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Smartphone-only Internet Access is no longer an indicator of the Digital Divide in Educational Environments

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Introduction

Communication involves the transmission of information. The same applies to education, or learning, where the process is defined in terms of giving and receiving instruction. There is little doubt that information communication technologies (ICT) play a large role in education, improving the teaching and learning processes in today's world. Even ten years ago (a lifetime in technology), Sangrà and González-Sanmamed emphasized ICT "as a mechanism at the school education level that could provide a way to rethink and redesign the educational systems and processes, thus leading to quality education for all" (Sangrà & González-Sanmamed, 2010, p. 207).

A decade later, technology is moving so fast that 90% of the world's data was generated in only the past two years (IBM Marketing Cloud, 2020). The future of education and innovative technologies adapt so rapidly that studies cannot keep up and are often outdated within a year or two. Previous assumptions about digital divides, negative connotations of smartphone-only Internet users, and online learning must be reevaluated frequently, and pedagogical innovation matched with technological innovation.

Unfortunately, many students lack access to a desktop or laptop computer at home and, or do not have a broadband connection to the Internet. The argument negatively portraying this usage gap, referred to as the digital divide, is often countered by those who contend that smartphone technology has at least offered alternatives to those in lower socio-economic groups. This is especially prescient in India where there have been campaigns for a while to offer many poor students free smartphones to help them complete schoolwork.

There is a proliferation of smartphones, lower pricing, and often better connection speeds every year. However, recent surveys suggest that those using smartphones in educational situations do not achieve the same results as those using home computers. A study from Michigan State University's Quello Center found that "contrary to some expectations that students can get by

through the use of a cell phone as a substitute for high-speed home Internet access, those who rely on a cell phone only for Internet access outside of school experience as large, or larger, gaps in performance than those with no home Internet" (Hampton et al., 2020, p. 5).

Because there are over 4 billion phones (Nunez, 2020) in the world today, it would be beneficial to understand whether there are inherent limitations that prevent educational effectiveness in using smartphones. Similarly, is educational content simply not created, or framed, in a practical way to take advantage of the numerical superiority of these devices? Would pedagogical innovation usher in new and improved ways of communicating instruction to smartphone users? Is there a causal effect of smartphone-only usage to educational performance or would the individuals in these demographics still do poorly even if they had home and, or other broadband alternatives?

The answers to these questions can be deduced through review of current literature, data accumulation on usage patterns of both the Internet and smartphones among school-age children, and factual analysis of current and future smartphone advancements. The purpose of this study is to demonstrate that smartphone-only connection to the Internet is no longer an indicator of unequal access to digital communication including education. There are other variables involved that need to be understood in future research.

Literature Review

Review of recent (past two years) scholarly work researching digital delivery of educational content concentrate around three major areas of analyzation: digital divides, pedagogical approaches, and smartphone dependence (ubiquity, especially in young people's lives). Added to this literature review is additional examination and assessment of current and future technology innovations covered in news and corporate publications. This evaluation is productive as it starts

to build a bridge toward integration in physical access that parallels ubiquitous computing, and this is especially impactful for educational ICT.

Digital divide in education

Much of the current literature surrounding education and technology focuses on divides between demographic groups. The digital divide has been highlighted for some time now in scholarly journals and conferences. In 2019, Warf writes: "for many others—the familiar litany of the poor, the undereducated, ethnic minorities, and the socially marginalized—the Internet remains a distant, ambiguous world" (Warf, 2019, p. 77). While there is little doubt that socio-economic conditions do play a part in acceptance into, and participating in the technology revolution, this statement portrays a bleak world where physical access to technology, or uneven access, denies basic necessity.

A report from the Quello Center at Michigan State University also paints a dismal picture of the physical disparity in technology and predicts those on the wrong side of the gap may even be disadvantaged for life by lack of home connectivity, and smartphone Internet is no substitute. Hampton et al. (2020), refer to the *homework gap*, and although they do not emphasize a causal effect whereby only having a smartphone predicts educational achievement, they do correlate poor performance with lower-income level or geographical status (rural, urban, etc.), of which those included have no home computer/broadband or just a smartphone. The authors draw this distinction by placing the gap between home Internet users and smartphone Internet users, stating that "students without home Internet access and those who depend on a cell phones to access the Internet when away from school are less likely to participate in all online, educational activities outside of school" (Hampton et al., 2020, p. 7).

