University of Georgia (UGA) Research Study Summary

The Effects of Cogent Education's Interactive Cases with SABLE *(Skills and Assessments-Based Learning Environment)* on Student Learning

Real World Skills, Real Time Data
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Research was conducted over three years with 2,300 students by the College of Education at the University of Georgia (UGA), to study the *educational effect* of Cogent Education's Interactive Case modules and SABLE (Skills and Assessments-based Learning Environment). Cogent Education's **Interactive Case** modules are real-world case studies that use interactive simulations to enable students to take the role of a professional scientist. Students solve problems by making observations, collecting and analyzing data, forming and testing hypotheses, and communicating their findings. **SABLE** is a system that analyzes the student data *as they are using the software*, *in real-time,* and produces a "heat map" of performance (red, yellow and green) to instantly identify student's challenges, allowing teachers to rapidly address difficulties individual students are encountering.

The UGA research team reported that the effect of Cogent Education's Interactive Case modules, when used with SABLE, on student learning was "**staggering**". The research team at UGA conducted interviews throughout the process to determine teachers' attitudes toward the Interactive Cases, SABLE, and their use of the real time data. **A summary of the research findings is as follows:**

1. The Interactive Case modules engage students in their learning
2. Teachers value the Interactive Case modules and SABLE in their instruction
3. Interactive Case modules and SABLE increase student learning
4. Students use critical thinking skills when using the Interactive Case modules with SABLE
5. Teachers used and valued SABLE's real time data concerning critical thinking
6. SABLE's delineation of skills was valuable to teachers
7. SABLE effectively helped teachers differentiate instruction
8. SABLE's real time data improved student performance when using the Interactive Case modules
9. Professional Development for the Interactive Case modules and SABLE can be effectively implemented in-person or remotely
10. There are no technological barriers to deploy the Interactive Case and SABLE in schools and schools districts
11. Security requirements relating to student data in SABLE have been successfully implemented
12. Teachers would like more Interactive Case modules in their biology curricula

UGA Research: The Educational Effect of SABLE

Teacher surveys: The critical needs of educators are for effective curricula materials that focus on the development of critical thinking skills and address key pain points in their biology courses. The University of Georgia (UGA), gathered data from teachers via anonymous surveys to gather teachers' opinions of the Interactive Case modules and the SABLE analysis system. **Table 1** contains data from one of their surveys regarding the SABLE modules from 27 of the participating teachers:

Table 1. Customer survey data

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The Interactive Case modules effectively teach science concepts	100%	0%	0%	0%	0%
Using the Interactive Case modules resulted in a deeper understanding of the science concepts than my usual materials	96%	0%	4%	0%	0%
The Interactive Case modules effectively teach the scientific method	100%	0%	0%	0%	0%
My students were engaged while using the Interactive Case modules	96%	0%	4%	0%	0%
My students practiced critical thinking skills when using the Interactive Case modules	96%	0%	4%	0%	0%
I value these Interactive Case modules and SABLE for teaching	100%	0%	0%	0%	0%
I want more Interactive Case modules	100%	0%	0%	0%	0%

