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HELPDESK TOPIC BRIEF

Using Blended Learning to Support Marginalised Adolescent Girls' Education

A Review of the Evidence

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Purpose of this document

This document was produced in response to a request from the Foreign, Commonwealth and Development Office (FCDO) team that was submitted to the EdTech Hub Helpdesk in July 2020. This topic brief reviews evidence about the use of blended learning to support the education of marginalised adolescent girls in low- and middle- income countries. The document aims to inform the design of a new multi-country education programme in sub-Saharan Africa. We have selected sources that focus on this region wherever possible. This document builds on the work on remote learning written by the Education Endowment Foundation (2020) and commissioned by the EdTech Hub, which includes a section on blended learning.

To respond directly to the concerns of those designing educational programmes, we have centred our research around a set of six questions:

1. What impact does blended learning have on the learning outcomes of secondary education pupils?
2. What is the cost-effectiveness of blended learning?
3. What is the optimum balance between remote learning and classroom-based activities?
4. What factors have been shown to improve the impact of blended learning interventions?
5. How can education decision-makers mitigate the challenges associated with delivering blended learning country-wide?
6. How can blended learning meet the needs of learners in low- and middle-income countries (LMICs), especially girls?

1. Executive summary

1.1. Our definition of blended learning

There are varying definitions of blended learning across the literature. Three of the more common definitions are:

- **"Any time a student learns at least in part in a supervised brick-and-mortar location away from home and at least in part through online delivery with some element of student control over time, place, path and/or pace"** (↑Horn and Staker, 2011, p.3);
- **"The combination of face-to-face and technology-mediated instruction"** (↑Porter, Graham, Spring and Welch, 2014, p.185);
- **"The combination of multiple approaches to learning"** (↑Watson, 2008, p.5).

↑Horn and Staker's definition is the narrowest of the three as it focuses solely on learning outside of the classroom being delivered online. Web-enabled learning is likely to be a problem in LMICs, where issues linked to the infrastructure and the costs of devices and data limit access to the internet. Because of this, ↑Porter and colleagues' definition, which can be interpreted to include types of technology other than the internet, is more appropriate to the context of LMICs.

We, however, acknowledge that most of the literature on blended learning looks at interventions that are web-enabled. To align with this literature, throughout most of this topic brief we use the term blended learning in line with ↑Horn and Staker's definition. Nevertheless, to acknowledge the realities of LMICs, we point to blended learning interventions that match ↑Porter and colleagues' definition whenever possible.

↑Watson's definition contrasts with those of ↑Porter and colleagues and ↑Horn and Staker as it takes a much broader view of blended learning by moving away from thinking about the medium of blended learning to focus on its objective. This objective, according to ↑Watson, 2008, is to

> **"personalize learning, allow thoughtful reflection, and differentiate instruction from student to student across a diverse group of learners." (p.4)**

As previously stated, ↑Watson's definition doesn't reflect the bulk of the literature and thus won't be used in the majority of this topic brief. However, in question 2.6, we explore how taking on this broader definition can allow us to focus on low-tech interventions and approaches that are beneficial for the education of marginalised girls.

1.2. Summary of findings

Evidence from high-income contexts indicates that blended learning programmes with an online component can lead to a small increase in learning outcomes compared to traditional teaching (see Section 2.1). In some cases, low performing pupils have disproportionately benefited from blended

learning programmes. Evidence suggests that effective blended learning programmes will have these characteristics (see Section 2.4):

- use educational technology to supplement rather than replace face-to-face teaching;
- promote peer-to-peer communication and offer collaborative learning opportunities;
- scaffold the transition from traditional teaching to ensure pupils have the self-regulation and digital skills they need to perform well;
- align content with the national curriculum;
- support teachers to develop the pedagogical skills to facilitate blended learning activities.

In low-income countries where pupils have lower digital literacy skills and less access to devices for online learning, blended learning programmes must consider limitations in infrastructure and the existing skills base. Blended learning that combines face-to-face and online instruction may not represent a cost-effective intervention to raise the learning outcomes of marginalised girls, given system-wide challenges that should be addressed (see Section 2.5). In this context, education decision-makers should consider blended learning programmes that integrate lower and more widely available forms of technology such as television and feature phones (see Section 2.6). Blended learning programmes with offline components are likely to be more accessible in low-income countries. This type of blended learning may be implemented as a means to increase access to education for marginalised groups, including girls.

