

The Positive Impact of eLearning— 2012 UPDATE

Studies indicate that ICT-enhanced learning can benefit students, teachers, families, societies, and economies.



EXECUTIVE SUMMARY

Effective eLearning comes from using information communications technology (ICT) to broaden educational opportunity and help students develop the skills they—and their countries—need to thrive in the 21st century. While conclusive, longitudinal studies remain to be done, an emerging body of evidence suggests that eLearning can deliver substantial positive effects:

- Students are more engaged and able to develop 21st century skills.
- Teachers have a more positive attitude toward their work and are able to provide more personalized learning.
- Family interaction and parental involvement may increase.
- Communities benefit from bridging the digital divide. Economically disadvantaged students and children with disabilities benefit particularly.
- Economic progress can result from direct job creation in the technology industry as well as from developing a better educated workforce.

This paper summarizes some key research findings, to help educational leaders identify relevant eLearning benefits and make judicious decisions as they develop their eLearning strategies. To further aid in planning, we share findings relating to the challenges of eLearning implementation, and provide a bibliography for additional reading.

Skills for the 21st Century

Tomorrow's citizens and workers deserve an education that prepares them—and their nation's economy—to thrive in a world of rapid change and widespread globalization. Currently, the Organization for Economic & Cultural Development (OECD) is working to integrate 21st century skills such as collaborative problem solving into the Program for International Student Assessment (PISA). With the plan to move towards fully technology based assessments, the OECD recognizes how technology enables the ability to conduct independent research, think critically and solve problems, communicate and collaborate, and understand societal issues related to digital citizenship.¹ Pilot tests of the first release of collaborative problem solving tasks have taken place, starting with Australia and Singapore, and continuing with the Netherlands, Finland, and Costa Rica, who completed the pilots in November.

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eLearning Overview

Technology integration to support education has been underway for many years. Some of the common ways of integrating technology into education include:

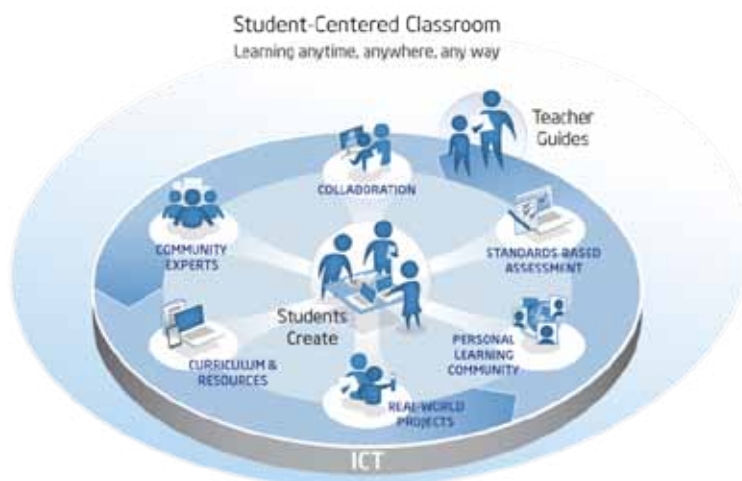
- Teacher PC programs provide encouragement and financial assistance for teachers to acquire PCs and integrate ICT into their teaching practices. When most effective, these programs include professional development and policy modifications, as well as updated digital content and curriculum resources to help teachers use technology to enhance teaching and learning.
- PC labs are frequently used to offer technology access when resources are severely constrained. While PC labs provide some exposure to technology, they limit teachers’ ability to incorporate technology into the curriculum, and often are used only to teach computer literacy.
- Classroom eLearning brings PCs into the classroom, typically via systems stationed at the back of the classroom or computers on wheels (COWs) that are shared by different classrooms. Students have a dedicated device for part of the school day, with the focus on using PCs to enhance learning across the curriculum and not simply to develop technology skills.
- One-to-one (1:1) eLearning provides each teacher and student with a dedicated laptop for use at school and, in

many cases, at home. Laptops serve as personal teaching and learning tools that are used throughout the day for many educational tasks and subjects. In a 1:1 environment, students get the maximum value from access to PCs, Internet connectivity, and their integration into the education environment.

- In a flipped classroom usage model, students acquire basic knowledge and comprehension of assigned learning materials the night before, leaving the next school day an opportunity to apply these newly-acquired concepts to collaborative, problem-solving project-based learning.