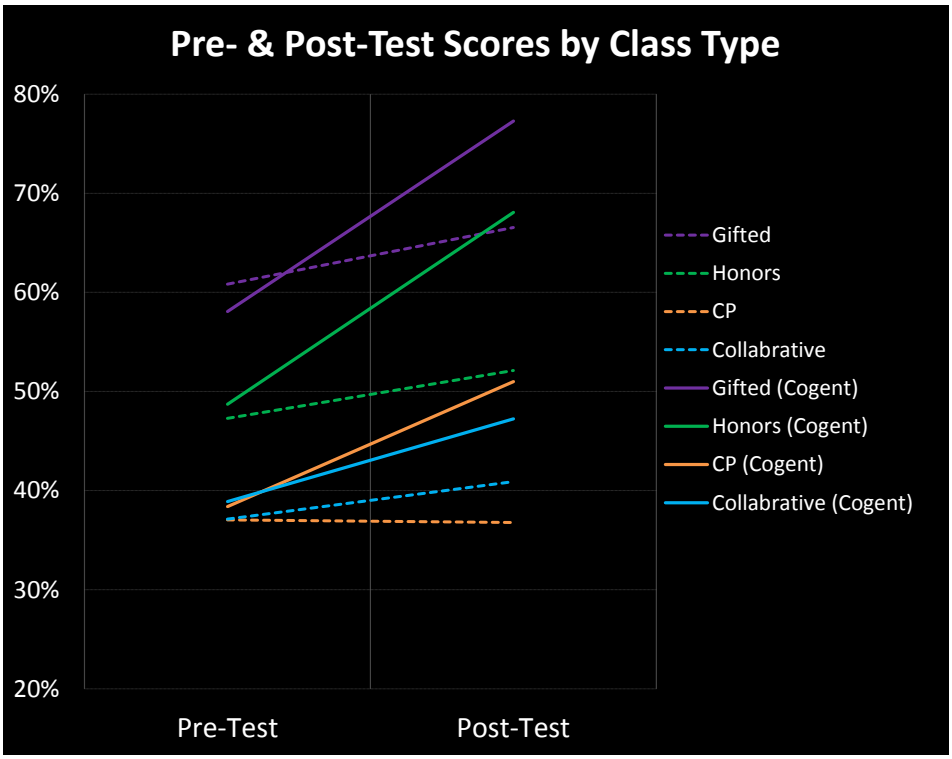
The educational efficacy of SABLE: A brief outline of the research study design conducted by the University of Georgia (UGA) is as follows: 6 biology teachers participated in the study to determine the

efficacy of: 1) traditional instruction (control year, "Year 1", "business as usual"), and 2) The Interactive Cases modules ("Year 2"), teachers replaced 3 traditional lessons with Interactive Cases modules). In the Fall of 2013 ("Year 3"), we extended this study to examine the effect of the real time data from the SABLE system on student performance within the Interactive Case modules. A total of 2,300 students were included in the study.

The University of Georgia (UGA) utilized a quasi-experimental study design to examine: (1) learning associated with classroom use of these interventions as assessed by validated pre and post-test measures in a curricular unit on the cell structure and function ("cell unit"), and 2) qualitative methods to examine the *in situ* learning that students experienced while completing the Interactive Case modules. Student data included pre-test, post-test, participant observation, and analysis of student work. Teacher data included participant observation, teacher interviews, and lesson plan analysis. Teachers were trained to use SABLE to invite students, create assignments, and analyze data. The study demonstrates the progressive effect of empower teachers to use real time data from SABLE to implement formative instruction built upon the development and practice of critical thinking skills.

Assessment Items: The pre-test and post-test assessment items were tested and refined with over 1000 students from varying educational backgrounds to ensure appropriate objective alignment and analysis of item level difficulty prior to the research study. During Year 1, all teachers agreed to administer the test to their students *without* seeing the assessment items. This provided researchers with baseline data that resulted from normal instruction. Upon completion of the cell unit, students completed the post-test. During Year 2, the assessment was administered the same way, and teachers replaced 3 of their traditional lessons with the Interactive Case modules.

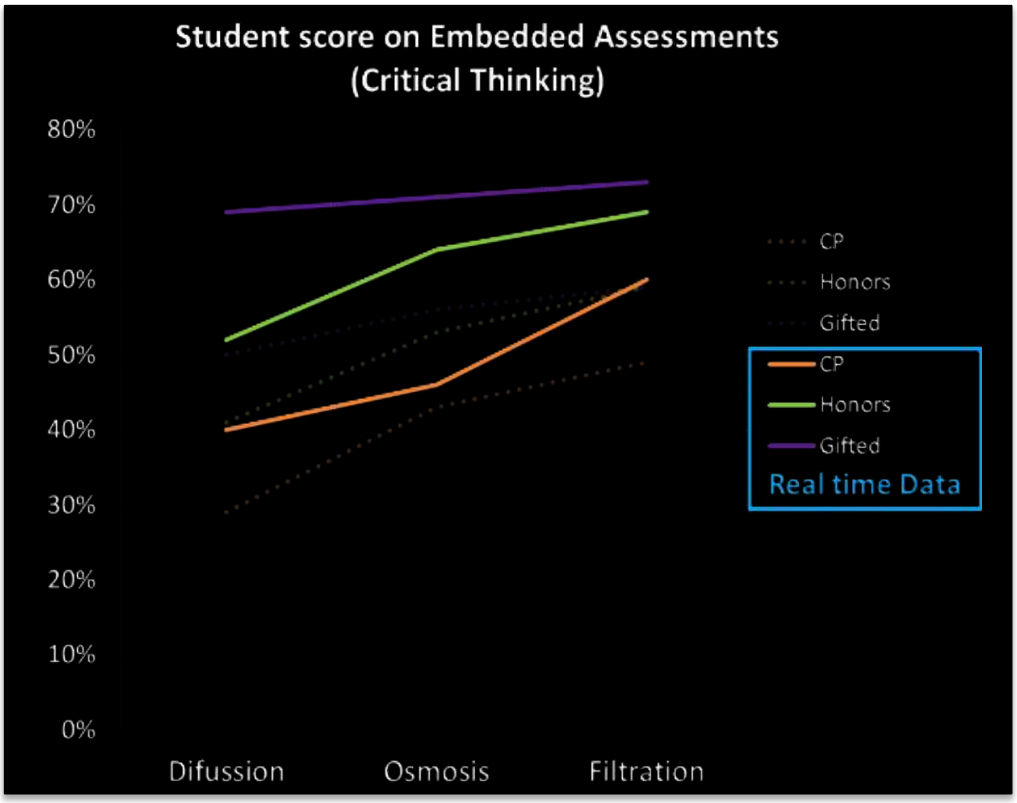
Replacing just 3 traditional classes with 3 Interactive Cases elicited significant learning gains in all learner groups (Gifted, Honors, College-Prep, and CP-Collab [special needs]). The Results of the pre and post tests are shown below.



