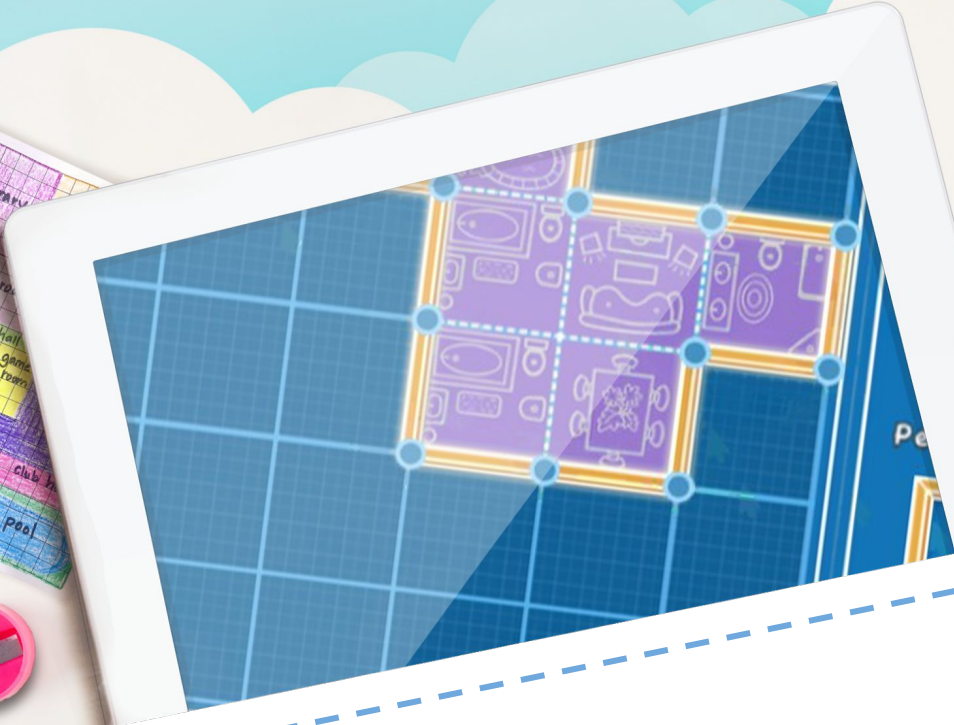


DOES YOUR BLENDED RESOURCE MAKE THE GRADE?

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- 1** DO THE DIGITAL RESOURCES AUGMENT HANDS-ON LEARNING EXPERIENCES?
 - 2** ARE THE RESOURCES BUILT ON RESEARCH-BASED PEDAGOGY?
 - 3** DOES IT SUPPORT TEACHERS & BUILD TEACHER-CAPACITY?
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INTRODUCTION

A few years ago, we wrote a piece called “Does Your Digital Math Resource Make The Grade” in which we outlined six considerations when evaluating digital game-based learning resources for math. Since that time, technology in the classroom has become less of a luxury and much more of a necessity. As a result, educators have come to expect more from the digital tools they bring into their classroom.

We asked teachers, parents, principals, superintendents, math coaches and more about what they look for in a digital resource these days and it quickly became obvious we were asking the wrong question. The conversations invariably shifted to discussions of how digital resources are often used ineffectively in the classroom and the importance of the interplay between digital resources, hands-on resources, and the teachers themselves.

That's why, in this expansion on our earlier work, we want to better understand...

DOES YOUR BLENDED RESOURCE MAKE THE GRADE?

For the purposes of this investigation, **a blended resource will be defined as one that makes use of digital and hands-on tools**. Both elements ought to be present for teachers as they plan lessons, facilitate assessment, and conduct student-centred interventions. Additionally, learning resources of both types should be available for students as they explore, learn, and apply new concepts.

Separate digital resources and hands-on resources can be implemented in tandem to create blended learning experiences. However, teachers often report that this disconnected patch-work approach breeds challenges which highlight the importance of seeking out blended learning resources. Blended tools with both types of resources under one roof help teachers make connections between them and make crafting differentiated lessons, for example, much more intuitive for teachers.