Recent discussion on the digital divide has begun to question the more simplistic view that physical access, be it home Internet, smartphone Internet or home computer is the only thing causing

disparities between the digital achievers and the *mobile underclass* (Napoli and Obar, 2014). Disparities in just physical access are now being labeled first-level and, indeed, a second-level divide may exist on totally independent variables. As Van Deursen and Van Dijk write: "for a long time, a common opinion among policymakers was that the digital divide problem would be solved when a country's Internet connection rate reaches saturation. However, scholars of the second-level digital divide have concluded that the divides in Internet skills and type of use continue to expand even after physical access is universal" (Van Deursen & Van Dijk, 2019, p. 369).

Pedagogical approaches

Online and technological learning tends to elicit a lot of advice on best approaches and these methods are contemplated in the current body of literature. Review and analysis of different styles of teaching, or methods are prevalent in research journals, scholarly articles, and from other educationally focused nonprofit and governmental organizations. The United Nations Educational, Scientific and Cultural Organization (UNESCO) recently posted a brief on their Learning Portal describing how "ICT in education and Information and Communications Technology (ICT) can impact student learning when teachers are digitally literate and understand how to integrate it into curriculum" (UNESCO, 2021).

There are many scholarly articles articulating the best ways to construct and distribute knowledge and the associated computer technology impacts. Sangrà and González-Sanmamed confirm the need for teaching analysis in their article on the role of ICT in improving teaching, outlining "several aspects to be observed and promoted, such as widespread access to broadband technologies, professional development support policies for teachers, more research into how people teach and learn using ICT, development of new high-quality online content, and adaptation of current regulations to make the use of ICT at schools easier" (Sangrà & González-Sanmamed, 2010, p. 208).

In another journal article, Jagušt et al. analyze both formal and informal learning styles and how they interact with ICT noting that "technology can enhance learning in and out of classroom, especially by impacting student interest, motivation, and engagement" and that "the successful bridging of the gap between learning spaces could further benefit from including more online social learning activities into the designed learning process and from involving teachers as cocreators of the learning process and resources" (Jagušt et al., 2018, p. 417). This and other literature portend the ongoing and future struggles to determine how technology coincides with pedagogy.

Smartphone ubiquity

A third area of concentration in scholarly writings on ICT use in education focuses on smartphone ownership, usage, and capability. Many research articles align smartphone-only Internet usage with lower socio-economic status and imply that those using only a smartphone (or cellular phone) for Internet exist in a disadvantaged state. Further review, however, details the staggering statistics of smartphone ownership and the strong feelings of identification associated with smartphones. According to Warf, in 2019, there were "more than 10 times as many mobile phones as landlines; in some countries, there are more mobile phones than people. For many people who cannot afford a personal computer, or even a cybercafe, mobile phones are the major means of connecting to the Internet" (Warf, 2019, p. 81).

Also important is the number of recent acquisitions of smartphones. The proliferation of cell phones, and later smartphones, was astounding ten years ago when Pew Research did its first survey of ownership. Yet now, 81% of Americans own smartphones and mobile phone ownership is at 96%! (Pew Research Center, 2018). Pew Research correctly identifies that "for a number of Americans, smartphones serve as an essential connection to the broader world of online information" (Smith & Page, 2015, p. 3). Table 1 lists a number of smartphone uses.

Table 1. *United States Smartphone Use in 2015*

62% of smartphone owners have used their phone in the last year to look up information about a health condition.	40% to look up government services or information.
57% have used their phone to do online banking.	30% to take a class or get educational content.
44% have used their phone to look up real estate listings or other information about a place to live.	18% to submit a job application.
43% to look up information about a job.	

(Smith & Page, 2015, p. 5).

The growth of access to the Internet associated with increased smartphone ownership most definitely has implications for education and for innovative new uses in educational communications. It also has, though, other connotations combined with vast improvements in technology and miniaturization of electronic components: The ability of smartphones to act like other computers, laptops, and tablets. When this convergence is fully realized, smartphone-only Internet may not be an indicator of uneven digital access. "*Smartphone dependence*—in which one's only means of accessing the Internet is via a smartphone," (Tsetsi & Rains, 2017, p. 239) will become irrelevant. The theory that smartphone-only is a primary barrier in digital education connectivity may obfuscate other key indicators now assumed benign. Smartphone access may simply be a choice.

