research, fellows and teachers would have opportunities to interact with university science and math administrators to gain better understanding and appreciation for each nation’s educational system. In particular, fellows and teachers would explore alternative methods for integrating science and mathematics into high school curricula.

As a result of supplemental funding, two fellows and two teachers went to Europe. One fellow and one participating BHS teacher went to the University of Brescia for two weeks during the 2003 summer to interact with researchers working on the development of metal oxide sensors to detect gases emitted from foods, liquids, landfills and environmental pollutants in the atmosphere and workplace. At the Otto-von-Guericke University, another fellow and BHS teacher spent two weeks interacting with researchers pioneering work in the areas of fluid sensors and water quality. These interactions produced a number of sensor-related learning modules deployed in Maine high schools during the 2003-2004 academic year. Modules involved determination of the quality of coffee, olive oil and wine, detection of gases emitted from landfills in Bangor, Maine, and ozone monitoring in the atmosphere.

Vetelino traveled to Europe, spending one week at each site, closely monitoring interactions relative to the GK-12 Sensors! program. Vetelino furthermore initiated cooperative research programs with both the Italian and the German groups, which enabled a German student to spend four weeks during the 2004 spring and summer at UM. The graduate student was involved in both research and interactions with high-school students. The focus of the high school activities was the study of an oil quality sensor for possible use in an internal combustion engine.

III. August 2003-Spring 2004: Second Academic Year

In August 2003, a workshop was conducted so that GK-12 Fellows could coordinate activities for the upcoming 2003-2004 academic year. In contrast to the 2002 summer activities, which formed modules for students at the sophomore, junior or senior level, the 2003 workshop focused on developing portable modules appropriate for ninth grade students. At that meeting, fellows and teachers were divided into a number of interest groups focused on subjects like air quality, water quality, sound and light, and transportation. Each group developed several portable modules appropriate for ninth grade students. During the 2003-2004 academic year, 25 such modules were developed, demonstrating the program’s capability to implement similar technologies in schools with vastly different resources.

In addition to module development, fellows organized community outreach programs in Bangor, Maine. During the spring of 2004, under the direction of fellows Eeva Hedefine and Bradley Neumann, Bangor High School students in James Smith’s Senior Seminar used a Geographic Information System (GIS) and handheld Global Positioning Systems (GPS) to produce emergency response maps for local public safety personnel. The students were presented with certificates of achievement by the Bangor City Council and were recognized by the Bangor School Committee. The police and fire departments have asked the students to continue their project by mapping Bangor International Airport, and the assistant police chief invited them to submit a proposal for a portion of the city’s Homeland Security Funds.

Fellows also wrote and submitted a number of journal articles. These articles were written with the assistance of various high school teachers. Each article focused on the description and implementation of the fellow’s portable modules in the classroom.

IV. Spring-Summer 2004: RET-Sensors!

In the spring of 2004, the University of Maine, with John Vetelino as PI and Constance Holden as Co-PI, received
funding for a three-year NSF grant, RET-Sensors (NSF- 0401439). As a result, during the summer of 2004, ten middle and high school teachers from mostly rural areas were brought to UM and provided unique opportunities to be involved in cutting-edge research in sensor theory, design, fabrication, testing, and/or applications. The RET portion expanded the GK-12 Sensors! program into nine rural Maine high and middle schools: Brewer High School (BHS) in Brewer, ME; Bucksport High School (BuHS) in Bucksport, ME; Central High School (CHS) in East Corinth, ME; Hampden Academy (HA), a high school in Hampden, ME; Hermon Middle School (HMS) in Hermon, ME; James F. Doughty School (JFDS), a middle school in Bangor, ME; Maine Central Institute (MCI), a high school in Pittsfield, Maine; Reeds Brook Middle School (RBMS) in Hampden, ME; and William S. Cohen School (WSCS), a middle school in Bangor, ME.

