

Using the Hitachi TM3030 SEM to Engage Learners at All Levels in One of America's Most Challenging Regions

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In 2011, a team from Ohlone College in Newark, California offered advanced technology training that promised to bring scanning electron microscopy learning opportunities to the San Francisco Bay Area and beyond. Among those to attend this meeting were members of the Enochs High School Forensic Biotechnology Program. This was significant in that these teachers worked in an area called California's Great Central Valley. This challenging region was named by *The Economist* the "Appalachia of the West" [1]. *Forbes Magazine* using business metrics found four of the top 20 of "America's most miserable cities" in this region [2]. Law enforcement reports put the area on *Forbes* list of "Most Dangerous Cities" in 2015 and the Drug Enforcement Administration placed the county in which Enochs High School resides near the top of the state in illicit methamphetamine labs per square mile [3].

Responding to a request from Enochs High Forensic Biotechnology School teachers in the summer of 2012, Hitachi High Technologies sent Dr. Barry Weavers and Dr. Nancy Weavers to train educators, and students, to use the TM3000 scanning electron microscope (SEM) [1]. What has developed since that time was a partnership that engages learners, allows for enriched vertically and horizontally-articulated learning opportunities and collaboration with local laboratories to provide students with advanced learning environments not formerly present in their region.

During that first meeting, the SEM was delivered, and a group of students and teachers gave up a summer's day to develop a crime scene scenario that would be factually based, technology-rich and engaging for learners. With students taking the lead in developing the mystery, motive, means, and opportunity were blended with the investigative powers of the SEM. These highly motivated learners prepared samples that supported the storyline of the scenario, argued the case from both sides before the Hitachi representatives and the teachers attending, and developed a lesson that was used the following fall semester.

The support of the Hitachi High Technologies of America continued when students were challenged to find ways to fulfill the learning potential of the device. Contacts with local elementary and middle schools indicated that grades 5 and 6 were most interested in working with their older peers and visitations to the high school were arranged. Realizing that 58% of the district's population was Hispanic, but only about 6% of the STEM jobs are held by this demographic, a concerted effort was made to engage both low income and Hispanic students, resulting in visitations by schools that represent these demographics. Elementary school teachers, a principal, and parents brought their young learners to use the device. A partnership was formed with the on-campus learning challenged resource students to use the SEM as well. At-risk youth were engaged on several occasions when they were attending disciplinary sessions on Saturday. In all cases, students, who are "digital natives" learned how to use the device quickly and were able to teach their peers how to prep samples, image and make corrections in minutes. Likert surveys indicated a high degree of satisfaction with use of the device [2].

Working with the Brandman University, School of Education, Enochs Forensic Biotechnology Program teachers were challenged to use the device to develop a cross-curricular thematic unit [5]. The result can be seen on YouTube wherein a student who was working on a plant project in her agriculture class, made an image of a leaf stoma [6]. This was then transmitted to the digital arts students who rendered the image in color, then the ceramics class students who made clay models of the plant structure. This was followed by music students preparing and playing music for the lesson, with finally, a mathematics class executing a living ratio of the magnification.

In 2016, a representative from the Winston Churchill Memorial Trust, investigating educational best practices in the United States visited the Enochs Campus. Travelling from London, he selected the Enochs High School's use of the Hitachi SEM as an example of exemplary student engagement.

The updated TM3030 SEM saw use in off-campus settings as well. Enochs High teaching staff arranged to have it delivered to the California State Fair in Sacramento to highlight the lesson for the fair going public, and during the summers of 2016 and 2017, the device has played the same role in the California Northstate University's Summer Forensic Science Camp. A collaboration with Sierra Research Labs in Modesto resulted in the Hitachi being placed in the laboratory and teaching staff learning authentic research use of the images for publication.

President Robert Gordon of Hitachi High Technologies of America, on several occasions visited the school and worked in support of students. In 2017, when Hitachi Corporation of Japan chose to do a video illustrating its corporate identity, the Enochs High School Forensic Biotechnology Program, and its use of the Hitachi TM3030 SEM was selected as the only educational partner school in the world.

Has the Hitachi SEM been effective in engaging science learners? Overall measures of student achievement, which include the use of the device and its images from 2012 forward are supportive of its value [4]. While there has been no study yet of the device's effectiveness separate from baseline performance of program students. It may be argued that the SEM had broadened the scope of the existing science program far beyond what was initially envisioned and has engaged learners at all levels [7].

References:

- [1] Wozniacka, Appalachia of the West, *The Economist* (2013).
- [2] Forbes, America's most miserable cities (2010). Retrieved from <https://www.forbes.com/pictures/mli45hdlg/19-modesto-calif/#2089fcb660de>
- [3] Yellin, Do you live near a meth lab? (2017) Retrieved from <http://money.cnn.com/interactive/news/meth-lab-map/> See Stanislaus County.
- [4] Menshew, Conference proceedings of SPIE (2014) p.4.
- [5] Menshew, Conference proceedings of SPIE (2015) p.3.
- [6] YouTube: Inspiration, (2015) Retrieved from <https://www.youtube.com/watch?v=JwhAH89cqk>
- [7] Menshew, Using Biotechnology, CSI, and Zombies to Promote Science Education in one of America's Most Challenging Regions (2015) p.4.