Foreseeing the impacts of innovation on educational interaction

If one searches the Internet for information on smartphones and education in 2021, they are likely to come across many news and corporate results like the following headlines:

- Your phone is now more powerful than your PC
- Why flagship phones seem to have more RAM than an average PC?
- This $200 Linux smartphone can also be used as a PC
- Amid the new COVID-19 'normal,' the laptop and smartphone need to merge

The obvious drawback in smartphone access for education is screen size. This has long been an obstacle, and paired with slower processing and less RAM, smaller devices were simply not

as productive for business or school endeavors. 30+ years ago, the laptop computer was a mainstay of business professionals because of convenience and not because of it being the best option of for getting work done. As laptops became more powerful, businesses and schools began to use them in docks whereby a user could simply have one computer and use it for all functions. The size of the components was no longer a factor in prohibiting full functionality.

As smartphones take advantage of advancements in microelectronics, there is a future where these devices could be our only computer. But, even if this does not happen for a few years, there are still available options today that can help those unable to purchase additional computer equipment take advantage of online educational opportunities and participate in learning activities. Many smartphones are equipped to send video and audio, as well as receive video and audio. They are more than capable of allowing a user to participate in a web meeting, even allowing simultaneous chat and multitasking. With the addition of a mouse and keyboard, and *casting* to larger screens, full scale computing operations are comparable. As many more software programming options take advantage of ubiquitous computing, varying levels of device will not necessarily hamper common operations needed to participate in education. Immersive technology will not only be limited to larger, at-home, systems. Smart phones will no longer be used just for *extractive* purposes. As Enderle states in a recent computer web post, “it's now past time to consider merging the use cases for laptops and smartphones so we can more aggressively use their combined features to everyone's advantage” (Enderle, 2020, p.1).

Arguably, there will still be tiers in computer capabilities. Socio-economic levels will dictate, to some degree, the speed, style, and miscellaneous luxuries available. Likewise, creators of educational products will still be accountable for creating inviting and engaging learning materials. However, advancements in computing will largely change the current distinction among have and have-nots in the argument that physical barriers are the only indicator of uneven

access. This sentiment even appears on the International Society for Technology in Education (ISTE) webpage: “Thanks to an exponential increase in ubiquity and computing capacity, today’s smartphones offer endless possibilities for higher engagement, enhancement of student understanding and extension of learning beyond the classroom, particularly if a student doesn’t have internet at home or attends a school where 1:1 is not an option” (Ehnle, 2020, p. 1).

Methodology

This study is designed to answer the research questions: 1. What are the inherent limitations in using smartphones? 2. will pedagogical innovation usher in new and improved educational instruction? 3. is there a causal relationship between smartphones and educational performance? These can be deduced through review of current literature on the digital divide, on innovative uses of technology, the pervasiveness of smartphones, and new advancements in technology. Many of the scholarly articles available have already done quantitative analysis in these areas with surveys and verifiable data. Data will be accumulated and patterns in ICT in education identified.

There are also several public research data sets available on ICT in education. The topic area is a laudable one and there are public and governmental agencies concerned with beneficial outcomes. Data from these organizations relating to smartphone and computer ownership and usage will also be analyzed. These agencies include Pew Research, the National Center for Education., Michigan State University, and ISTE.

Finally, a check and balance on data collected from public sources will be an online survey of local high school students concerning smart phone usage. A simple questionnaire of 10-20 questions will be used to measure the desire to have more educational material accessible on smartphones and if it would be motivating enough to further engage in learning. The short survey will be used in order to engage participants for only a short period of time. The input will be

biased by geographical location and age range, but it will add validity to previously collected data sets relating to the research questions.

Validity and reliability of the study will partly be controlled by recognizing only nationally respected data sources like university or government agency data sets. Analysis of the literature would include peer-reviewed journals only and truthful answers to survey questions could be controlled by anonymity of the online survey and short, closed-end questions to avoid confusion and translation into usable data.

The data collected is presumed to answer the four research areas/questions. Further classification will require additional time, although importance of up-to-date information has been previously designated as imperative. 6-18 months of coding may be required. Answers to the research questions will yield affirmation or negation of the hypothesis that physical technology is no longer as significant in predicting digital disparity, especially in education.