Teachers spent eight weeks becoming acquainted with cutting-edge sensor science and engineering through daily interactions with sensor faculty, senior researchers, graduate students, UM GK-12 Sensors! fellows, and Research Experience for Undergraduates (REU) students in the UM Laboratory for Surface Science & Technology (LASST). The RETs were involved in research on biosensors, chemical sensors, and fluid-phase sensors. Examples of RET research ranged from developing sensing systems for measuring motor oil degradation to detecting low levels of algae toxins and heavy metals in Maine lobsters. In addition to working with a specific sensor research group, teachers became familiar with other state-of-the-art sensor-related science and technology facilities in the university and neighboring small sensor businesses. The RETs also enrolled in ECE 465, an upper-level undergraduate course entitled Introduction to Sensors, which presented the theory and applications of various types of semiconductor, acoustic, magnetic, thermal and optical sensors, in order to give teachers a sound background in sensors. Teachers received academic and recertification credit for the course. The summer program concluded with the August Summer Workshop, during which the RETs shared their summer research experience in formal presentations and offered ideas for integrating sensor science and technology into their curricula. All 2004 RET participants became 2004-05 GK-12 Sensors! cooperating teachers, continuing working relationships established during the summer RET program with GK-12 fellows.

V. August 2004-Spring 2005: Third Academic Year

RET Sensors! established a formal bridge to GK-12 Sensors!, forming a strong linkage between UM and participating secondary educational institutions. Furthermore, in school systems where GK-12 Sensors! has been established at the high school level, the RET-Sensors! program provides an opportunity to extend its presence into the systems’ middle schools by offering fellowships to interested teachers in participating school systems. Expanding its presence from six to eleven schools, four of which were middle schools, GK-12 Sensors! anticipates achieving greater impact on student interest in pursuing careers in science and engineering. Introducing sixth, seventh and eighth graders to graduate researchers and engaging students in hands-on science and technology inquiries, and maintaining such exposure throughout high school, provides continuity of exposure throughout their secondary education.

An evidence of the maturity of the linkage between UM and Bangor High School was the introduction of a course on sensor science and technology into the BHS curriculum. Introduction to Sensors is a hands-on, inquiry-based course being offered to Honors students. Godsoe and third-year GK-12 Sensors! fellow, Lester French, designed the course using material gathered from sensor research performed in LASST. The year-long course features lectures, labs and other hands-on exercises, and field excursions such as visits to the United Technology Center’s (UTC) Photonics Laboratory (Bangor, ME) and various sensor-research laboratories at UM. Early fall 2004 lectures introduced sensors and sensor systems by considering the human body as a sensor system. New concepts and technologies introduced in lecture were supported with in-class examples and demonstrations of sensors, including altitude sensors, accelerometers and piezoelectric sensors (from LASST). In the lab, students built optical interferometers, learned microfabrication skills, built and tested a photoelectric pulse plethysmograph heart-rate monitor, and developed projects involving Lego® Mindstorm robots equipped with pressure and light sensors. Spring 2005 hands-on activities include building a microphone using a thin-film pressure transducer and working in teams to propose, design, and build a physical sensor. Students have shown significant initiative in working on their class projects.

Several new community outreach projects emerged in spring 2005. A multi-class Global Information System (GIS) project was developed by a GK-12 Sensors! fellow working in the History Department at BHS. The project, sponsored by Environmental Systems Research Institute, Inc. (ESRI), a world leader in GIS software development, involved the creation of a digital community atlas of the historical geographies of Bangor. Known nationally as the Community Atlas Project, teachers and students were asked to define the nature of their community by creating maps, writing community descriptions, and compiling images to be combined in a visual presentation and posted on the Internet. The project involved four World Geography classes and two Civics classes, all at the freshman level and housed in the History Department. Students created their community atlas through the use of a Global Positioning System (GPS), GIS, basic html coding, digital cameras, scanners, and computer skills. The final product was posted on the Web by ESRI and presented to both the City of Bangor and the Bangor Historical Society as a display on the city’s website, a digital PowerPoint presentation, and a physical poster presentation.

