Blended Science: Blended and Problem-Based Learning Hybrid

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In education, many things have changed, yet so many things are the same. We find that policies, student and populations, demographics, and especially technology, continue to evolve and impact the progress of education. Every year, educators are introduced to newer learning management systems, digital resources, and teaching methods that are expected to be executed effectively. A common scenario:

> Ms. Chemistry uses Google Classrooms to post Google Form Quizzes, notes, announcements, videos, and extra resources. She may ask them to use the Google Slide to fill in their notes and she may have students complete the worksheets using the videos and resources that she uploaded. When she hears of a new game or interactive program, she tries it out with her students. When she wants them to collaborate, she posts a Google question or discussion and has them comment as an exit ticket. All her lessons are adapted to be completed on smartphones, even though she has a class set of computers. She has one to two labs per unit and will have active hands-on- group or individual- lessons for the students. Her students can work with a partner and use their Google Classroom resources to complete their reviews. Assessments are given online.

Like Ms. Chemistry, many educators are investing their time and effort to be innovative and engage students in active learning environments, but struggle to reach all her learners. There are students who need far more one-on-one attention and others who are ready to move on and learn something new. Also, educators are so overwhelmed with the high demands of teaching that their resources, such as technology, are not being used to its maximum potential. So, the problems with in. As a result, educators are more commonly, unable to properly prepare students to be enter the workforce because they cannot effectively communicate with others, solve problem, and utilize technology. As

they move on to college, they are overwhelmed by the decision of a major that will affect them for the rest of their lives. Not much care or attention has ever been given to how students prefer to learn, yet they are faced with the plethora of choices by their housing, financial aid, and academic advisors. They are possibly entering secondary education with few skills to provide them with enough confidence to choose and continue a college program. Like in Ms. Chemistry's class, what makes educational programs inadequate is that it does they do not provide enough individualization and personalized instruction, few 21st Century Skills are taught, technology use is not maximized, and lessons are not as meaningful or authentic to students.

This review of literature will discuss the benefits and fidelity of Blended Science, a hybrid of Blended Learning and Problem-Based Learning and how to remedy the inadequacies in the classroom. To focus this research, this question is asked: How can educators provide students with a more meaningful, engaging, and personalized educational program which builds 21st Century skills that prepare them for future careers?

The purpose of this review is to support the implementation of a hybrid course with the benefits of both Blended Learning and PBL with the intention to take the strongest components of each to create a flexible and adoptable program by any teacher. A helpful consideration for this review is that Blended Science is sustainable without a complete district or school adoption. For example, the Biology department or a few Biology teachers may want to adopt Blended Science without adapting schedules, blocks, or room assignments to mimic signature Blended Learning methods. The Biology team may use Blended Science with fluidity because it is in their own classroom- with their own set of class laptops. Activities are designed to offer opportunities to alter their

personal classroom environment to differentiate instructions (e.g. tutoring in one corner, lecture at the front, collaboration at the tables).

This review defines the two components of the hybrid, the benefits of both and the potential of combining them.

Blended Learning

According to Horn & Staker's *Blended: Using Disruptive Innovation to Improve Schools* (2014), BL is the combination of two major ideas: competency-based learning and individualized learning. A personalized learning environment allows differentiation through allowing students to move ahead or stay behind in lessons, with opportunities to attend tutoring and perform lessons in which they prefer. Competency-based learning is when students show mastery of a subject which is affected by the lack of personalized learning. Together, these two ideas unite in an instructional ensemble to provide students with a sense of ownership for their lessons and a sense of accomplishment that results in developed skill.

The method of Blended learning must be executed in a specific way. The student having the choice over the path, the pace, the time, and/or the place to complete a task as part of the personalization (Horn & Staker, p. 34.) The students must learn something away from the classroom and make connections with the lesson in person (p.35). This means that students must choose the lessons they want and take the time they need, seek tutoring, and then turn it they are ready. Some instruction will be done at home before class. Blended Learning allow students to choose to be in their seat if they choose. Evidence of a disruptive model of BL classroom is when a guest cannot tell where the front of the

classroom because the students have dispersed to the part of the room that is tailored to their needs and preferences (p. 75)

Benefits of Blended Learning. In 2010, 150 people in American schools named the following reasons for transitioning to BL: (1) Desire to personalize by preventing students from falling behind (2) Closing the achievement gaps (3) Allowing their students to access special academic programs of different levels (4) To afford tutoring for everyone without spending money on tutors Students were now able to take advanced courses or receive credit when or if they fell behind. (Horn & Staker, 2014, p. xxvi). Due to standardized testing and strict requirements to mirror all team members in a PLC, Professional Learning Community, educators move with the pace of the district and are forced to teach to the standard. Students are inevitably left behind and fail to demonstrate the mastery of content. BL allows teachers to design individual lessons for students with different aptitudes and personal experience which also builds ownership (p.xxvi)