2. Questions and answers

2.1. What impact does blended learning have on the learning outcomes of secondary education pupils?

Evidence from high-income countries on the impact of blended learning on pupil learning outcomes indicates that compared to traditional face-to-face instruction, this type of educational design has a small but significant positive impact. This conclusion is supported by five meta-analyses which considered the international literature (↑Bernard, Borokhovski, Schmid, Tamim and Abrami, 2014; ↑Means, Yukie, Robert and Baki, 2013; ↑Vo, Zhu and Diep, 2017; ↑Wandera, 2017; ↑Zhao, Lei, Yan and Tan, 2005) and one meta-analysis which focussed solely on Iran (↑Najafi and Heidari, 2018). Details about each of these studies can be found in this document's appendix (see Section 5).

It is important to note that none of the reviewed meta-analyses focused specifically on LMICs. They all reviewed quasi-experimental or random-assignment studies in settings in which the observed pupils had access to the technology required for blended learning. Select low-income populations in sub-Saharan Africa may have limited access to high-tech devices commonly utilised for blended learning, such as laptops. Importantly, there is a significant gender digital divide in low-income countries with girls having less access to technologies (↑Webb et al., 2020). The impact of blended learning on girls in low-income countries is thus likely to look very different from the scenarios reviewed by the meta-analyses above.

Regarding marginalised pupils, some evidence suggests that in certain circumstances, blended learning can have a disproportionately positive impact on pupils with low levels of learning. For India, ↑Linden (2008) found that poorly performing pupils experienced the largest gains in a computer-assisted learning programme that supplemented traditional teaching. Likewise, ↑Muralidharan, Singh and Ganimian (2019) reviewed a technology-aided, after-school instruction programme in India. They observed that this supplementary programme led to **"similar absolute test score gains for all students, but much greater relative gains for academically-weaker students."** They attributed this disproportionate increase in test scores to the fact that computer-aided programmes can effectively cater to a wide range of pupil learning levels and target instruction to the level of the child.

We note that all of the above meta-analyses reviewed at least some evidence on tertiary education due to the limited availability of evidence on secondary education. However, the two studies that included literature on both secondary and tertiary education (↑Means, et al., 2013; ↑Wandera, 2017) concluded that the impact of blended learning on pupil outcomes did not vary within the age-range considered.

Figure 1. SPARK schools in South Africa.

SPARK schools are a network of 11 primary schools, mainly in South African cities. These schools use a 'Learning Lab', rotational, blended learning programme, which combines traditional classroom instruction with adaptive software, intended to accelerate learning. The blended learning component of this programme has been deemed successful and Lab-rotational models have been extended from serving 160 pupils in 2013 to 4,000 pupils in 2017. However, SPARK does note that **"solid connectivity and good infrastructure are essential"** (↑UNICEF, 2018, p.3) to ensure the programme is successful.

Overall, evidence from several meta-analyses suggests that blended learning can have a small, positive impact on secondary pupils' learning outcomes compared to traditional teaching. However, the potential of blended learning is unlikely to be realised in sub-Saharan Africa since pupils — and especially girls — often do not have access to the technology or infrastructure required for online blended learning. If

pupils with pre-existing low achievement levels could gain access to blended learning, the evidence suggests that they could obtain disproportionate benefits compared to their higher-achieving peers.

2.2. How cost-effective is blended learning?

Existing literature on blended learning has little evidence on the cost-effectiveness of blended learning programmes. However, we know that blended learning does not usually reduce the costs of education delivery as learners still require face-to-face instruction (↑Means, et al., 2013).

As detailed in the previous section, the introduction of blended learning can have a small, positive impact on pupil learning outcomes. However, the majority of rigorous studies on blended learning focus on high-income countries with existing favourable infrastructural conditions (see our appendix). Blended learning programmes in low-resource settings will either require an infrastructure component with increased cost or be less effective as learners cannot access a suitable device or the internet.

At the same time, blended learning allows for more flexibility in learning. Pupils may have a degree of control over time and place as well as learning path and pace (↑Horn and Staker, 2011). This flexibility may be especially important for girls who struggle to continue learning. Blended learning programmes which take into account the lack of infrastructure and devices present in sub-Saharan Africa by including offline components could have high potential in that region.

In Section 2.6, we outline alternative forms of blended learning that can meet the needs of pupils in LMICs.

2.3. What is the optimum balance between remote learning and classroom-based activities?

Evidence indicates that educational technologies cannot substitute for all aspects of teaching. In a meta-analysis on the impact of technology on pupil learning, ↑Tamim and colleagues (2011) found that the use of technology to supplement teaching (e.g., computer-assisted learning) had a significantly higher effect size than the use of technology to replace direct instruction. In a study on the One Laptop per Child programme in India, ↑Ale and colleagues (2017) emphasised the role of teachers in supporting learners to effectively use — and benefit from — educational technology. Similarly, ↑Cui and Zheng (2018) noted that teacher involvement in peer evaluation in online blended learning environments can lead to significantly improved learning outcomes. In other words, a blended learning programme should build on, rather than replace, the work of teachers, and blended learning interventions should always include a face-to-face component.