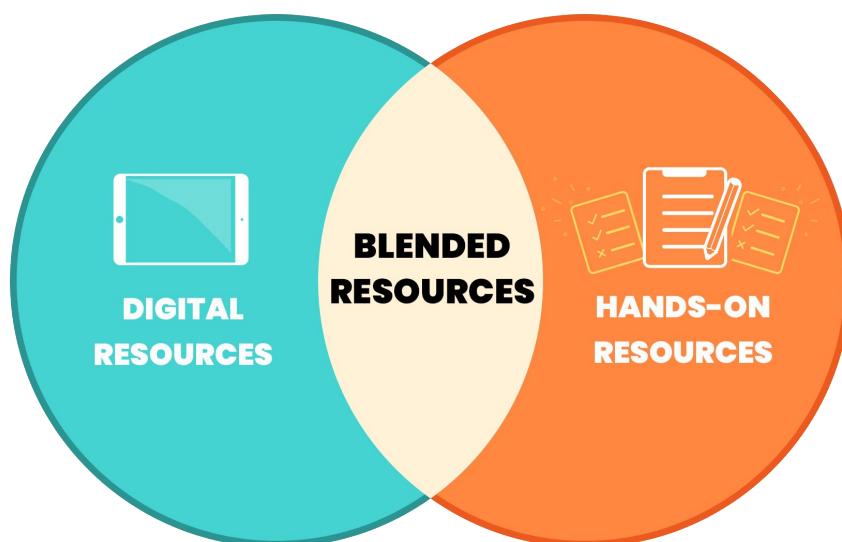
Before we dive into blended resource evaluation criteria, it should be clear that although the primary focus on this investigation is on numeracy (particularly for K-6), many of the considerations can be applied to blended learning resources for other curricular areas as well.

DO THE DIGITAL RESOURCES AUGMENT HANDS-ON LEARNING EXPERIENCES

Ruben Puentedura's famous SAMR model is widely revered as a "powerful conceptual tool to think about technology integration and edtech's best uses."¹ Although this analysis will not propose that any one tier of the SAMR model is inherently better than any other, Doug Clements' work on concreteness fading does suggest that technology should not be used to substitute or replace hands-on learning when it comes to early math education.²

Some digital resources may appear as sophisticated learning tools due to their production value but upon closer inspection it becomes clear that they are simply replacing printable worksheets with gamified digital versions. For instance, consider whether students are encouraged to think critically and conceptually about presented tasks or if students are simply answering rote problems. In her book "Mathematical Mindsets", Jo Boaler laments that "the vast majority of math apps and games are unhelpful, encouraging drill and rote memorization." This highlights the importance of looking for resources that "approach mathematics conceptually,"³ and serve to enhance the tasks in which students engage offline.

Hence, when evaluating blended resources, look for resources in which the technology serves to enhance and build upon more tangible learning experiences rather than replace them. Furthermore, consider whether those offline activities are rote drills and worksheets or are lesson plans that support the implementation of rich hands-on tasks?



¹ Terada, Y. A powerful model for understanding good tech integration (2020)

² Clements, D & J. Sarama. Learning and teaching early math: The learning trajectories approach. (2020)

³ Boaler, J. Mathematical Mindsets. (2016)

ARE THE RESOURCES BUILT ON RESEARCH-BASED PEDAGOGY?

Some resources can actually be quite detrimental for students and can have negative impacts on student confidence, anxiety, and mindset towards math. This is why it is vitally important to carefully consider the pedagogy on which the resources are built.

Reflecting on resources that rely heavily on game mechanics to keep students engaged highlights an important distinction between “gamification” and “game-based learning”. In the latter, students learn through playful exploration within an environment in which they can experiment and fail safely. This encourages creative problem-solving and a growth mindset which will be discussed later. The former, however, incentivizes behaviours through rewards. Gamified resources typically encourage students to follow specific procedures in order to get correct answers as quickly and efficiently as possible. This fosters a fixed mindset and a Pavlovian response to the types of problems students encounter.

Thoughtlessly applied gamification is sometimes referred to as “chocolate – covered broccoli”⁴

because of the way it sugar-coats the learning. Even though many students will say they enjoy the game, their enjoyment rarely stems from their engagement with the math - instead, they deploy tactics that avoid or expedite the math problems so they can spend more time building their collections and customizing avatars. In our conversations with parents, one referred to themselves as their child’s “cheat code” in that they would constantly ask, “How do I do this problem?” in order to get back into the game. At first, they thought it was great that their child was so engaged with their learning, but it soon became clear that the learning was secondary to the gameplay and was, therefore, ineffective.

Similarly, the hands-on resources ought to be more than worksheets and flashcards. When asked about the longevity or “replayability” of these rote activities, many teachers with whom we spoke were taken aback. One responded, “Well, it’s not like students are asking to erase their answers and do the worksheet over again.” This is not to suggest that worksheets and rote exercises are not valuable in certain circumstances, but the procedural fluency promoted through this form of practice drills is only one of five intertwined strands of mathematical proficiency as proposed by Kilpatrick et al.⁵ Hence, it is important to look for hands-on tasks that offer more than practice drills. There is a reason why these are often colloquially referred to as ‘drill-n-kill’ worksheets.