In addition to the support and attention BHS teachers and students in civics, history and human geography have received from external agencies such as ESRI, the History Department
was solicited in February 2005 by the Bangor Public Safety Department (BPSD) to produce a plan for applying existing BPSD homeland security money toward creating a spatial information lab at BHS, for developing the city’s GIS into the indefinite future. BHS instructors were also invited to submit proposals to support student-centered research for homeland security applications of GIS-based projects, and Maine’s U.S. Senator Susan Collins was approached for additional support.

Twenty-five new portable learning modules were generated. Presentations describing GK-12 Sensors! experiences were made at national conferences by the principal investigator, fellows and teachers. PI Vetelino presented “Work In Progress—Integration of Sensors Into High School Classrooms” at the October 2004 IEEE Frontiers in Education Conference [1]. Fellows Hedefine and Neumann presented “Applying GIS Technologies to Enhance Emergency Response.” at the 2005 National Science Teachers Association National Convention, Dallas, TX, March 2005 [2]. 2004 RETs Tracy Vassiliev [3] and Patricia Bernhardt [4] also reported on the integration of the GK-12 Sensors! fellow and activities into their middle-school classrooms. Furthermore, in August 2004, former GK-12 Sensors! Fellow Andrea Lynn Martin received her Masters Degree in Chemistry from UM after successful defense of her thesis, titled Development of a Nitric Oxide Gas Sensor and Air Quality Projects in a High School Chemistry Classroom [5]. In her thesis, Andrea describes & analyzes the impact of her GK-12 Sensors! secondary classroom interactions, particularly the educational effectiveness of air quality projects. The results revealed a dramatic improvement in students’ understanding.

**PROGRAM EVALUATION**

Program evaluators Mark W. Anderson and Kevin J. Boyle have provided initial assessments [6] of the effectiveness of the GK-12 Sensors! program on students, fellows, and teachers. Based on narrative one-time and pre/post surveys, Anderson and Boyle found that fellows seemed to have more impact on middle school students, freshman, and sophomores. This is not surprising, since most students in their junior and senior years have already formalized their plans after graduation. Anderson and Boyle saw a clear positive impact of the program on teachers, fellows and the general Bangor community, based on surveys, program self-assessments and face-to-face interviews. Teachers report that the program does appear to stimulate significant renewal of interest in and enthusiasm for STEM teaching. Fellows report greatly improved teaching and professional presentation skills, general communication skills, and more familiarity with active/cooperative learning techniques. Community members, who include parents and city employees in the police and fire department, were excited about the tangible spin-offs the program provided to both the students and the City of Bangor.

Data for quantitative determination of program impact and outcome were collected from BHS 2004 graduating seniors and will be collected from the 2005 BHS graduating population and other program cohorts. Comparative analysis of these data will begin during summer 2005.

**SUSTAINABILITY**

A proposal for five-year Track II-NSF funding for GK-12 Sensors! was submitted in June 2004, was favorably reviewed and recommended for funding if available. However, in October of 2004, NSF notified UM that the Track II GK-12 Sensors! proposal had not been selected for funding, citing budgetary reductions as a principal factor in the decision. The NSF GK-12 Program Director advised Vetelino to resubmit the Track II proposal for reconsideration in June 2005, anticipating the release of additional federal funds to the program at that time.

Anticipating the need for independent financial support of GK-12 programs, Monroe Duboise from the University of Southern Maine, Susan Brawley from UM, and Vetelino, the principal investigators of three GK-12 programs active within the UM System (UMS), met in the spring of 2004 to discuss strategies for securing self-sustaining support for GK-12 type programs. As UMS is a network of public educational institutions, an obvious source for ongoing funding was the Maine State Legislature, the ultimate funding source for UMS. Taking advantage of the state’s relatively unencumbered political infrastructure, PIs informed all appropriate intermediary administrative levels of their desire to appeal for such support directly to the UMS Chancellor, Joseph Westphal, who serves as representative of and liaison between UMS and the state legislature. The PIs met with the Chancellor, who strongly supported the GK-12 type programs, indicating their alignment with the vision of the mission of UMS and the significance of promoting math and science education to the economic development of state. Westphal put forward a proposal for state support of GK-12 programs through the creation of a budget-line item in the UMS annual appropriations request, establishing dedicated funding for UMS fellowships involved in promoting K-12 math and science education. As a result of the efforts of the GK-12 PIs and the support of the chancellor, in the spring of 2005, Orono State Representative Emily Cain introduced Bill LD 119, which if passed by the legislature and governor would enact ongoing funds to create graduate fellowships within the University of Maine system that are geared at enhancing science and math education at the secondary school level [7]. The proposed annual funding level for the next two academic years is $2.5 million. At present, the bill awaits committee hearings. Should LD 119 be passed into law, there would exist a funding mechanism to sustain GK-12 Sensors! beyond NSF funding.