Figure 2. A randomised control trial comparing the impact of different approaches to blended learning in India.

↑Linden (2008) evaluated two different approaches to implementing a computer-assisted learning programme in India. In the first approach, computer-assisted learning directly replaced classroom activities. In the second approach, computer-assisted learning supplemented classroom activities.

The study found that pupils who followed the first approach learned significantly less than they would have through normal classroom activities. In contrast, pupils who followed the second approach made small learning gains. These learning gains were largest for the lowest-performing pupils.

The paper suggests that the technological components of blended learning programmes have a greater impact when they build on in-person learning activities. These activities could take place in schools, community centres or a local equivalent. This approach could prove particularly beneficial for the most marginalised learners including adolescent girls.

If a wholly tech-based approach to blended learning cannot effectively replace classroom activities, what balance should education decision-makers strike between tech-based learning and classroom-based activities?

In a recent randomised controlled trial, ↑Bettinger and colleagues (2020) examined the impact of replacing teacher-led activities with different 'doses' of computer-assisted learning in 343 Russian schools. The study compared the impact of a single 45-minute 'dose' of computer-assisted learning per week, a double 90-minute 'dose' of computer-assisted learning per week and no computer-assisted learning. While a single 'dose' of computer-assisted learning improved academic results, an additional 'dose' had significantly less impact on learning outcomes. The paper suggested that this diminishing rate of return could stem from poor self-regulation skills (↑ibid.; ↑Rasheed, et al., 2020).

In a meta-analysis on blended learning, however, ↑Means and colleagues (2013) presented mixed findings on the impact of the amount of time spent learning online versus the amount of time spent learning in school. While 18 studies concluded that pupils who spent more time learning online achieved higher results, 9 studies found that pupils who spent more time in a classroom achieved better learning outcomes.

These inconclusive findings suggest that other factors — quality of content, pedagogy, and educational scaffolding — may matter more than the precise balance between time spent on remote learning and time spent on classroom activities.

2.4. What factors have been shown to improve the impact of blended-learning interventions?

2.4.1. Building in peer support

Several of the meta-analyses detailed in this document's appendix highlighted the value of communication between pupils (↑Means, et al., 2013; ↑Cui and Zheng, 2018). ↑Cui and Zheng (2018) specifically conducted a meta-analysis on peer evaluation in secondary and tertiary blended learning environments in high-income contexts. The authors found that peer evaluation can have a positive effect on learning outcomes. They noted that anonymous peer marking had a higher impact on outcomes than non-anonymous peer marking. Moreover, teacher-supported peer-reviewing had a higher impact on learning outcomes than unsupported peer-reviewing. In a systematic review, ↑Poirier, Law, and Veispak (2019) similarly noted that the facilitation of peer-to-peer communication via messaging platforms or forums was a common feature in some of the positive evaluations of blended learning environments.

An additional study on peer evaluation found that pupils participating in an internet-enabled, peer-evaluation approach performed better than pupils participating in an internet-enabled, streaming-video approach. For the peer-evaluation approach, pupils were asked to present a paper to the class in person. The video of their presentation was then uploaded online, where peers would evaluate each other. Pupils who participated in the peer-evaluation approach were significantly more satisfied and motivated with their learning than the other pupil group (↑Hsia, et al., 2015).

Figure 3. Peer-to Peer University's learning circles in Kenya, South Africa, Zimbabwe, Uganda, and India.

The Peer-to-Peer University (P2PU) is an organisation that organises free, in-person 'learning circles' or study groups for learners who have enrolled in massive open online courses (MOOCs). Learning circles gather in public spaces such as libraries or community centres generally for two hours a week, for six to eight weeks.

MOOCs are known to have low completion rates (↑McAleavy, et al. 2018). However, a recent review of P2PU found that three-quarters of learning-circle respondents reported having been able to achieve

the goals they set out to achieve in the circles. They emphasised that regular meetings had played an important role in their success. This highlights the importance of social and emotional support and group discussion for online components of blended learning interventions (↑Fellows, 2018).

2.4.2. Scaffolding pupils' learning to promote their independence

In a systematic review of the literature on blended learning, ↑Rasheed and colleagues (2020) emphasised that pupils need to have adequate self-regulation skills and technological competence to be able to study independently from their teachers at their own pace. If pupils lack the self-regulation skills needed to manage their studies, they will not engage with the educational content offered via blended learning. Interventions using achievement badges may help pupils become more aware of their learning progress and reduce procrastination (↑Auvinen, et al., 2015). Other studies have pointed towards smartphone-based initiatives, such as SMS reminders, to supplement blended learning (↑Davis and Abbitt, 2013).