Effect of the real time SABLE data system on student performance on critical thinking tasks: The University of Georgia (UGA) compared the embedded data from a sample of 100 students from three ability bands to determine *if* student responses to assessments relating to critical thinking improved with teacher access to the real time data from SABLE.

This analysis supports the teachers' assertion that real-time data and intervention into the student's learning experience improves the learning outcomes associated with the SABLE modules. As one teacher explained, "SABLE feedback is the piece that I needed. With my gifted kids, I sent each student feedback the *same day* that they completed the case study. The students then went back to the SABLE learning environment and re-examined what they had learned. Now I can guide this learning experience."

Student scores from the Interactive Case modules improved as students completed more cases (Diffusion, Osmosis and Filtration), and were significantly higher when teachers had access to SABLE's real time data. Student scores either without or with teacher access to real time data are shown below.



Interview Triangulation: During the data collection, the researchers conducted multiple member checks to confirm that the teachers agreed with the analysis of the ongoing teaching and learning, taking place. Interviews with teachers provided insight into the ways in which teachers used the Interactive Case modules and the ways they perceived students to benefit from that use. A variety of themes emerged from these interviews and those include the following: (1) the nature of the Interactive Case studies, and real world scenarios, was distinctive to the students and aided their memory of the biological concepts addressed; (2) as one teacher said, "kids made the connections and kept the connections" which means that in her view, students made concrete connections between cellular/tissue function and the biological processes being studied, but that they also made connections to their own lives and cited family health issues that corresponded to the persons/animals in the modules; (3) the Interactive Case modules produced the best student learning that these teachers had observed in their recent experiences with teaching the cell unit –

this was attributed to both the structure of the Interactive Case modules, which promoted understanding, but also the emphasis on vocabulary (such as distinguishing hypotonic, hypertonic, and isotonic); and (4) One hundred percent of the teachers expressed their belief that the Interactive Case modules should become regular instruction for all students.

Comments From Teachers on the Interactive Case Modules and SABLE: One hundred percent of the teachers explained that students intuitively *knew* how to navigate the Interactive Case modules. As one teacher explained, "the students fully recognize that we are in this together. I am *in* this experience with them, so they give it their best. SABLE allows me to give my gifted kids room to breathe, room to think, while still examining what they are doing, where they are going."

Teachers with students identified as low-achieving explained that the real-time capability of SABLE was of value in helping these students. For example, the department chair of a large metropolitan school explained, "we cannot have students wasting time in our courses, flying under the radar so to speak. Just because a child is quiet, just because a child is typing *does not* mean they are learning. Now I know what my students are doing and I can intervene in real-time. I *know* that our students will perform better based on this ability."

When surveyed, one hundred percent of the teachers believed that the student's learning experience was deep and rich. As another teacher explained, "I am confident telling you that the SABLE intervention worked because I managed the learning environment throughout. When a student had a problem, I saw it and I addressed it, immediately. My students did not spend two weeks waiting for me to find time to grade the material. I answered them in the computer lab. SABLE enables me to teach the way I want to teach."