Problem-Based Learning

According to Lee & Blanchard (2019), Problem-Based Learning was a strategy that uses problems to guide students to collaborate and take part in self-directed learning. It requires constructing questions to make their own conclusions and produce something that demonstrates their understanding. To constitute PBL, it was be student-centered and self-directed, in groups, teachers must be facilitators, the lessons must be related to the real-world, and develop problem solving skills (Lee & Blanchard, 2019, p. 2). Because the most important key to PBL is solving problems, the way the guiding question is asked will determine the success of the project. The study conducted by Svihla & Reeve, *Facilitating Problem Framing in Project-Based Learning*, emphasized the significant

effect of asking a question correctly. They suggest that the way the question is asked, called problem framing, determines if the research is purposeful and prompts critical reflection. The study showed that when teachers framed the questions, students became designers and took more ownership of their projects, rather than relying on the teachers. Poorly framed questions let students away from the focus of the lesson relied on heavier scaffolding. The question provides a path that the student buys into and the journey is supported by the teacher. (Svhila & Reeve, 2016, p.1-5). This notion is consistent with Blended Learning.

Benefits of Problem-Based Learning. A study conducted by Virtue & Hinnant-Crawford (2019) in Michigan, Texas and North Carolina for a project Problem/Project-Based Learning School system called New Tech Network. They studied the perspectives of students on PBL across disciplines. The focus group used a semi structured protocol, and students were asked about their experiences with PBL curriculum and their perceptions of how the use of PBL impacts her educational experience and personal development. They found that students preferred projects to assignments, they believed they were doing hard valuable work. Their experience during their projects allowed themselves to be creative and found themselves excited and enthusiastic because they were related to everyday life. They felt their experience was memorable and expressed pity for those who were not involved in the program. Researchers found that student perspectives we're unique and authentic and spoke volumes of their powerful experiences (Virtue & Hinnant-Crawford, 2019). The strength to take away from this study and PBL is that students were engaged and found this to be memorable and valuable experience because the projects were authentic and related to real-world experiences. This is something educators want in for their own classrooms.

Odell and Kennedy (2019) reviewed a transformation of a Texas charter school to meet accountability standards. Over the course of five years, this school's use of PBL resulted in a significant increase in student engagement shown measured by an increase in attendance and a decrease in discipline referrals. Also, the districts assessment scores showed steady improvement while the average state assessment scores did not (Odell & Kennedy, 2019, p10).

Lee and Blackwell (2014) his study investigated a faculty that attempted to implement PBL and found that students were motivated to perform their best and they were very engaged in each project because the projects simulated future careers (Lee & Blackwell, 2014).

Blended Science

To understand the hybrid, Blended Science, we must revisit the question: How can educators provide students with a more meaningful, engaging, and personalized educational program which builds 21st Century Skills that prepare them for future careers? The information as defined from above about Blended Learning and Project-Based Learning suggest that they provide invaluable skills and produce students who are ready for the future. According to Horn & Staker (2014), Blended Learning must include a student having the choice over the path, the pace, the time, and/or the place to complete a task as part of the personalization (Horn & Staker, p. 34.) The students must learn something away from the classroom and make connections with the lesson in person (p.35). The components of PBL that are already like Blended Learning are that it is student-centered and self-directed, in groups. Teachers are still facilitators, the lessons are related to the real-world, and develop problem solving skills (Lee & Blanchard, 2019, p.

2). Svhila & Reeve (2016), suggested question framing influenced PBL (Svhila & Reeve, 2016, p.1-5). The strengths of each will be combined.

Blended Science Instruction. Carefully constructed questions will serve as the bridge between Blended Learning and Problem-Based Learning. The question will guide for Blended Learning to helps manage the differentiation of lessons.

Blended Science will have all the following:

- Carefully constructed questions will be used to direct the lessons;
- Students will be assigned a problem and must produce a product;
- Students will have the choice over the path, the pace, the time, and/or the place to complete a task as part of the personalization;
- Small group tutoring available always;
- Lessons outside of the classroom will be assigned;
- Technology will be available and will always be at their disposal;
- Scaffolding lessons will be offered for different abilities and interests;
- The class will be broken down into 5 parts: *Establishing our Goal, Scaffolding Lesson, Laboratory Exploration, Product, and Collaboration.* Students will have the choice of when and how to complete the modalities for *Scaffolding Lessons, Product, and Collaboration;*
- Student will connect in groups to *Establish* our *Goals* and *Collaborate* to be consistent with Blended Learning.

Program Fidelity

The fidelity of new programs is always in question. The preferences for teachers to teach and students to learn in creative ways such as in Blended Science are powerful enough to sustain a program. Considering adequate and consistent professional development to support teachers is paramount. Furthermore, students' positive experiences will motivate them to support Blended environments.