Research Overview

A variety of studies have evaluated the impact of eLearning and concluded that—supported by holistic approaches that include appropriate policies, infrastructure, professional development, and curricula—eLearning can help produce positive outcomes. However, despite a large body of research evidence, there are no longitudinal, randomized trials conclusively linking eLearning with positive learner outcomes. Reasons may range from economics to ethics—if you have a limited budget for educational interventions, do you spend the money on the students or evaluations? So, while it’s important not to overstate what the research shows, an emerging body of evidence strongly suggests that effective eLearning can produce promising effects. Research also seems to indicate that a more technology-rich environment delivers greater impacts.



In reviewing the research, we have found many positive educational impacts resulting from effective integration of ICT in classroom teaching and learning. From these results, it is easy to conclude that the potential of ICT and 1:1 student and teacher computing provides noticeable promise for transforming teaching and learning, provided sufficient implementation strategies are followed.

For the purpose of this research review, we've organized the findings around five major areas of benefit: student learning, teaching and administration, family and home, social and community, and economic development. The studies we cite represent examples rather than an exhaustive list. Detailed references may be found in the bibliography at end of this white paper.

STUDENT LEARNING

Studies on effective integration of technology in education show the opportunities ICT provides to help increase student engagement, motivation, and attendance—key requirements for learning. The potential for eLearning to improve performance on core subjects and foster the development of 21st century skills in mature and emerging economies depends on the schools ability to model student-centered, highly personalized learning environments.

Engagement, Motivation, and Attendance

- Elementary teachers indicate the greatest impact on student success may be attributed to their motivation to learn (62 percent vs. 44 percent for high school teachers). (Project Tomorrow, U.S.)
- Responses from 388 district technology directors indicate that about half of those surveyed in a recent study on teacher Web 2.0 use reported an increase in students' familiarity with technology. Similarly, almost half of these teachers indicated that the students are more motivated to learn as a result of Web 2.0 use in their district. Other outcomes identified in the study include: an increase in student academic engagement (39 percent), and improved students' collaboration

skills (38 percent)." (IESD, U.S.)

- In a study of the educational impacts of the Berkshire Wireless Learning Initiative (BWLl), teachers overwhelmingly reported improvements in student engagement and motivation resulting from their participation in a pilot program that provided 1:1 technology access to all students and teachers across five public and private middle schools in western Massachusetts. Teacher survey responses indicate that 83 percent of the teachers thought engagement had improved for their traditional students, compared to 84 percent for at-risk/low achieving students, and 71 percent for high achieving students. Similar to the results on student engagement, teachers overwhelmingly found that the 1:1 pilot program enhanced their students' motivation. 76 percent of 1:1 teachers reported student motivation improved for their low achieving students compared to 73 percent for traditional students and 59 percent for high achieving students. (Bebell & Kay, U.S.)

Greater Technology Integration, Greater Benefits

The effects of 1:1 eLearning appear to increase as technology is more deeply integrated into the educational experience and students and teachers have technology access throughout the day.

Personalized Learning

Technology enables new learning experiences when combined with the traditional

school experience. Blended learning is when a student learns partially through a formal education environment away from home and at least in part through online delivery with some element of student control over time, place, path, and/or pace.

- The International Development Bank has observed multiple justifications for implementing 1:1 programs: 1) improving economic competitiveness by preparing students for a technology-saturated workplace through educational and social initiatives, 2) creating equity of access to digital resources and reducing the digital divide, and 3) increasing the quality of education through new practices such as student-centered learning. (Severin & Capota, Global)
- Blended learning provides a personalized experience that allows each student to work at his or her own pace, supplementing the school curriculum. By leveraging technology, blended-learning programs can let students learn at their own pace, use preferred learning modalities, and receive frequent and timely feedback on their performance for a far higher quality learning experience. Online programs can capture student performance data in real-time across the school, allowing teachers more time to help students who need it. (Horn et al, U.S.)
- In addition to the more personalized, learner-centric academic pathway, students and parents express interest in online and blended learning environments due to the opportunity to offer expanded course options and address



scheduling concerns. When asked about why they would like to take an online class, middle school students identified a desire to be in control of their own learning (45 percent), to get extra help in a challenging subject (44 percent), and to work at their own pace (42 percent). Today, five times as many parents stated they would incorporate online classes into their vision of the ultimate school for their child, an increase from those who responded in a similar way in 2008. (Project Tomorrow, U.S.)