Pupils — and especially those from low-income households — might also be limited by their digital skills (↑Rohs and Ganz, 2015). Low digital literacy can lead to pupils spending more time on learning how to use the technology than on studying (↑Prasad, et al., 2018), or it might delay them in receiving feedback from teachers since they might have to wait until they meet their teacher in person to hear about their performance (↑Zacharis, 2015). Accordingly, ↑Bernard and colleagues (2014) note that when working in the online portion of blended learning,

> **"students need to [...] be provided with scaffolded experience and allowed to practice in real learning environments. This is important for students in BL [blended learning] settings because, by and large, these students are working outside of the orbit of direct teacher influence." (p.117)**

To provide scaffolding, a gradual transition from face-to-face to progressively more blended learning is advised.

Figure 4. Implementing blended learning in secondary schools for girls in Saudi Arabia.

↑Bukhari (2016) studied the implementation of a blended learning programme in previously traditional secondary girls' schools in Saudi Arabia. The author concluded that blended learning allowed girls to learn at their own convenience and contributed to their genuine interest in the use of computers. However, there were problems with the workload of pupils during the transition from traditional to blended learning. These problems led the author to recommend that educational decision-makers actively seek feedback from key stakeholder groups during the implementation of blended learning programmes. Additionally, the author noted that teachers had trouble integrating face-to-face teaching with e-learning and thus recommended that teachers need to be trained in blended learning practices.

2.4.3. Educating teachers

In the same way that pupils' blended learning experiences need to be scaffolded, teachers also need to be provided with adequate support. Teachers need to be technologically competent to be able to upload

learning materials for pupils and to manage their remote learning experiences. In a review of the challenges of the online component of blended learning, ↑Rasheed and colleagues (2020) noted that teachers lack confidence, time and willingness to learn how to use the new technologies needed to teach blended learning courses. This might cause teachers to become resistant to the implementation of blended learning programmes.

To respond to this issue, educational institutions need to provide adequate support to their teachers, as well as their pupils. Teacher education is especially important given the suggestion that blended learning may become a permanent feature of education service delivery as a result of the COVID-19 crisis (↑Global Online Learning Alliance, 2020). Educational institutions may incur costs for teacher professional development and ongoing support which need to be taken into account in the assessment of the feasibility of blended learning interventions.

Figure 5. Teacher education in Malaysia.

In response to COVID-19, Malaysia's Ministry of Education launched a digital learning community for teachers (Komuniti Guru Digital Learning) with support from UNICEF. The platform offers video tutorials and quizzes on remote learning, and opportunities to interact and share best practices with other teachers. Although this approach limits the reach of the programme to only those teachers who have access to the internet, 2,400 teachers in Malaysia have been able to use the learning community. Almost 50% of them are serving children in rural communities.

Starting on June 24, schools have gradually reopened in the country with a focus on blended learning. In line with the idea that continued support for teachers is needed, the learning community aims to provide tailored support to foster skills and help teachers adapt quickly to the combination of face-to-face and online instruction (↑UNICEF, 2020). As many countries move to blended learning models, this initiative highlights the need for investment in teachers, with a lens on equity and reaching all learners, both during and after COVID.

2.4.4. Encouraging the use of appropriate pedagogy

In their meta-analysis, ↑Means and colleagues (2013) highlight that pedagogy can significantly moderate the effect of blended learning on outcomes for pupils. The authors note that higher pupil scores are associated with teacher-directed expository or collaborative forms of instruction rather than independent online pedagogy. This finding is corroborated by ↑Bernard and colleagues (2014) who point out that building collaborative learning opportunities into blended learning assignments can improve outcomes and potentially strengthen pupils' motivation and self-regulation.

2.4.5. Aligning content with the school curriculum

Like other out-of-school interventions, the online component of blended learning programmes needs to be integrated with the in-school curriculum. This is demonstrated in a study by ↑Banerjee and colleagues (2007) who conducted randomised experiments to evaluate two remedial programmes in India. The authors compared a programme that provided children with a trained female tutor from the local community for two hours a day with another programme in which pupils engaged in computer-assisted learning (CAL) for two hours per week. Although both programmes were extremely effective, the CAL programme produced slightly larger effect sizes. Importantly, the latter programme became even more effective in the second year when a developer aligned its content to the curriculum.

2.5. How can education decision-makers mitigate the challenges associated with delivering blended education country-wide?

2.5.1. Addressing gaps in understanding and use of ICT infrastructure

Challenge: Due to rapid implementation schedules, governments often do not take stock of existing ICT resources and tools available to support learning.

Key considerations: In addition to data on pupil demographics and education infrastructure, policymakers should take stock of ICT infrastructure. This should include the availability and use of five major technologies (radio, TV, non-smartphone, smartphone, laptop), in addition to internet and electricity access across the country (↑Haßler, et al., 2020). Rather than investing in new and innovative technologies, quick wins can stem from using readily available technology that pupils and families are already familiar with (↑Trucano, 2013). By taking this critical first step of data collection, a multimodal strategy can be more effectively designed to reach learners.