Analysis, Limitations, and Expectations

What is noticeably missing in literature about ICT in education is strategy and frameworks to take advantage of future advancements. Scholarly literature concerning technology is often outworn and can be short-lived. Topics in the subject may be better served by structuring conceptual ideas on digital communication and later tailoring them to the actual available technology. Disconnecting physical distinctions of disparity and shifting analysis to intangible, missed opportunities in curriculum construction would serve a better purpose. Then, researchers would be free to concentrate on other causes, correlations, and connections to poor performance with the goal of truly helping all to succeed.

Proving that smartphone advancements negate the connection between smartphone-only Internet and poor educational performance opens new areas of investigation into actual causes of disparity in digital education delivery. Availability of technology, or physical access to a home computer and, or

broadband at home, is not necessarily the only issue. Smartphones could be used for education now, but many students just do not use them. There is also a lack of educational programming or curriculum that takes advantage of smartphones or does not account for minor differences.

A critical limitation in this study is that correlations can be made but establishing cause and effect will be difficult. Students with smartphones only can be better served, but will any advancements in smartphone technology be moot? Access, high-quality content, and other technological improvements can only do so much if users are ambivalent and not interested. Other psychological and social factors will affect overall numbers for successful learning. Other factors are involved that may more accurately predict poor performance and smartphone-only adoption might not be so much of a factor. It is just highlighted as a cause now because a lot of the literature strongly corelates it with low performance.

Another limitation to be accounted for is geography. The literature review here attempts to account for non-U.S. perspectives. Several articles from other countries have intentionally been reviewed, but there are a limited number of studies available outside of the United States. While there will be commonalities in technology change, there will be a wide variety of differences in developed countries versus developing countries. This study will reflect mostly conditions in the United States.

Due to the predominance of scholarly articles that link smartphone-only Internet use with being on the wrong side of the digital divide, accepting that the link is either neutral or diminished will be difficult for many researchers to accept. Researchers should approach effectiveness in digital education with a perspective looking forward. Physical, technology-related barriers are not always indicators of other more pressing issues even if there is a correlation in statistical analysis. Without data to support deficiency in smartphone-only Internet, researchers will need to look for other *second-level* issues to explain the digital divide.

References

Anderson, M., & Horrigan, J. B. (2016). *Smartphones help those without broadband get online, but don't necessarily bridge the digital divide*. Pew Research Center. https://www.pewresearch.org/fact-tank/2016/10/03/smartphones-help-those-without-broadband-get-online-but-dont-necessarily-bridge-the-digital-divide/

Anderson, M., & Kumar, M. (2018) *Digital divide persists even as lower-income Americans make gains in tech adoption*. Pew Research Center. http://www.pewresearch.org/fact-tank/2017/03/22/digitaldivide-persists-even-as-lower-income-americans-make-gains-in-tech-adoption/

Dubey, Y. (2020). *Why flagship phones seem to have more RAM than an average PC?* Fossbytes. https://fossbytes.com/flagship-phones-ram-vs-pc-ram/

Ehnle, K. (2020). *6 ways to use students' smartphones for learning*. International Society for Technology in Education. https://www.iste.org/explore/toolbox/6-ways-use-students

Enderle, R. (2020). *Amid the new COVID-19 'normal,' the laptop and smartphone need to merge.* ComputerWorld. https://www.computerworld.com/article/3566370/amid-the-new-covid-19-normal-the-laptop-and-smartphone-need-to-merge.html

Engel, A., Coll, C., Membrive, A., & Doller, J. (2018). Information and communication technologies and students' out of-school learning experiences. *Digital Education* Review. *33*(2018), 130-149.

