Is Excessive Use of Technology Hindering the Development of Problem-Solving Skills in Gen Z

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Abstract: *Problem-solving skills are crucial for an individual to lead a productive life and for being able to face life's challenges. They are essential for making more appropriate decisions that have a direct impact on the individual's personal and professional life. These problem-solving skills cannot be developed overnight. The learning is lifelong. However, the key foundation is laid in the formative years. It is believed that problem solving skills should be taught as early as the preschool years and thus, have been an integral part of academic learning across the world. However, studies have begun to discover how excessive use of technology maybe hindering the development of this crucial skill in the current generation. This paper analyses the impact of technology on this fundamental learning in our youngsters and analyses possible solutions.*

Keywords: Problem solving, technology, learning and skills, adaptability, decision making

1. Introduction

The current generation will live and work in increasingly disruptive environment. They would have to compete with technology and befriend it to succeed. The fourth industrial revolution will be characterized by increased technology disruption causing a major upheaval in the job market at all levels. While technology is already taking over tasks that are repetitive and routine in nature and don't need advanced cognitive skills, it is also making way for new occupations. This disruption is here to stay. Most of the new job opportunities will be disproportionately in the non-routine category requiring advanced cognitive skills that cannot be automated or left to machines. This requires the younger generation to have more advanced problem-solving skills to succeed amidst a disrupting and rapidly evolving ecosystem. Since technology is evolving at a rapid pace, youngsters will have to learn to adapt faster and develop problem solving skills that keep them ahead or compatible with technology. The Future of Jobs 2020 report [1] clearly states that "COVID-19 has caused the labour market to change faster than expected and that what used to be considered the "future of work" has already arrived".

By 2025, automation will disrupt 85 million jobs globally in medium and large businesses across 15 industries and 26 economies. According to Saadia Zahidi, Manging Director, World Economic Forum. "Accelerating automation and the fallout from the COVID-19 recession has deepened existing inequalities across labour markets and reversed gains in employment made since the global financial crisis in 2007-2008. It's a double disruption scenario that presents another hurdle for workers in this difficult time. The window of opportunity for proactive management of this change is closing fast. Businesses, governments, and workers must plan to urgently work together to implement a new vision for the global workforce." The only silver lining being that the same report concludes that some 97 million new jobs would be created in the same timeframe due to AI.

New jobs are more likely to be concentrated in the nonroutine and cognitivecategory requiring higher-order cognitive and soft skills that are less susceptible toautomation [2]. Technology disruptions are also likely to reduce the shelf life of jobs creating a situation where professionals will have higher adaptive, critical thinking and problem-solving skills. All these are essential to unlearn, relearn and discern at a faster rate.

In the light of the above, studies showing declining cognitive skills due to excessive use of technology in the younger generation should be a cause of concern of alarming proportions, particularly for the academicians and those stake holders who play a crucial role in developing these skills in the younger generation in the formative years.

Spurred by an overload of research findings acclaiming the positive effect of inserting technologies in the normal course of instruction on students' performance [4,5,6,7] has made Information and Communication Technologies (ICT) an integral part of our academic environment. In fact, it is considered a quintessential element and a hallmark of a more progressive system. Digital devices such as computers, tablets, iPads, word processors, e-mails and the Internet have entered the classroom and transformed, with, teaching and learning. Post COVID there has been an increased pressure on the academic fraternity to embrace technology and encourage its usage among students.

The dilemma is that while "on the one hand, the potential of digital technologies to enhance learning has been well established [8,9] in terms of "enhanced diversity of learning provision, equity of access to higher education, increased efficiency of delivery, and personalization of learning processes"[10,11], its important to study the shortcomings of its excessive use.

2. What are problem solving skills?

Problem-solving skills are the ability to identify problems, brainstorm and analyse possible solutions and implement the one that is most suitable after having thoroughly assessed the challenges of implementing it and the significance of the given chosen solution. Problem solving skills will be also needed at every stage of implementation where decisions need to be taken on unseen variables that might arise.

Good problem skills require an individual to be intuitive, creative, alert, adept at research, analysis and decision making. the process normally has the following stages:

a) Problem Identification:
This is the first stage. The problem solver must have the ability to identify and recognise the problem and the need to resolve it. He must comprehend the nature of the problem at hand and be able to define its structure and extent.

b) Structuring the Problem:
This stage involves understanding the details and magnitude of the identified problem. This requires sharp observation skills, comprehensive scrutiny and fact finding to get clarity on its structure. This could also involve a basic SWOT analysis both of the problem and the resolving mechanism.

c) Identifying Possible Solutions:
This stage involves brainstorming possible solutions. in a team setting this stage could involve seeking different perspectives on the problem and ideas for its solution.

d) Arriving at a conclusive decision.
This stage involves careful analysis of the different possible courses of action and understanding the possible challenges in executing them and choosing the best solution for implementation. In companies this is a crucial stage as one might have to consider various factors before arriving at the best course of action. It also might entail evaluation of cost and time constraints.

e) Implementation:
This stage involves acting on the selected solution or course of action and monitoring to ensure that the team or individuals who implement do not get diverted from the determined course.

f) Monitoring/Seeking Feedback:
This stage is concerned about evaluating whether the chosen solution achieved its aim of solving the identified problem. This could include taking feedback from various stakeholders on whether it helped alleviate the identified problem.