2.5.2. Addressing the high cost of devices

Challenge: Learners, especially those in marginalised groups, cannot afford the digital tools that blended learning requires.

Key considerations: A recent report published by the ↑Alliance for Affordable Internet (2020) provided three key actions that policymakers can take to lower device costs: (1) reduce taxes on low-cost devices to bring down costs for consumers, (2) use Universal Service and Access Funds (USAFs) to subsidise devices, and (3) support projects to help people spread the cost of devices over a period of time. For example, an analysis of the digital infrastructure in Senegal revealed that the cost of mobile broadband services was 12% of the average monthly income, which is substantially higher than in other countries (e.g., 6% in Kenya; ↑World Bank, 2019). Based on these findings, the World Bank recommended that governments implement pricing reforms to increase access to digital services (↑ibid.). In general, reducing taxes on and importing technology, especially devices suitable for blended learning, will make those technologies more affordable to more learners from low-income backgrounds.

2.5.3. Addressing the lack of use of devices

Challenge: Even when access is not an issue, learners are either not using certain technologies at all or not using technologies for educational purposes.

Key considerations: Device ownership does not necessarily correlate with device usage or learning (↑McBurnie and Haßler, 2020). While more Kenyan households own a radio set than television, more Kenyan children have tuned into television lessons than educational radio broadcasts during the COVID-19 pandemic (↑Uwezo, 2020). To understand local attitudes about technology, collaboration with community actors and the development of informational campaigns about technology use is crucial (↑Hubber, et al., 2016).

2.5.4. Addressing the limitations of ICT infrastructure

Challenge: Poor infrastructure and internet connectivity can prevent learners from accessing blended learning activities and materials. A survey of pupils engaged in online and / or blended learning in South Africa found that 53% of respondents experienced unreliable internet connectivity and 35% of respondents faced broader digital infrastructure issues (↑Fisher, et al., 2017).

Key considerations: Long-term planning and public-private sector coordination are required to address these structural issues (↑Allier-Gagneur and Moss Coflan, 2020). In the short term, measures should be taken to reach marginalised learners, such as those living in rural regions, who may be particularly disadvantaged by limited infrastructure. High-tech initiatives that rely on stable internet and electricity

will have limited reach and success. In Ghana, the One Laptop Per Child (OLPC) project was suspended in 2010 due to gaps in infrastructure and the sustainability of the project was limited by electricity shortages in rural communities (↑Leslie Steeves and Kwami, 2017). Furthermore, a phone survey in Senegal found that only 1% of learners have accessed online learning materials since the start of COVID-19, likely due to unavailability of the internet (↑Le Nestour, et al., 2020). Offline and low-tech options for the delivery of blended learning must be considered for LMICs.

Zero-rating, which allows users to access certain sites and applications at no data cost, serves as an example of how governments can work with private companies to reduce structural barriers to online learning. However, zero-rating has received criticism for siloing users within the subsidised websites (i.e., creating 'walled gardens' and an anti-competitive environment) (↑Dixon, 2017).

Figure 6. Raspberry Pi for Learning Initiative (Pi4L) in Lebanon.

Implemented by UNICEF Lebanon, the Pi4L initiative uses Raspberry Pi hardware and software to deliver learning offline and in computer labs. Pi4L blends face-to-face instruction with digital, accessible materials. Modules for pupils cover literacy, numeracy, science and coding. There is additional content for teachers, community facilitators and teacher trainers with accreditation by The College of Teachers in London (↑Lewis and Thacker, 2016).

2.5.5. Removing barriers for girls

Challenge: Barriers including language, location, cultural beliefs and limited leisure time prevent girls from benefiting from technology-based education interventions.

Key considerations: Education technology can work equally well for boys and girls. However, access to technology is often unequal. Inside the home, girls disproportionally bear the burden of household chores (↑Wenham, et al., 2020) and may be limited by gendered attitudes. Outside of the home, girls are likely to have more limited access to community internet and media facilities due to concerns for their safety (↑Naylor and Gorgen, 2020). This is illustrated by a UNESCO survey which found that the ratio of male to female mobile readers is three to one. Despite this ratio, women have more positive attitudes about reading, and reading on a mobile phone, than men. This suggests that access, not lack of interest, will be the predominant factor in ensuring that blended learning includes and supports the learning of girls (↑West and Chew, 2014). If the gender digital divide is not taken into account before a programme is implemented, gender disparity is likely to increase as a result of the programme.