- An analysis across 13 countries integrating ICT into specific classrooms found that teachers, whose students have lab and classroom access to ICT, or have a 1:1 environment, were both significantly more likely to use ICT than their peers who only have access to a computer lab. This finding suggests that having some flexibility in where students can access the Internet enables teachers to use more ICT with their students. (Light & Pierson, Global)
- A recent study of technology and student achievement indicates that when implemented properly, schools with a 1:1 student-computer ratio outperform all other schools both academically and in reduced disciplinary actions and dropout rates with increased student graduation rates. (Greaves et al, U.S.)

PERFORMANCE

- In a study across multiple countries with high-performing education systems designed to learn from their experiences with ICT, researchers found that a majority of countries studied have established ICT standards

for ICT competencies for students. Fifteen of 21 countries reported ICT standards for students that were either embedded in other academic content standards or in separately articulated documents. (U.S. Dept. of Education, 2011, Global)

- A meta-analysis of 50 study effects found students in online conditions performed modestly better, on average, than those learning the same material through traditional face-to-face instruction. In addition, the same study found that blended instruction, combining online and face-to-face elements, had a larger advantage relative to purely face-to-face instruction than did purely online instruction. (U.S. Dept. of Education, 2010, Global)
- In most classes that were observed, students displayed basic use of ICT in their schools such as conducting Internet searches, performing routine skills or completing exams. However, innovative uses of ICT in the classrooms afforded new learning opportunities previously unavailable such as analyzing data or information, accessing information not available in print, and using ICT to collaborate with other students to construct project based learning activities. (ITL Research, Global)
- Results from a two year study of a pilot program for tablet PCs in the classroom indicated that using tablet PC's requires more collaboration and project-based work. In addition, teachers' perceptions overwhelmingly indicated that certain student competencies related to 21st century skills were improved for their students (autonomy, organizing, selecting information, searching for information,

and using ICT). (Universidad Autónoma de Barcelona, Spain)

- In one two-year study of upper elementary classrooms with 1:1 computing access, students outperformed non-laptop students on English Language Arts (ELA) literary response and analysis and writing strategies (Suhr et al., U.S.). Similarly, another study of Texas' 1:1 laptop pilot investigated the extent to which a sample of middle schools successfully implemented a 1:1 program as well as the relationship between the implementation strength at the school, teacher, and student levels and students' reading and mathematics achievement. It was students' use of laptops outside of school for homework and learning games showing the strongest implementation predictor of achievement. (Shapeley et al., U.S.)

Technology plays three important roles in transforming schools into systems that employ these key principles of a sound education environment: engaging content, exploration and analysis that deepen learning, and high-quality teaching, all aligned to assessment and accountability. Technology's first role is as a learning tool for more student-centered learning. It's second role is to enable data collection to better understand and inform educational and instructional decision making. Third, technology plays an undeniable role in transforming political, social, cultural, civic, and economic systems around the world. Therefore, education decision makers must recognize it is an enabling force behind globalization, knowledge work, and entrepreneurship. (Metiri Group, Global)

It is critical to consider the multiple components of effective ICT use in schools beyond the student and understand the



importance of holistic planning, with attention to access, policies, connectivity, professional development, and curriculum, in order to achieve desired benefits.

TEACHING AND ADMINISTRATIVE OUTCOMES

Researchers have reported that issuing laptops to teachers, or helping them purchase laptops, can empower them to teach better, increase lesson planning and preparation productivity, gain a more positive attitude about their work, and improve efficiency of management and administration tasks.