Table 2 contains teacher's comments from a survey regarding the Interactive Case design, interactivity, student engagement and teaching from participating teachers:

Table 2. Teacher Comments.

Comments on module design	Textbooks' coverage of osmosis is confusing for students. What's important is for students to be able to apply the concepts of osmosis to real-world situations. This case study allows me to delve into osmosis in a way that was impossible before. The Interactive Case module provides a real-world scenario that involves the scientific method and problem solving. The way the case study leads a student through the scientific method is a strength.
Comments on scaffolding and learner levels	The Interactive case study module anticipated all questions and provided lots of background information. It can take a beginner with no knowledge, to full understanding of the concepts in a short time. Accessible to all learner levels, and allows students to go at their own pace. This approach allows advanced students to interact at a greater depth. The Interactive Case study is scaffolded to allow gradual release of knowledge and responsibilities to students.
Comments on student engagement and teaching	This Interactive case study module provides a great way to teach osmosis. It provides interactive opportunities along with allowing students to improve their thinking and writing skills. This allows students to see the process and its effects while interacting in a trial and error format that traditional labs do not allow – amazing! The pictorial examples of the brain and water movement are phenomenal. The simulations and 3D effects are a great way to engage the students. The Interactive Case study requires them to think critically. Your materials are truly remarkable and will definitely be a hit with educators worldwide.

Conclusions of the study (from UGA): Collectively, we have triangulated findings that suggest a synergistic effect of Interactive Case modules within the context of appropriate, content-rich professional learning. We have shared qualitative and quantitative findings from a controlled study with a sample size of 500 students to display the power of the Interactive Case modules and SABLE in teaching fundamental biological processes to *all* students.

Preliminary data from the research has been presented at professional conferences:

1. Hodges, G., Oliver, J. Steve, Robertson, T., Ducrest, D., Eason, S., Maloney, J., Perry, P., Martin, M., & Holden, J. (2014). Creating, developing, and sustaining successful partnerships among schools, universities, and small businesses to create novel immersive learning environments for secondary students. Presented at the Third Annual Georgia Scholarship of STEM Teaching and Learning Conference on March 7, 2014 at Georgia Southern University.
2. Hodges, G., Ducrest, D., Robertson,T., Perry, P., Holden, J., Oliver, S. Eason, S., Maloney, J., (2014). Using computer based interactive case studies in the biology classroom. Presented at the Georgia Science Teachers Association in Macon, Georgia on February 7, 2014.
3. Oliver S., Hodges, G., Rogers, W., Kwon, K., Raven, S., Jurkiewicz, & DuBois,S. (2014). *A longitudinal study of teaching the cell unit in introductory high school biology*. Presented at the Association of Science Teacher Educators in San Antonio, Texas on January 16, 2014.
4. Hodges, G., Oliver, S., *A longitudinal study of 3-D interactive case studies in the secondary classroom.* Presented at the School Science and Mathematics Conference in San Antonio, Texas on November, 14, 2013.
5. Hodges, G. W., Tippins, D., & Oliver, J. (2013). A Study of Highly Qualified Science Teachers' Career Trajectory in the Deep, Rural South: Examining a Link Between Deprofessionalization and Teacher Dissatisfaction. *School Science & Mathematics*, *113*(6), 263-274. doi:10.1111/ssm.12026
6. Hodges, G. & Oliver, S. (2013). *Pedagogy, Practice, and Partnership in the Biology Classroom*. Presented at the National Association of Biology Teachers, November 21, 2013 in Atlanta, GA.
7. Hodges, G., Oliver, S., Robertson, T., & Moore, J. (2013). *The implementation and evaluation of technology based learning experiences: Leveraging technology to individualize learning experiences.* Presented at the International meeting of the Association of Science Teacher Educators in Charleston, South Carolina on January, 12, 2013.
8. Hodges,G., Oliver, S., Robertson, T., & Moore, J. (2012). *Creating and evaluating novel instructional materials to assess higher order thinking in science*. Presented at The School Science and Mathematics Conference, (Birmingham, AL).
9. Hodges, G., Oliver, S., Robertson, T., Moore, J. et. al (2012). Evaluating the assessment of student learning related to novel instructional materials. National Association of Research and Science Teaching.