When girls are provided with access to devices, they may, in fact, feel more empowered than boys and are likely to make greater use of them (↑Webb, et al., 2020). Within the context of blended learning, this is demonstrated by a study of the consequence of a higher education blended learning course for women in Saudi Arabia. The study indicated that, in a context where the women had prior access to the devices and the digital skills needed to successfully complete a blended learning course, blended learning especially helped women overcome the geographical, social, and professional constraints of their studies. Blended learning allowed the learners to have greater flexibility to pursue their formal education while attending to their professional and social commitments (↑Tamim, 2018).

For more information produced by the EdTech Hub on girls education and technology see ↑Webb and colleagues (2020), ↑Naylor and Gorgen (2020) and ↑Allier-Gagneur and Moss Coflan (2020).

2.6. How can blended education meet the needs of learners in low- and middle-income countries, especially girls?

The evidence reviewed in this topic brief indicates that, in contexts where pupils have access to the right devices and have prior knowledge of using technology, blended learning can have a small, positive impact on learning outcomes. This 'best case' scenario is unlikely to be present in sub-Saharan Africa

where the costs of devices and data are high, and where infrastructural issues often limit access to electricity or the internet. In real-life sub-Saharan contexts, the small positive effect of blended learning is likely to either disappear or become negative if internet connectivity is required.

This means that we need to move away from thinking of blended learning as purely the combination of online and face-to-face teaching. In fact, existing evidence suggests that the means through which content is delivered does not truly affect learning outcomes. ↑Means and colleagues (2010), for example, note that seven out of eight studies in their blended learning meta-analysis found no significant difference across media types. With this in mind, and to allow for flexibility in delivery which better fits the reality of sub-Saharan Africa, it is helpful to take up a broader definition of blended learning.

↑Wilson and Smilanich (2005) offer a more flexible view of blended learning, defining it as

> **"the use of the most effective training solutions, applied in a coordinated manner, to achieve learning objectives." (p.12)**

This definition, which puts the focus back on the results rather than the method, aligns with ↑Watson's (2008) view of blended learning as **"the combination of multiple approaches to learning"** (p.5). These definitions allow us to consider which low-tech versions of blended learning as well as approaches to learning have been shown to be effective for the education of girls.

2.6.1. Low-tech options for blended learning

Given gaps in ICT infrastructure in LMICs, connectivity requirements for blended learning can be addressed through low-tech modalities, such as mobile devices, television, or offline initiatives.

Mobile phones can serve as a tool for blended learning. Based on a review of mobile-based programmes for sexual and reproductive health in LMICs (↑Ippoliti and L'Engle, 2017), SMS messaging can, for example, be both cost-effective and useful to support learning and connection. Girls in India, Malawi, and Rwanda were found to use phones that can access the internet to learn about sexual and reproductive health and rights (SRHR), as it allows them to anonymously find relevant information through Google, Youtube, Facebook and/or WhatApp (↑Women Deliver and Girl Effect, 2020).

However, there are limitations regarding how the phones can be used. A survey conducted across Malawi, Rwanda, Nigeria, India, and Bangladesh revealed that boys are more likely than girls to use their mobile device for activities requiring an internet connection. This is likely due to the fact that a lower proportion of girls own a smartphone (↑Girl Effect and Vodafone Foundation, 2018). Interventions that require access to smartphones are thus unlikely to reach all girls.

Figure 7. Using mobile phones for learning in Senegal.

The Jokko Initiative in Senegal piloted an in-person, mobile-phone, literacy course and SMS Community Forum in 15 villages. Through the forum, participants could send free SMS messages to each other to practise literacy skills. The initiative was targeted at girls and women in the villages to support peer interaction and empowerment. Follow-up surveys showed significant improvements in literacy scores, with large effects on girls and women (↑Beltramo and Levine, 2012).

Television can also provide an interesting alternative to reach pupils who may not have a phone. In a recently published account of African countries' responses to the COVID-19 crisis (↑Global Online Learning Alliance, 2020), representatives from Senegal mentioned that the country had been delivering online classes as well as educational content prepared by teachers, through television and radio. They explained that Senegal would continue to provide lessons through radio and television although the

country was getting ready to go back to school. This account is in line with the idea that, due to the COVID-19 crisis, blended learning is likely to become a permanent feature of education service delivery.

Alternatively, blended learning can be facilitated by the use of offline downloadable resources. These resources may then be used by children outside of the classroom to allow them to study independently. While there are a large number of offline resources available, as catalogued by a recent ↑World Bank (2020) document, the Learning Management System (LMS) Kolibri provides an especially interesting example.

Figure 8. Using Kolibri to access downloadable content.

Kolibri is a free, open-source LMS. Kolibri's content library catalogue contains lessons, assessments, and games tailored for use on the offline platform. This system allows educators to download content and updates when they have access to the internet. Users can later share the items they downloaded with other devices, thus creating an offline network which can be accessed by communities without network access. Kolibri is designed for offline, school-based usage, but can contribute meaningfully to out-of-school learning as well (↑Learning equality, 2020).