Student-Centered Teaching and Preparation

- Results of a study to investigate any change in student teachers' intentions and actions in integrating technology into their teaching following participation in a course to provide more pedagogical knowledge about how to integrate the technology in their future teaching showed increases in each of the following: their intentions to use ICT for student-centered learning, their intentions to be a facilitator in class, and their confidence level in playing a leadership role in integrating ICT in schools. (Choy et al., Global)
- Although results of specific implementation and outcomes of the 1:1 initiative varied, teachers reported that within months of the initial student implementation, teacher and student use of technology increased dramatically across the curriculum in nearly all of the participating classrooms. On average, teachers reported widespread adoption of new and novel approaches across their traditional curriculum. (Bebell & Kay, U.S.)
- The quality of the type of work a teacher assigns strongly predicts the quality of the work that a student completes. Based on the rubrics for learning activities of 21st century skills, over 90 percent of the variance in student work scores was due not to differences in the students but differences in the classroom learning activities the students completed within the classroom. (SRI International, Global)

Attitudes and Productivity

- A teacher's effectiveness can be improved through effective ICT use. Nearly a majority of teachers across all grade levels responded that they are more productive as a result of technology use. Almost two-thirds of secondary teachers and 56 percent of elementary teachers say they are better organized as a result of the use of technology in their classroom. When considering how many years of experience a teacher has, 68 percent of teachers with 1 to 3 years of experience say that technology has increased their effectiveness by making them more productive. (Project Tomorrow, U.S.)
- An analysis across 13 countries integrating ICT into specific classrooms highlights the importance of key contextual factors that enable teachers to be more successful integrating technology into their teaching strategies: easy access to ICT resources for their students and receiving adequate support. (Light & Pierson, Global)

Management and Administration

- Administrators report using a wide variety of technology tools and services for their professional tasks. Almost all administrators at 99 percent are tapping into communications tools to connect with peers or parents. At 66 percent, slightly more administrators are creating multimedia presentations than teachers. Administrators are also demonstrating some advanced technology skills by participating in webinars (66 percent) and professional online communities (60 percent). (Project Tomorrow, U.S.)
- Adoption of learning management systems offers new possibilities for managing courses and delivering instruction, and often online instruction. Learning management systems (LMS), also known as curriculum or course management systems, are platforms that offer discrete digital spaces for courses in which teachers and students can upload or download material, create content, and respond to one another's materials in blogs, wikis, and discussion forums. (U.S. Dept. of Education, 2011, Global)

FAMILY AND HOME EFFECTS

Parental involvement and other home effects are often secondary, if not peripheral, to the goals of eLearning deployment. Nevertheless, eLearning does seem to produce some positive effects in the home.

- Similarly, analysis of PISA results indicates that computer use at school appeared to have little impact on results, while using a computer at home had a more marked impact on results. "To help students at school, computer use should be integrated into curricula and more invested in training teachers to use them for teaching and to help students learn," says the Organization for Economic Co-Operation and Development. (OECD, Global)
- Student technology use is more prevalent at home. Students are using technology at home even when homework does not require it as 86 percent of students say they use more technology outside of school than in class, 94 percent of students say they use technology to study or work on class assignments at home, while just 46 percent of faculty say they regularly assign homework that requires the use of technology (CDW-G, U.S.)

SOCIAL AND COMMUNITY EFFECTS

Technology access enables dynamic opportunities for research, collaboration, problem solving, and communication beyond the formal school environment. Two areas that illustrate these rapid changes in skill development are from library technology use and exploration into the benefits of game-based learning.

- At-risk and low-achieving students, and students whose parents do not have a bachelor's degree, experience greater positive impact than other groups when 1:1 eLearning is deployed. For example, the Texas Technology Immersion Pilot showed that economically disadvantaged students reached proficiency levels matching the skills of advantaged control students. (Texas Center for Educational Research, U.S.)
- A qualitative study focused on two U.S. schools with high percentages of immigrant and/or impoverished

students. It analyzed the use of 1:1 eLearning to help English language learners develop academic literacy. At an elementary school, Latino fourth-grade students used laptops for pre- and post-reading. At a middle school, immigrant and refugee students used laptops in community projects that required independent reading and research. At both schools, students achieved reading test scores that were higher than their state averages, and the middle school students' writing scores were above average as well. (Warschauer, U.S.)

- In studies of students with disabilities, researchers have observed improved student self-esteem, increased motivation and ability to work independently, and other academic achievements such as improved quality and quantity of student writing. (Harris, U.S.)

A number of studies suggest that, from a long-term perspective, a wide array of social and community benefits are associated with improved education. These benefits include reduced criminal activity, reduced reliance on welfare and other social programs, increased charitable giving and volunteer activity—even attainment of desired family size and improved health for the individual and his or her family. (Riddell, Global) Knowing the many ways in which eLearning can improve education, it's intriguing to consider that eLearning may indirectly enhance these areas as well.