Look for resources in which students encounter rich contextual math tasks and that require them to think critically about their approach. By deploying tools that focus on constructing solutions rather than simply supplying answers, students are afforded a high degree of agency and become more creative and perseverant problem-solvers. Look for resources that offer open math tasks in both their digital and hands-on components. Investigate the feedback students receive when they make a mistake and whether the tasks are self-regulatory. Can students leverage tools and models when solving problems? Does it adapt and scaffold to meet individual students’ needs and spur on progression along research-based learning trajectories? Avoid resources that have leaderboards, timers, penalize mistakes, and inject rote questions that interrupt the gameplay.

Math should not be a barrier to the fun parts – math should be the fun parts.

⁴ Bouchard, S. [TEDx: Chocolate Covered Broccoli: Building Better Games](#) (2011)

⁵ Kilpatrick, J., Swafford, J., & B. Findell. [Adding It Up: Helping Children Learn Mathematics](#) (2001)

DOES IT SUPPORT TEACHERS AND BUILD TEACHER-CAPACITY?

Blended or otherwise, resources should not propose to do a teacher's job for them. **Technology should never replace what a teacher is doing or override a teacher's professional judgement** when it comes to lesson planning and student intervention. Instead, much the same way technology should enhance the learning experience, an effective blended resource should support a teacher in their practice.

Look for resources that expose teachers to a diverse range of inquiry models, rich tasks, and instructional strategies. Exposure to these tools should not cause teachers to rely more heavily upon them; rather, it should empower and inspire them to craft and deploy impactful lessons of their own. Number talks⁶, for example, are most effective when a teacher is able to ask questions that build on students' ideas rather than following a script.

In terms of assessment and intervention, **an effective blended resource is one that will leverage hands-on resources that set the stage for teachers to make rich observations**, will leverage the digital assessment systems to highlight trends and make recommendations for next steps, and will do both in concert with each other. Thus, look for resources that treat digitally collected performance data as a formative tool for helping teachers identify and address emerging needs. No app will ever know a class better than their teacher, so be wary of tools that use assessment data to propose absolute performance ratings as a summative measure.

Aside from the implicit supports built into an effective blended learning resource, look for more explicit supports as well. Technology in the classroom is not a new idea, but truly blended approaches to teaching and learning that make the best of both digital and hands-on experiences are still being developed and understood. Look for resources with embedded supports beyond simple "how-to" tutorials – consider how the tools support effective implementation of the underlying pedagogy and how those ideals can be extended beyond the use of the tools themselves.

***an effective
blended resource
should support
a teacher in
their practice***

Finally, consider how the tools remove logistical constraints for teachers when it comes to lesson planning. The digital tools should have a high degree of responsiveness to each student's needs and progress along with the student to keep them in their zone of proximal development⁷. Additionally, with recommendations and seamless connections between the digital and hands-on resources, an effective blended learning tool should make crafting richly differentiated lesson plans much more accessible for teachers.

⁶ Parrish, S. Number Talks: Whole Number Computation, Gr K-5: A Multimedia Professional Learning Resource (2014)

⁷ Kurt, S. "Lev Vygotsky – Sociocultural Theory of Cognitive Development" in Educational Technology, (2020)

IS IT VERSATILE?

They say necessity is the mother of invention. In today's educational ecosystem, teachers need to be able to adapt to diverse and evolving student needs and learning environments that can pivot from the classroom to online lessons to asynchronous learning at the drop of a hat. Therefore, **we need innovations that can help teachers keep up and thrive in any learning environment** and deploy any instructional mode.

Effective blended learning resources help teachers plan full-group discussions, small-group investigations, individual practice, and home-learning activities by supporting the implementation of resilient learning routines.

Look for tools that can be implemented as instructional supports for math talks, centre-based lessons, remote teaching, and all of the aforementioned lesson modalities – a tool should do more than simply offer opportunities for additional practice.



DOES IT POSITIVELY IMPACT STUDENT MINDSET?

When asked what achievement in math class looks like, many of the educators we interviewed spoke less about test scores and calculation skills and more about confidence, perseverance, and a growth mindset towards math.

There are stacks of books and research papers written about what a growth mindset is and how it applies to mathematics education. Pervasive recommendations in this body of work include celebrating hard work and effort rather than correct and speedy answers, encouraging creative problem-solving rather than following procedures, and embracing mistakes rather than penalizing them.

An effective blended resource will feature open tasks that invite students to explore, debate, communicate, reason, defend their choices, and do so seamlessly through both the digital and hands-on components.

Therefore, it is important to investigate the types of tasks students encounter. As mentioned previously, flashy game mechanics can mask otherwise uninspired rote drills and position math as the “cost-to-play” an otherwise fun game. Be mindful of whether students are being motivated to get an answer quickly by following specific procedures, or if they are empowered to explore and try different approaches.