2.6.2. Accelerated learning

Accelerated learning programmes (ALPs) are a supplemental form of education often linked to covering the official national curriculum in a shorter period of time. These programmes can be targeted towards learners and girls who have not been reached. Those organised by the Afghanistan Primary Education Program (APEP) and BRAC are examples of such interventions (↑Longden, 2013). Literature on ALPs has identified common approaches to establishing gender goals through targeting (e.g., hiring female teachers for girls-only or mixed classrooms), awareness (e.g., teacher education on inclusion and gender issues), and quotas (e.g., holding a certain number of seats in ALPs for girls; ↑Myers, et al., 2017). Accelerated learning programmes serve to equip participants to effectively integrate into the formal education system.

Accelerated learning programmes can make use of blended learning methodology. ↑Patchan and colleagues (2014), for example, report that, in higher education, asking pupils to use online, supplemental resources to prepare for their in-person classes means that they are able to cover twice as much content as pupils in a traditional teaching model. ↑Lovett and colleagues (2008) found that university students using blended instruction in a statistics course achieved comparable learning outcomes to students using face-to-face instruction, in half the amount of time. While this shows that blended courses can improve the speed of learning, ↑Lovett and colleagues did note that those findings are not applicable across all contexts. The authors highlighted that students at the university already had familiarity with online learning activities, which may have amplified the effects of blended instruction on learning outcomes.

2.6.3. Collaborative learning

Collaborative learning enables learners to work together in small groups to achieve a common goal. It is an approach that might be especially appropriate for blended learning and for girls. A study in Nigeria by ↑Suleiman, et al., 2017 notes that:

> **"Computer-Based Blended learning strategy improved students' retention in chemistry in collaborative learning settings better than in individualized learning settings and in lecture methods. It was therefore recommended**

among others that students should be exposed to Computer-based blended learning strategy in collaborative learning settings in order to aid their retention of chemistry concepts." (p.268)

The impact of collaborative activities on learning is positive, with low costs for continued teacher education (↑Education Endowment Foundation, 2018). In various studies, girls have articulated preferences for activities involving interactions with peers, which can take place both within and outside of the classroom (↑Abbott, et al., 2008).

Figure 9. Using mobile phones for collaboration in Kenya.

↑Zelezny-Green (2014) reports that, in Kenya, secondary school girls often use their mobile phones to call classmates to discuss and work on assignments together. This type of collaboration, which can take place at any time, allowed them to create connections between formal learning in the classroom and informal learning.

Local facilitators with low-tech devices can further support collaborative learning for girls. To reach the most marginalised girls, in-person meetings are generally most impactful. Facilitators can be equipped with smartphones and sufficient education on digital best practices to guide small group discussions outside of school. The smartphones can also serve as tools to collect data on learner progress and to align efforts across the government, NGOs and other educational players (↑Naylor and Gorgen, 2020).

2.6.4. Maintaining safety for girls

Maintaining safety and learning continuity for girls is always important but has become an even more relevant concern due to the COVID-19 crisis. Because of school closures, girls are at an increased risk of experiencing gender-based violence (GBV). Schools provide nutritional and social support and being out of school due to an emergency increases the likelihood of child marriage and early pregnancy. Due to these various factors, some girls may not return to schools when they reopen (↑Naylor and Gorgen, 2020).

Since blended learning allows learners to continue studying at home or in groups, it can mitigate the impact of emergencies on girls. Blended learning can take place in safe spaces (either in person or virtually) and enable girls to interact and learn together. The provision of safe spaces can be used for social, psychological, and academic support. Safe spaces have additionally been shown to empower girls and to lessen GBV (↑Sperling and Winthrop, 2016). Girls with access to mobile devices can also be engaged through interactive and reflective activities on social media platforms (↑Naylor and Gorgen, 2020).

Figure 10. Safe spaces for women in Sierra Leone during the 2014 Ebola crisis.

↑Bandiera and colleagues (2018) studied the effects of the Empowerment and Livelihood for Adolescents (ELA) intervention, delivered by BRAC, on 4,700 women in Sierra Leone. Protective spaces for women to gather together, provide support for each other and engage in skills training were provided. The post-baseline period of the study overlapped with the onset of the 2014 Ebola crisis.

Villages were randomly assigned to the intervention to identify the impact of the spaces on women. Findings showed that there was an increase in pregnancies and a drop in school enrollment in the long term for women living in control villages. However, in the treatment villages with the safe spaces, these impacts were effectively countered. ELA is thought to have reversed the negative effects of the

emergency thanks to its provision of complementary skills and time spent in the protective space away from men.

