K-12 STEM Education
in a Digital Platform Era

greenbricks

This was a collaboration between Green Bricks Education Society, Skye Consulting, teachers, teacher candidates and students currently enrolled in K-12 education in British Columbia. Many thanks to all who contributed to this resource.

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What you will find in this guide

Introduction

According to the World Economic Forum[1], our recent global pandemic has resulted in educators being compelled to use various tools and technology in order to teach K-12 students, and subsequently have experienced new possibilities for the future of education. Digital learning has been thought of as a second-best option to traditional classroom learning. However, the past nine months have revealed that there are many benefits to online learning, and particularly for different types of learners.

We believe that online learning will be seen as a credible learning option moving forward. Subsequently during the Fall 2020 we held collaborative meetings and surveys with representatives from Green Bricks Education Society, Skye Consulting, school district representatives, K-12 teachers and students. These meetings and surveys were held online and were a practical opportunity to share knowledge, best practices, ideas and resources to make Science, Technology, Engineering, and Math (STEM) classrooms come alive in an effective virtual format. The meetings took place via Zoom, with a facilitator to lead participants through a series of discussions. We provided breakout sessions and online surveys, in order to have smaller groups to provide comfortable spaces to share experiences and generate ideas.

The topics of discussion included:

1. What worked/didn't work as an educator/learner online
2. Best practices on how to bring the classroom science laboratory to home-based learning
3. What technology tools and platforms worked
4. What online STEM resources were accessed

Participants also shared what new ideas they have now discovered to make the learning meaningful and fun, and what positive outcomes from the online experience they will continue.

https://www.weforum.org/agenda/2020/03/4-ways-covid-19-education-future-generations/ [1]

Benefits and challenges of online STEM learning identified

Students:

During our collaboration meetings and surveys, we invited participants to share benefits of the online learning platform and we noted that students of all ages had similar feedback:

Benefits of online STEM learning reported by students

Time management	School environment	Responsibility	Comfort
I could wake up a 9:00 am, roll out of bed and join the class	*I am a shy student and would never ask questions in class, but I now can message my teacher and ask my questions*	*I liked creating my own work schedule*	*I got to wear my comfy pjs during my classes*
I wasn't restricted to class time to finish an assignment so I could plan out my time according to what worked best for me	*I don't like how loud the class can get so online learning eliminated this background noise*	*You had to be responsible and accountable for your own assignments as you couldn't say that you didn't have enough time in class*	*I got to learn with my dog at my feet*
	No one asked me to take off my hat in the hallway		*I liked getting help from my parent*
			I liked being able to make a cup of tea as it made me feel like an adult learner

Challenges of online STEM learning reported by students

Technology difficulties	Lack of socialization	Overwhelming	Lack of routine
Our platform was often glitchy *Normally I ask lots of questions and it was hard to text or email these* *The response to a question was often hard to understand and would be easier to walk up to the desk and ask* *Some teachers didn't know how to use the platform and we had lost assignments*	*I miss my friends* *I didn't like group work online as I missed working with a group* *Some students struggled as they need the classroom setting*	*It felt easy to fall behind without a teacher catching this in class* *The pace of the course was too fast as many units condensed to cover all topics* *We learn a lot more material when in class compared to what we learned online.*	*Even though I liked sleeping in I found it hard to stay with a routine* *Some teachers had no meeting times, so it was hard to have no face time with the teacher* *I preferred learning from a teacher than Khan Academy*

Teachers/District Representatives:

All teachers reported having some level of frustration and a feeling of being overwhelmed but there were also some benefits that surprised some teachers.

Benefits of online STEM learning reported by teachers

A new collaboration with grade teachers at my school	*It was a challenge to email all parents and teachers so we were forced to adapt new technology like classroom portals that I will continue to use*
Since my students were way better adopting this technology than me, I learned a lot from my students, so the teacher became the student	*This platform allowed parents to be involved in their child's education in new ways*
I watched my students succeed with new levels of responsibility over their learning	*Got to try the flip math class approach which I really liked*
I got creative with my teaching coming up with new ways to get students to buy-in from home	*Re-designing learning to be more competency based*
Students developing their independent learning skills	*Students who normally didn't participate due to anxiety, participated*
Created a sense of community as we were all struggling together	*Many effective and interactive online resources such as Phet so my courses become more project and inquiry focused*
I learned new technological tools that were helpful like using Teams to make editable worksheets	*As time went on and students had the right technology, we had more and more students participate*

Challenges of online STEM learning reported by teachers

Trying to learn and then teach my students and their parents how to use the district portal	*Often the Teams platform was glitchy and it would drop meetings*
It was that much harder to work with my English language learning students as there was little support	*Many students had WIFI issues, so the telephone was always more efficient but took so much time to call my students*
It was a challenge to get all my students on board, so student accountability was an issue	*Some students struggled with time management and it was hard to support them when I wasn't seeing them*
Getting my students to respond to my posts was challenging at first	*No clear guidelines as to what we could ask students to complete so often some students did not complete all assignments*
Adapting my classroom resources to work online was very time consuming	*I had to become a tech support and expert so I could learn ways to keep my students engaged online*

Recommendations for continued online STEM learning

After collecting the results from participating teachers and students, we have compiled a list of recommendations that would allow for continued success of online STEM learning. Even if we are back in the regular classroom setting soon, we see a continued hybrid of learning environments, including more optional online courses so this list could serve as a tool to help with this process. Some districts are already employing a variety of these recommendations, but we wanted to capture a complete list of ideas.