GK-12 Sensors! has also secured a number of other funding sources, helping ensure the mid-term sustainability of the program; in particular, the continuity of the program beyond the June 31, 2005 termination of Track I funding. UM Vice-President for Research, Michael Eckardt, has promised bridge funding if available, to provide fall 2005 fellowships for students currently in the GK-12 program.
In addition to financial support, the sustainability of the GK-12 Sensors! program can also be judged by the strength of the vital linkages between the University and the secondary schools. This can be measured in terms of long-term impact on secondary curriculum and teaching practices, university-to-secondary-school relations, secondary school investments in maintaining projects and programs initiated through GK-12 Sensors!, continuing fellowship programs that maintain post-secondary student contact with high and middle school students, and the recognition of the relevance and value of GK-12 Sensors! fellows’ experiences to scientific research, and the effect that the program has on public. Learning modules collaboratively developed by fellows and teachers have been permanently incorporated into secondary school curricula. A full-year high school course focusing on sensor science and technology has been implemented at BHS. UM RET teachers and other teachers have first-hand experience of the hands-on inquiry-based nature of scientific research work, which, according to informal self-evaluations, is having a lasting impact on teaching practices and significantly enhances their efforts to restructure science curricula in terms of active learning. Faculty at participating schools maintain a relationship with the UM and LASST through regular field trips to campus research facilities, where students are introduced to state-of-the-art research facilities and researchers at all academic levels. The BHS Homeland Security project offers a significant example of participating schools investing in programs initiated by GK-12 fellow-teacher interactions. The NSF-funded RET program at UM will continue to provide two more years of additional exposure of high-school teachers to the methods and curricular modules developed by GK-12 Sensors! A three-year NSF Research Experience for Undergraduates (REU) program funded in 2005 under the direction of Dr. Vetelino will incorporate sustained interactions between participating undergraduates and their alma maters, initiating a new source of bridge-building between UM and middle and high schools in the state and throughout the nation.

SUMMARY
At the end of its third year, GK-12 Sensors! has a presence in 11 rural and urban Maine secondary schools and has penetrated all middle and high school levels. Participating teachers have been cultivated by participation in eight-week summer RET programs in which teachers and GK-12 fellows interact, develop relationships and initiate curriculum planning and coordination. Critical to the long-term success of GK-12 Sensors! is the ability to establish vital links to secondary school teachers. Forging such stable, long-term connections involves a number of factors, including (1) identifying science teachers who are excited to bring sensors into their classes as a vehicle for motivating science concepts and activities; (2) helping interested teachers become comfortable with and knowledgeable about sensor science and engineering; (3) establishing teacher-fellow relationships, matching a teacher with a fellow whose research best fits that teacher’s existing science curriculum, interests and resources; and (4) providing adequate time for growing teacher-fellow relationships before placing fellows in classrooms, so that teachers and fellows can develop working rapport for discussing sensor science, strategizing the incorporation of sensors into existing curriculum, creating new learning modules/lesson plans, thereby insuring a smooth transition of the fellow into the classroom environment.

Fellows have honed their interpersonal and pedagogical skills. Furthermore, they have gained invaluable knowledge about how the aspirations of students can be fostered in secondary schools. The curriculum has been enlarged and aligned with state standards using cutting-edge sensor technology. The greatest beneficiaries of GK-12 Sensors! are the students. Contingent on the Maine State Legislature’s enactment of Bill LD 119, GK-12 Sensors! will become a permanent and major UM initiative to improve the aspirations of Maine youth and provide a positive effect on economic development in the State of Maine.

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