3. Implications for programme design

Evidence suggests that blended learning has a small, positive impact on learning outcomes, compared to traditional teaching. However, the studies used to reach this conclusion focused on blended learning in the context of high-income countries and considered blended learning as a mix of online and face-to-face instruction. In low-income countries, delivering this type of blended learning would lead to high costs and — where access and infrastructure are unreliable — likely have lower improvements in learning.

Even if blended learning with an online component is not the right intervention to replace traditional teaching for all pupils in low-income countries, low-tech versions of this approach could be beneficial for marginalised women. Approaches to blended learning that make use of television, radio, telephones, or offline resources can provide marginalised girls with the flexibility they need in situations where they would be at risk of dropping out of school.

Furthermore, in the context of COVID-19, several countries have reopened schools and, in parallel, are keeping alternative forms of education that were implemented during the crisis. Future blended learning initiatives could make use of this momentum and the structures that were built to support it to encourage blended learning for marginalised girls.

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5. Appendix

Authors (Year)	Method	Findings	Reported impact	Remarks
Bernard et al. (2014)	Meta-analysis of 117 studies featuring blended learning in their experimental condition and classroom instruction in their control condition and focussed on the impact of blended learning and technology use in higher education.	Improvement in achievement related to blended learning is low but significantly greater than 0.	0.334, p<0.01 for blended learning vs. traditional classroom instruction.	Like Means et al. (2013), couldn't control for the fact that pupils in blended learning setups might spend more or less time on studying than their peers who attended face-to-face classroom instruction. Blended learning pupils might also have access to different learning materials. Additionally, in practice, blended learning is likely to serve pupils with different sets of requirements than pupils attending regular schools.
Cui and Zheng (2018)	Review of 23 studies focussed on using peer evaluation in blended learning environments. Studies included secondary as well as higher education contexts but the impact of peer evaluation was similarly positive at secondary and tertiary level.	Peer evaluation activity had a medium effect on pupils' learning achievements. It is especially impactful when it is anonymised and supported by teachers.	0.68, p<0.05	
Means et al. (2013)	Meta-analysis of 45 studies featuring random-assignment or quasi-experimental designs focussed on the impact of online education for measures of learning. Studies included secondary as well as higher education contexts but the effect sizes were found not to be significantly moderated by the	On average, pupils in blended learning conditions performed modestly better than those receiving face-to-face instruction. Pupils who were exposed solely to online education without a face-to-face	0.35, p<0.0001 for blended learning vs. face-to-face.	Studies on blended learning did not control for the fact that the interventions they were studying included additional elements such as extended learning time, additional instructional resources and course elements that encourage interaction among learners. This is justified by the fact that part of the justification for the need for blended learning is the willingness to increase the amount of time

	pupils' age.	component did not perform significantly better than pupils in traditional face-to-face situations.		a pupil spends on learning. Focussed on web-based approaches to blended learning and did not take into account studies including other types of technology which might be more appropriate for contexts with low levels of resources.
Najafi and Heidari (2018)	Meta-analysis of 20 Iranian experimental and quasi-experimental studies.	Blended learning has a significant positive effect on academic achievement.	0.591, $p<0.1$	Najafi and Heidari do not explicitly compare learning outcomes linked to blended learning with those obtained in traditional, face-to-face contexts. Also doesn't specify the educational levels to which the reviewed studies refer.
Vo et al. (2017)	Meta-analysis of 40 studies focussed on higher education.		0.385, $p<0.001$ for blended learning vs. face-to-face education. Higher effect size for STEM disciplines compared to non-STEM disciplines.	
Wandera (2017)	Meta-analysis of 30 studies featuring experimental, quasi-experimental, mixed methods and longitudinal designs focussed on the comparison of the effect for pupil performance of teacher-centred face-to-face, blended learning and online learning. Studies included secondary (5 studies) as well as higher education contexts (25 studies) but the meta-analysis concluded that the	Of the three education modalities (blended learning, teacher-centred face-to-face, and online), blended learning outperformed the others in terms of desired learning outcomes.	0.397 overall. 1.733 for studies conducted in Africa (based on 1 study).	

	education level of the pupils included in the studies did not affect learning outcomes.			
Zhaeo et al. (2005)	Meta-analysis of 51 studies	While Zhao et al.'s study focussed on distance education in general, subsequent moderator analyses found that studies of blended approaches in which 60–80% of learning was mediated via technology had significantly more positive effects relative to face-to-face instruction.	0.10, p>0.05 for distance education vs. face-to-face.	Included a wide range of outcomes (achievement, beliefs, and attitudes, dropout rate) and averaged them out in their studies to compute an overall effect size. This is problematic since the features of an intervention that positively influence an outcome are likely to differ based on the chosen outcome.