- Offer greater financial support for school districts and schools to upgrade internet systems and equipment in the classrooms
- Ensure all students have a working device and WIFI to work from home
- Set up district support lines offered in various languages to assist trouble shooting technical issues
- Organize provincial and district professional development workshops for teachers to better understand how to utilize district approved platforms so teachers can learn how to use breakout rooms, white boards, etc.
- Facilitate specific professional development workshops specific to each subject to share best practices and actual online lab examples teachers can adapt and use
- Create a document for students and parents/guardians to sign (similar to school code of conduct) so students understand and accept online etiquette like keeping lines muted, responding to teachers' online posts on the classroom portal, etc. so student expectations are captured.
- Share tips for teachers on virtual classroom management
- Understand better cyber security to keep online learners safe but also not to discount certain platforms like Zoom
- Encourage more collaboration between grade and subject teachers to share resources and best practices
- Create BC wide resources that allow teachers to create technology-based assignments

Online resources for STEM classrooms

Online STEM Tools

Here is a list of online STEM tools teachers and students shared with us during our collaboration meetings. If you have any further resources to share, please email info@greenbricks.ca

Name	Details
Gizmos	Gizmos includes interactive math and science simulations to engage your students.
Khan Academy	Created by experts, Khan Academy's library of trusted practice and lessons covers math, science, and more.
PhET	This provides fun, free, interactive, research-based science and mathematics simulations.
Kahoot	Create interactive trivia from scratch, use their question bank to mix and match questions, edit a template, or reuse existing games.
Flipgrid	Create a discussion topic; share it with your learning community and learners record and share short videos with you and your class.
YouTube	This offers educational videos, science experiments and lots more.
Math Antics on You Tube	This is a site that provides videos and supplementary materials covering five math topics: arithmetic, fractions, geometry, precents, and algebra basics.
Skype a Scientist	Skype a Scientist creates a database of thousands of scientists and helps them connect with teachers, classrooms, groups, and the public all over the globe.
Scratch	With Scratch, you can learn basic coding skills by creating interactive stories, games, and animations.
Microbit	A 'next step' to Scratch this coding site guides students to learn coding and see the JavaScript behind the scenes.

Teachers Pay Teachers	Purchase send home science kits by Teachers pay Teachers
Online Ocean	At home learning with Ocean Wise, bringing the ocean to your virtual classrooms.
BC Lung vaping toolkit	BC Lung has created resources to teach your students the emerging science on vaping. Elementary program available now and Secondary program coming March 2021
Move and Play with Dash	This article provides practical ideas of ways that PHE educators can use this time of students learning from home more meaningfully.
National Geographic TV	The flagship channel airs non-fiction television programs produced by National Geographic and other production companies.
BC Hydro Power Smart for Schools	Engage your students with classroom ready resources focused on energy, electricity, electrical safety, conservation, and sustainability.
Space Foundation Discovery Center Virtual Fieldtrip	The Space Foundation Discovery Center takes advantage of extraordinary teaching tools to deliver our virtual programs, including Science On a Sphere® and our programmable robots used in a simulated Martian environment.
Conservation Quizzes	The Conservation Quizzes are a few fun quizzes on various nature topics
Junior Achievement Investment Strategies Program	The Investment Strategies Program is a learning opportunity for Grade 8-12 students to explore the ways in which people save and invest for their future.

Virtual field trips and classrooms workshops

Here is a list of virtual workshops that come to your classroom via a link like Zoom. If you have any further workshops to share, please email info@greenbricks.ca.

Name	Details
Green Bricks	Green Bricks involves B.C. youth in sustainable land use and development through science-based virtual workshops.
FVRD Air Quality	For schools in the Fraser Valley, the FVRD is offering Air Quality education workshops to grades 5 &10. Contact fiona@skyeconsulting.net to book your classrooms.
Metro Vancouver Watershed	In lieu of regular field trip programming, Metro Vancouver is offering teachers and students in Metro Vancouver the opportunity to participate in the Virtual Watershed Field Trip.
DreamRiders	Through live theatre and the best of the digital classroom, DreamRiders engage, inspire and empower kids to become agents of change in their families and communities.
ScienceWorld Virtual Fieldtrip	Online Science Adventures is an interactive, high-energy Science World program developed for schools across BC.

For any corrections, additions or suggestions, please email info@greenbricks.ca.