Individuals with great problem-solving skills can think both, analytically and creatively.

3. How is excessive use of technology an impediment to the development of competent problem-solving skills?

Students using digital devices is no longer a privilege/singularity of the developed world, as usage among students has seen a phenomenal increase even in the so called developing and underdeveloped economies in the last decade. This trend has seen a huge upsurge post the COVID 19 pandemic.

A Pew Research Center report of 2022 reveals that 95% teens in the US have access to digital devices, such as smartphones (95%), desktop or laptop computers (90%) and gaming consoles (80%). The study shows there has been a surge in daily teen internet users, from 92% in 2014-15 to 97% today. In addition, the share of teens who say they are online almost constantly has roughly doubled since 2014-15 (46% now and 24% then) [12]. However, this phenomenon

is fast catching up in developing and underdeveloped countries too. according to the "India Lockdown Learning" report by Vidyasaarathi, a scholarship management portal promoted by NSDL e-Governance to assist students in their education financing process found that 79% students in India use a smartphone as the primary mode for online learning, while only 17% have access to laptops and 4% to tablets for learning purposes. This trend is now permeating the rural and the less affluent areas too. According to the Government of India Economic Survey 2020-21, "the percentage of school students owning a smartphone in rural India has increased from over 36 per cent to 61 per cent" and this trend is now showing any signs of slowing down. The statistics from across the world also show an upward trend. What is worth noting is that the age where children get exposed to digital devices is declining at a worrying pace. The latest 2023 report of Ofcom [13], UK's communications regulator states that "majority of homes with children aged 0-18 (97%) had access to the internet in 20222. Most children aged 3-17 went online (at home or elsewhere) via mobile phones (69%) and tablets (64%), although the types of devices used vary by age of child". An increasing number of parents don't hesitate to hand a digital device to a toddler to keep them engaged while they go about doing their daily work or even when they need a breather.

According to leading brain scientist, Patricia Kuhl who runs experiments with more than 4,000 babies each year, "What we've discovered is that little babies, under a year old, do not learn from a machine," she says, pointing to several brain scans on a computer. "Even if you show them captivating videos, the difference in learning is extraordinary. You get genius learning from a live human being, and you get zero learning from a machine" [14]. It is this type of findings and trends that probably led the World Health Organization to strictly recommend no screen time for babies under 2 and no more than one hour of screen time a day for those aged 2 to 4 [15].

It is very important to note that Brain development is a protracted process that begins about 2 weeks after conception and continues into young adulthood 20 years later [16]. While the Brain development during the prenatal months is largely under genetic control, with limited impact of the environment which is restricted mostly to the food and alcohol, medical prescription consumptions of mother, the postnatal brain development is experience-dependent and defined by gene–environment interactions.

The final process involved in the development of the brain is called myelination. The timing of myelination is dependent on the region of the brain in which it occurs. Regions of the brain in certain sensory and motor areas are myelinated earlier in a process that is complete around the preschool period. In contrast, regions involved in higher cognitive abilities, such as the prefrontal cortex, the process is not complete until adolescence or early adulthood [17, 18]. This makes the school and college going years or the 3-21 age group very crucial in terms of development of cognitive skills. It is very important to note that "although basic sensation and perception systems are fully developed by the time children reach kindergarten age, other systems such as

those involved in memory, decision making, and emotion continue to develop well into childhood. The foundations of many of these abilities, however, are constructed during the early years". Which means that if the growth in the early years is impaired or disrupted it could cause long term damage or underdevelopment of cognitive skills. Studies have revealed that "experiences in the early years of childhood affect the development of brain architecture in a way that later experiences do not" [16].

Brain research suggests that brain development is a graded process, where the functioning of the higher level must be built on the foundation created by the lower ones. Which implies that if the formative years are impaired or restricted due to various external factors, it could possibly lead to severe consequences in both, the brain structure and function in later years. According to a UNICEF report too much screen time impairs the attention span of of children in the most crucial formative years. For children to have high level cognitive skills which includes problem solving skills, they must have the ability to concentrate and focus. "For a brain to develop and grow, it needs essential stimuli from the outside world. More importantly, they need time to process those stimuli. While reading storybooks out loud gives children time to process words, images and voices, the constant absorption of on-screen images and messages affects their attention span and focus" [19].According to a 2018 report of the National Institute of Health extended screen time can physically alter the brain and lead to premature thinning of the cortex, causing a decline in cognitive skills.