ECONOMIC DEVELOPMENT

So far, we've discussed research showing how eLearning improves educational achievement. Now we turn to studies that examine how improved achievement can affect a nation's economic prospects. For many countries, economic development is the driving reason behind eLearning investments.

Recent examples indicate that eLearning investments can improve economic

development in two ways: by direct job creation as governments procure the PCs, networks, software, and services to support the eLearning deployment; and indirectly, by developing a better educated workforce.

Achieving a workforce that is proficient in the use of technologies is seen as fundamental for meeting the labor demands of the new economy, and a way of increasing the productivity of that workforce. The OECD estimates the demand for employees with technology skills is growing at a pace that most labor markets struggle to satisfy, stating that approximately 16 million people are employed by the ICT sector, and representing approximately 6 percent of the OECD business sector employment. Furthermore, the estimate is that this sector is growing faster than most other business sectors. (OECD, 2010b).

- The current strategic plans for ICT in education across a number of countries include what is considered to be the importance of technology-related skills for success in today's global workforce. These policies state the importance of all students acquiring a solid grounding in ICT as a prerequisite for economic and social equity. Furthermore, educational use of ICT is considered an important means to promote greater social equity and the effective use of ICT to improve the quality of teaching and learning. These services include educational content, technical and pedagogical support, research, evaluation, and monitoring. (U.S. Department of Education, 2011, Global)
- The recent economic crisis has been credited with bringing about change. Many initiatives into school system reform are designed either to mitigate the potential ill effects of the crisis or to take advantage of new opportunities. Leaders engaged in these efforts are

aware of the relationship between economic development and the skill development of their youth. (Mourshed et al, Global)

- The numerous reports available from the OECD show that better educational outcomes can be a strong predictor of economic growth, however, a country's wealth and spending on education alone is not a guarantee for better educational outcomes. "On average, between schools, the percentage of the variance in student performance explained by a school's socio-economic background is smaller in digital reading (48.4 percent) than in print reading (56.8 percent). In contrast, within schools, the percentage of the variance in student performance explained by students' socio-economic background is larger in digital reading (7.4 percent) than in print reading (5.5 percent)." (OECD, Global)

Looking at the digital divide within the U.S., one study found that socio-economically disadvantaged students who have no or limited access to ICT at home have to spend more time looking for ICT resources outside the home. As a result, they have that much less time to finish the tasks required of them. These disadvantages, in turn, make such students less efficient ICT users. They generally have few skills in searching for information online, and are also less able to identify information that is relevant to the task at hand and to determine whether that information is credible. (Robinson, U.S.)

INDIRECT IMPACT: ECONOMIC BENEFITS OF A BETTER-EDUCATED WORKFORCE

A 2006 OECD report revealed a positive correlation between high economic and productivity growth with high levels of investment in ICT as a percent of GDP. Investments in ICT usually have direct demand impact on local telecommunications providers, hardware producers, software providers, and service providers for training. A look at some Intel Learning Services projects provides insight into how these investments might stir economic activity.

For example, a 2011 study conducted by Intel in partnership with Dalberg Global Development Advisors to evaluate the effectiveness of Intel Learning Series in Brazil showed that \$60M of government investments in computer manufacturing

Table 1. Economic Impact of Portugal's Project Magellan

	DIRECT IMPACT*	INDIRECT IMPACT	TOTAL
Jobs	350	1,120	1,470
Economic activity (based on sales of five million units through 2010)	EUR 1 billion (USD 1.386 billion)	EUR 1.26 billion (USD 1.746 billion)	EUR 2.26 billion (USD 3.131 billion)

* Result of manufacturing expansion.

Source: Vital Wave Consulting.