One way to tell if blended resources encourage growth mindsets in students is to investigate what happens when students make a mistake. Does the digital resource give them a red X and move onto a new problem or does it provide relevant and immediate feedback and encourage them to try again? Are the hands-on resources primarily worksheets or are they lesson plans for rich tasks, games, and investigations? Finally, are there clear connections between the hands-on tasks and the digital tools students and teachers are leveraging?



DO TEACHERS & STUDENTS FIND IT ENJOYABLE & HELPFUL?

When purchasing goods online, one can avoid being disappointed by a product not living up to expectations by referencing the customer reviews before “adding to cart”. The same idea is true when reviewing blended learning resources. There are resources available that have the playfulness and fun factor that kids love, but are lacking in pedagogical rigor. Similarly, there are resources that have the rich pedagogy that teachers crave but fail to inspire and excite students. There are resources that have both, but are so complex that they are difficult to use and implement effectively.

“...Look for resources that have a balanced blend of play and pedagogy...”

Look for resources that have a balanced blend of play and pedagogy and that do not have a steep learning curve for students and teachers. This will allow administrators and coaches to spend less time training teachers on how to use the tools and more time on how to use the tools effectively.

Furthermore, as referenced previously, districts realize a greater return on investment in tools that support teachers and teacher practice. If a tool can give teachers time back in their day by streamlining lesson planning and delivering impactful lessons while simultaneously facilitating assessment, then it is more likely to be implemented. For example, in instances where the digital components provide teachers with recommendations for hands-on activities based on student performance, teachers delight in the utility of the resource and make it a regular part of their day-to-day work.



BONUS | DOES IT HAVE TOOLS FOR ADMINISTRATORS?

When reviewing blended resources, consider what tools exist for school principals, curriculum coordinators, superintendents, and anyone whose responsibilities involve supporting teachers.

Blended resources have the unique potential to provide insights on student learning, adoption of the resources, and how they are being used in the classroom at the school, regional, and even board level. This allows educational leaders to rely less on lag measures like standardized test results to inform their professional development initiatives and become more responsive to the needs of their fellow educators.

Blended learning is not a new idea but we are still in the process of understanding the interplay between digital and hands-on resources and how to implement them effectively so as to bring out the best of both worlds. Teachers, parents, students, and educational leaders expect more out of the tools used in the classroom, and the criteria outlined here serve as a general guideline for evaluating such tools so as to minimize risk and maximize a school board's return on time and financial investments.

After interviewing teachers and educational leaders across North America, these are the considerations that were referenced again and again. Of course, there are others (eg. "Does it align with my curriculum? Can I control the content students see? Is it available in other languages? Is the data secure?") but many of these questions were not discussed in great detail here because these ought to be seen as prerequisite to a more thorough investigation. For example, not aligning with your curriculum or not allowing a teacher to assign content based on their lesson planning goals ought to be an instant deal-breaker.

Share these evaluation criteria with your colleagues to start a conversation around the tools teachers are using in your area. Whether you're evaluating your current resources or vetting new ones, ensuring schools have access to tools that support effective math learning and empower teachers and students is one of the most powerful steps educational leaders can take to support their teachers.

Does This Blended Resource Make the Grade?

Resource being evaluated:	5 Always	4 Most of the time	3 Sometimes	2 Rarely	1 Never
Do the digital resources augment hands-on learning experiences? Are the digital and hands-on components connected? Do the digital resources promote exploration within and beyond the digital environment?					
notes:					
Are the resources build on research-based pedagogy? Do the resources engage students in rich tasks rather than rote drills? Does it promote conceptual understanding, adaptive reasoning, and numeracy development?					
notes:					
Does it support teachers and build teacher-capacity? Do the resources facilitate qualitative observations by the teacher? Do the resources inform lesson-planning decisions and best practices?					
notes:					
Is it versatile? Does it support multiple teaching and learning styles? Can the tools be used for in-class and remote teaching scenarios?					
notes:					
Does it positively impact student mindset? Do the tools encourage students to keep trying? Does it focus on the problem-solving process and celebrate effort rather than focusing on correct answers?					
notes:					
Do teachers and students find it enjoyable and helpful? Do the tools have a balanced blend of pedagogy and play? Do the tools have a history of widespread and lasting adoption across school boards.					
notes:					
Does it have tools for administrators? Can school and school board administrators monitor impacts on adoption and student learning? Do the tools provide insights regarding professional learning decisions and ROI?					
notes:					

30 - 35 - This is an exceptional resource recommended for board-wide implementation.
24 - 30 - This is a valuable and effective blended learning platform and is recommended for schools.
18 - 24 - This resource can serve a variety of instructional needs but has deficiencies.
2 - 18 - This resource has significant deficiencies but may be useful in specific circumstances.
0 - 12 - This resource is not recommended and should not be used in schools.