Teacher Buy-In. Lee and Blanchard (2019) had compared two types of teachers: those who had taught PBL and those that didn't. Experience was a significant factor in deciding to implement PBL. Both groups knew that PBL enhanced critical thinking, technological skills, and collaboration skills, as well as help them advance professionally. Non-PBL teachers felt reluctant to try PBL because they did not feel supported by their peers, they were aware of the workload, and already felt the pressures of testing. Also, they felt pressure to master the content before teaching and would require more professional development before they would try PBL. However, experienced PBL teachers were passionate about the teaching method and saw effect it had on students and were more than willing to put in the time to continue to teach PBL (Lee & Blanchard, 2019, p. 2).

Teachers must be able to design lessons that enhance learning experiences, therefore reinventing the role of a teachers as suggested in the 2018 NMC Horizons Report. Teachers are guides or facilitators, architects of strategic planning (Becker, Brown, Dahlstrom, Davis, DePaul, Diaz, & Pomerants, 2018, p34). Teachers must want to participate in Blended Science to make the program successful. In conclusion, the program will survive if teachers are supported with professional development and have a community of teachers to work with.

According the Texas Education Agency, to be marked as Distinguished, teachers must design clear, well-organized lessons that allow students to take ownership of their learning (TEA, 2017, p.3). TEA encourages teachers to provide guidance for students to apply strengths, prior knowledge, and use skills. They must know students by making connections to interests and future learning expectations across content areas. The most daunting detail of T-TESS is that teachers must provide students with opportunities to use their own learning habits and learning styles to be successful and to do so teachers must have clear expectations on the outcome of a lesson (TEA, 2017, p.3). Teachers struggle to meet all distinguished areas of each dimension and are afraid to experiment with new technology and risk having bad evaluations. Blended Science will alleviate this problem.

Student Buy-In and Preference. The preference for Blended environments is increasing. According to the previously mentioned NMC Horizons Report (2018), educators' roles were driven toward virtual classes due to different forms of technology being applied in class. They also found that students and faculty showed a preference for hybrid courses (Becker, et. al, 2018, p19). The ECAR Study of Undergraduate Students and Information Technology showed that 55% of students preferred Blended Learning, opposed to face-to-face or all online classes. Students felt that their teachers used technology in creative ways to collaborate others (Galanek, Dana, & Brooks, 2018, p.18-219). The 2016 report stated that 79% of students say that technology helped them ask their instructors questions and 71% say that they were more engaged using technology (Brooks, 2016, p.17). Blended Learning is sure to last because there is so much demand to take part in it.

Adopting Educational Innovation

David Warlick said “We need technology in every classroom and in every student and teacher’s hand, because it is the pen and paper through which we experience much of the world”. Blended Science is an approach that is made possible by the pen and paper we call Information Communication Technology. 75% of people in the world have a cell phone and 6.3 billion people have internet service and will continue to grow. Our students will need the skill developed by innovation strategies through ICT. ICT is the infrastructure that enables the use of any kind of technological device to interact in the digital world. So, why should we adopt fully ICT and how can we learn from the successes and failures of other innovation programs to help ours succeed?

By implementing innovative approaches that integrate technology, we are resigning learning spaces by providing equitable instruction, while making learning and technology accessible from anywhere. We already have forms of ICT which include the use of cell phones, computers, SMART boards, and iPads (Rouse, n.d.). Our district has just issued devices for each student and now have subscriptions to Schoology, Zoom, Screencastify, Nearpod, and digital textooks.

The infrastructure we build through Blended Science and ICT can be guided through the lessons learned from the successes and failures of other organizations. The following successes and failures are those of institutions from around the world. Each case has attempted to adopt ICT through various innovation plans that aim to create self-directed and independent learners.

Successes of Various Institutions around the world. The following case studies describe the kinds of successes related to ICT and the implementation of an innovation programs around the world with varying levels of access and economies.

- In the UK, Personal Inquiry (PI) was a mobile learning project that used mobile devices that engaged learners through inquiry-based lessons in and out of the classroom (UNESCO, 2012, p.20)
- In the Philippines, the eSkwela Project, used ICT to support out-of-school youth and adults improved the economy. What worked is that they were able to make education accessible to your and adults that were 15 years and older, who were not able to successful in the school system (UNESCO, 2009, p.9).
- 100 OECD schools like in Greece and Finland, transformed instruction and made learning the driver of instruction (Author, n.d.).
- South Korea used digital textbooks and students became more self-directed learning (So, 2012).
- In Europe, they found that mobile devices made allowed learning throughout the day due to its availability (Hylen, 2012).
- In Tanzania, teaches who taught remotely, shifted their way of teaching. They found teaching enjoyable due to the dependence on making lessons more interesting. This demonstrated how ICT would drive instruction (Pima, 2019).
- In Spain, ICT made it possible to help student develop knowledge about careers in music through Blended Learning. They were able to take virtual field trips and speak to musicians from around the world through their technology. ICT provided students with a well-rounded education that prepared them for professions in music.