Education Transformation

- Criticism of ICT based education reform efforts consistently show that ineffective implementation undermines student learning opportunities and academic impact. As a result, increasing attention to the importance of measuring implementation efforts before assessing outcomes has provided insight into the nature of model implementation strategies, school change process, and the relationship to changing the whole school, including changes to the curriculum, and delivery of instruction. (Shapeley, U.S.)
- Research on effective integration of ICT in education illustrates that optimal learning results following the investment in technology require much more than the mere introduction of technology with software and web resources aligned with the curriculum. Effective technology integration requires the triangulation of content, sound principles of learning, and high-quality teaching—all of which must be aligned with assessment and accountability. (Metiri Group, Global)
- Inexperienced teachers are overwhelmed by classroom challenges such as lack of subject matter knowledge, classroom management, and diverse student needs. Results from a recent study on teachers new to the classroom suggest that these teachers may not have sufficient pedagogical skills and knowledge in planning to integrate technology in their lessons. (Choy et al., Global)
- Teachers often report that the majority of the professional development they receive focuses on ICT skills rather than ICT integration. There is a need for professional development courses that emphasize ICT integration into instruction to close the gap between the rhetoric of change and the realities of teacher understanding that translates into implementation. (SRI International, 2010)
- Lack of teacher knowledge about how to use the technologies effectively was the most frequently cited human-related barrier to adoption. The most often cited technology-related barriers included student safety concerns and limited support systems, including technology personnel. (IESD, U.S.).
- It is estimated that positive effects of laptop use appeared only after the second year of a recent ICT implementation study due to the steep learning curve required for both teachers and students experiencing a new 1:1 classroom. Interestingly, teachers explained that the first year required developing basic computer skills while their experiences the second year allowed them to focus their teaching more on content and learning. (Suhr, U.S.)
- Administrators who have the responsibility of empowering schools with technology face formidable challenges. In addition to ongoing funding issues associated with acquiring, implementing and maintaining the technology infrastructure, both principals and district administrators reported the challenges of staff professional development, technology support, and student safety online. (Project Tomorrow, U.S.)
- Data collected from schools that implement ICT strategies more successfully reported the keys to their successful implementation of Technology Immersion were committed leaders, thorough planning, teacher buy-in, preliminary professional development for teachers, and a commitment to the transformation of student learning. (Shapeley, U.S.)



resulted in job creation, higher wages, and increased revenue generation opportunities for the local businesses involved. The investments, made over four years, were intended to promote educational transformation by improving access through technology and to address high unemployment and underemployment for over 760,000 students. Results from the 2011 study show that:

- An estimated 650 jobs at four-times the national minimum wage were created.
- Revenue grew 15-20 percent for local OEMs and ISVs involved in the program.
- Development of intellectual capital in education-related technology manufacturing has opened up new export market opportunities for local OEMs and ISVs.
- Telcos received funding for Internet service in schools and homes to support 1:1 computer initiatives.
- Families of the students who were allocated the computers also received affordable internet service at home, allowing more than just students to benefit from access.

The strong results were also due in part to import restrictions on PCs, which created an opportunity to develop private manufacturing capabilities locally. A similar study on \$15M of government investments in Intel Learning Services in Macedonia yielded similar results despite relatively lenient restrictions on PC imports, especially impacting the public sector.

- About 90 jobs were created across multiple sectors.
- Wages for these new roles were likely in-line with the rest of the computer industry in the Balkans, which is 1.5 times the national average wage.
- Local businesses benefit and develop intellectual capital that can be exported.

In addition to the direct economic benefits, ICT investment that enables teachers and students to develop strong competency in the teaching and using of 21st century skills should also create a more competitive workforce in the long run.

LOOKING FORWARD

Technological advances affect every aspect of the modern society. In an increasingly digitized world, individuals who develop the proficiencies necessary to effectively utilize these digital technologies will be at an increasing advantage in educational opportunities, workforce development, and participating fully in society. While few rigorous experimental or controlled quasi-experimental studies on eLearning's benefits have been published, a critical mass of evidence indicates that investments in eLearning can deliver substantial positive effects.

For stakeholders engaged in discussions in education reform, it is critical that a wide spectrum of research be considered to help inform national policies as well as local school plans.

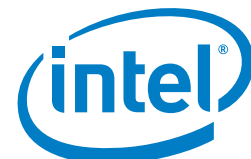
The Intel World Ahead Program, Intel Education Market Platform Group, and Intel Corporate Affairs education initiatives can help you design and deploy effective eLearning programs to transform education in your country.

Contact your Intel representative, or visit us on the Web at:

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1. <http://atc21s.org/index.php/pilot-tests-of-the-atc21s-assessment-tasks-have-begun/>

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