Gray, L., & Lewis, L. (2020). *Teachers' use of technology for school and homework assignments: 2018–19 (NCES 2020-048).* U.S. Department of Education. Washington, DC: National Center for Education Statistics. https://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2020048

Hampton, K. N., Fernandez, L., Robertson, C. T., & Bauer, J. M. *Broadband and student performance gaps.* James H. and Mary B. Quello Center, Michigan State University. https://doi.org/10.25335/BZGY-3V91

IBM Marketing Cloud. (2020). https://www.ibm.com/blogs/services/

Jagušt, T., Botički, I., & So, H. (2018). A review of research on bridging the gap between formal and informal learning with technology in primary school contexts. *Journal of Computer Assisted Learning*, *34*(4), 417–428. https://doi.org/10.1111/jcal.12252

Napoli, P. M., & Obar, J. A. (2014). The emerging mobile Internet underclass: a critique of mobile internet access. *The Information Society 30*(5), 323–334. https://doi.org/10.1080/01972243.2014.944726

Nunez, S. (2020). *Your phone is now more powerful than your PC*. Samsung Corporation. https://insights.samsung.com/2020/08/07/your-phone-is-now-more-powerful-than-your-pc-2/

Perrin, A., & Turner, E. (2019). *Smartphones help blacks, Hispanics bridge some—but not all digital gaps with whites*. Pew Research Center. http://www.pewresearch.org/fact-tank/2017/08/31/smartphones-help-blacks-hispanics-bridge-some-but-not-all-digital-gaps-with-whites/

Pew Research Center. (2018) *Mobile fact sheet*. http://www.pewinternet.org/fact-sheet/mobile/

Pew Research Center. (2018) *Internet/broadband fact sheet*. http://www.pewinternet.org/fact-sheet/internet-broadband/

Rosen, L. D. (2010). *Rewired: Understanding the iGeneration and the way they learn.* Palgrave Macmillan: St. Martin's Press.

Sangrà, A., & González-Sanmamed, M. (2010). The role of information and communication technologies in improving teaching and learning processes in primary and secondary schools. *Australasian Journal of Educational Technology*, *26*(8), 207-220. https://doi.org/10.14742/ajet.1020

Schindler, L., Burkholder, G., Morad, O., & Marsh, C. (2017). Computer-based technology and student engagement: a critical review of the literature. *International Journal of Educational Technology in Higher Education*, *14*(1), 1–28. https://doi.org/10.1186/s41239-017-0063-0

Smith, A., & Page, D. (2015). The smartphone difference. Pew Research Center. http://www.pewinternet.org/2015/04/01/us-smartphone-use-in-2015/

Summers, K., Alton, N., Haraseyko, A., & Sherard, R. (2018). Bridging the digital divide: one smartphone at a time. In A. Marcus, & W. Wang (Eds.), *Design, User Experience, and Usability. Designing Interactions. 7th International Conference, DUXU 2018. Held as Part of HCI International 2018. Las Vegas, NV, USA, July 15–20, 2018 Proceedings, Part II.* (pp. 653-672). Springer International Publishing.

Sung, W. (2016). A study of the digital divide in the current phase of the information age: The moderating effect of smartphones. *Information Polity*, *21*(3), 291–306. https://doi.org/10.3233/IP-160398

The Tribune. (2021). *Provide free smartphone to every student in state.* https://www.tribuneindia.com/news/amritsar/provide-free-smartphone-to-every-student-in-state-134113

Tsetsi, E., & Rains, S. (2017). Smartphone Internet access and use: extending the digital divide and usage gap. *Mobile Media & Communication*, *5*(3), 239–255. https://doi.org/10.1177/2050157917708329

Tung, L. (2020). *This $200 Linux smartphone can also be used as a PC*. ZDNet. https://www.zdnet.com/article/this-200-linux-smartphone-can-also-be-used-as-a-pc/

UNESCO. (2021). *Information and communication technology (ICT) in education*. *Brief 4. Information and Communications Technology (ICT) can impact student learning when teachers are digitally literate and understand how to integrate it into curriculum.* https://learningportal.iiep.unesco.org/en/issue-briefs/improve-learning/curriculum-and-materials/information-and-communication-technology-ict

Van Deursen, A. J., & Van Dijk, J. A. (2019). The first-level digital divide shifts from inequalities in physical access to inequalities in material access. *New Media & Society*, *21*(2), 354–375. https://doi.org/10.1177/1461444818797082

Walsh, P. (2020). *Innovative technology is the future of education*. Forbes. https://www.forbes.com/sites/forbestechcouncil/2020/07/23/innovative-technology-is-the-future-of-education/?sh=103c6af970e3

Warf, B. (2019). Teaching digital divides. *Journal of Geography (Houston)*, *118*(2), 77–87. https://doi.org/10.1080/00221341.2018.1518990