Failures of Various Institutions. The following statements are based on the failures of institutions from around the world who tried to implement ICT through innovation plans.

- LAUSD purchased iPads for the district without a goal or pedagogical plan (Lapowsky, 2015).
- The eSkwela program did not provide teachers with enough time to create lessons and struggled to deal with faulty technology (UNESCO, 2009, p.17).
- According to *ICT Innovation Schools*, not all schools adopted ICT simultaneously, but spread gradually. (Author, n.d.)
- Some institutions may not have considered safety and implementing rules through Digital Citizenship. (Fritschi & Wolf, 2012).
- A program called MoLeNET in the UK, involved too many partners outside their district. The efforts to collaborate were far to grade, causing the programs to lose funding and dry up. (West, 2012)
- In the US teachers do not agree with the use of cell phones in the classroom and have seen some resistance in allowing students to use them. Cyberbullying, cheating are some problems that teaches find that kept them from allowing them. Also, teachers demand that students use their laptops instead to a have fewer social distractions and to have a bigger functional view of the content. (Fritschi & Wolf, 2012).
- Students may have a strong student preference for in-person instruction rather than watching pre-recorded lessons, as in the case of music students in Spain. They experienced issues with late assignments and realized that remote learning required a structured schedule (Castro & Ponce de Leon, 2014).
- Pima (2019) found that teachers were more likely to handle innovation plans when they were more experienced (Pima, 2019).

- In Nigeria, teachers were not successful with technology integration when they did not have continuous professional development (Ifinedo, Hamalanen, & Saarela, 2019).
- In Mzumbe University in Tanzania, the participants did not have the technical expertise and resulted in a slow adoption process (Ghasia, Machumu, Vrije, & Zhu, 2020).
- This study followed 75 students in Ghana to determine their perception of ICT and Blended Learning. Blended Learning was intended to meet the needs of a diverse group of learners. The findings were drawn from their perceptions in terms of learning, communication, content, and experience. Students were highly engaged and accessed material at all times of the day. They found the course material to be helpful. Students did experience problems with the internet connection and access which suggests that reliable internet infrastructure is required to support fluid learning. I would use this case study to emphasize how different components of the existing LMS engage the learner and are preferred by the learner (Gyaase & Gyamfi, 2015).

Possible Gaps in Research. There are not many studies in the United States on the successes and failures of Blended Learning and PBL that helps us understand how to overcome the complexities of public schools. These studies mentioned motivation and a positive change in teaching but not many mentions how the implementation of ICT through Blended Learning or PBL bypassed district protocol and directives. It is vital to understand how to adapt the curriculum, benchmarks, and PLC to allow teachers the autonomy to pioneer a program.

Historical Patterns Around the World. The historical patterns around the world, as seen in these case studies, reveal how much the needs to run an educational program are common. The following statements are ways that we can implement a successful program:

- Allow collaboration and utilize teacher creativity . Making time to be creative along with a providing a support system for the instructors would keep a program moving forward.
- Keep students safe by practicing digital citizenship that is already a program associated with the district.
- Keep strong and visible, visionary leadership so that all stakeholders meet and collaborate with ease to keep the program going. Starting the projects with a small group and phasing in more candidates every year will allow the program steady growth and room for reflections to adjust.
- Providing training to teachers so that they can create cell phone policies and manage their classrooms. This limits the problem behavior such as cheating and cyber-bullying. Allowing mobile devices to research can create informal learning environments that can result in enjoyable on-going instruction.
- A way to improve this program could be to get a sponsor to ensure that the devices worked and had the proper maintenance.
- Providing on-going professional development is key.
- Phase in experienced teachers to pilot the program at first.
- Hold more emphasis and care in In-person instruction rather than virtual instruction.

Conclusion

According to Saavedra, A.R., & Opfer, Darleen (2012), based on hundreds of interviews with educational leaders, business owners, and non-profit leaders, 21st-Century Skills are survival skills and require higher-order thinking.

A few of these skills include

> Critical thinking and problem solving, Collaboration and leadership, Agility and adaptability, and Curiosity and imagination. (p.1)

Blended Science will use inquiry-based approaches by starting lessons with a goal or questions and give students the guidance to choose the modality that suits their needs. They will receive one-on-one attention, if needed. They will move on to the next topic if they are ready while others take their time. They will come prepared after watching videos or recorded lessons, so that the classroom can be a comfortable and versatile learning space. More importantly the students will learn those 21-Century Skills and be prepared to solve real problems as they did in science.

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