Its not technology that is as much a problem as its excessive use is. Studies have now begun to focus on the "Screen time" to get to the bottom of the problem. Screen time is a term used for "activities done in front of a screen, over the phone, such as watching TV, working on a computer, or playing video games. Screen time is a sedentary activity, meaning you are being physically inactive while sitting down. Very little energy is used during screen time" [20]. According to the DIGITAL 2023: GLOBAL OVERVIEW REPORT "teenagers spend 7 hours 22 minutes per day in front of screens. That equates to 43% of a teen's waking hours". What is worrying is that this pattern exists across the world with very little variation. The figure 1 below shows the statistics for average internet users for all age groups. Even though this does not specifically cover children, the averages for the 6-21 age group are not reportedly different as can be observed from figure 2. It is important to note that youngsters and children rarely give out accurate statistics of their screen time for the fear of being admonished.
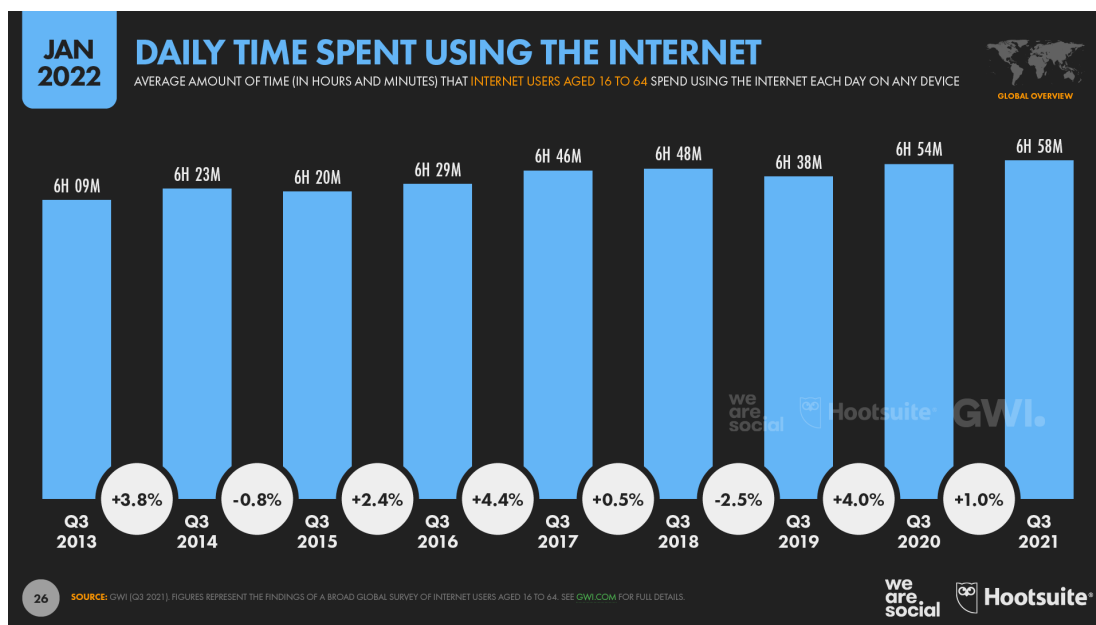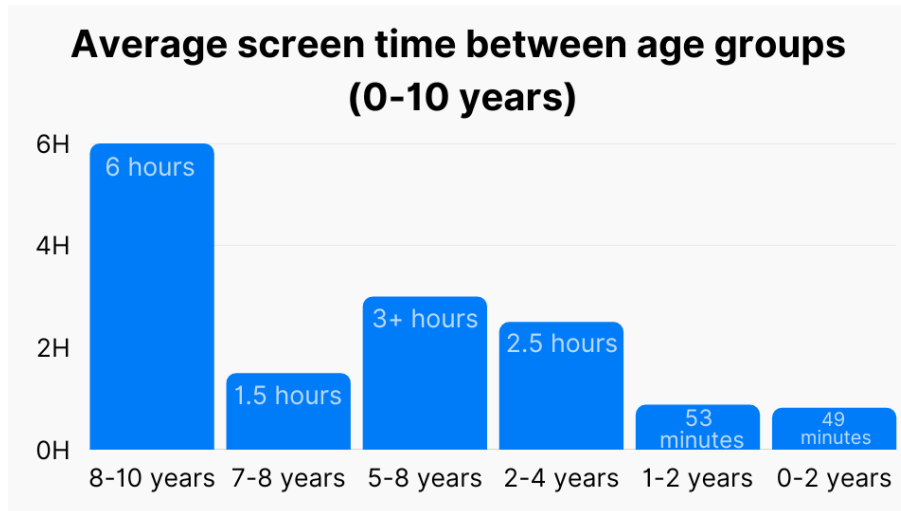

Figure 1

Figure 2
(Source: CDC)

Screen time causes an addiction just like any other and can damage one's physical and mental health if not controlled on time. "Screen use releases dopamine in the brain, which can negatively affect impulse control. It affects the frontal cortex of the brain, like the effect of cocaine and like drugs, screen time sets off a pleasure/reward cycle that can have a negative impact of your life. Prolonged use of watching TV, video games, scrolling through social media – all of that use acts like a digital drug for our brain" **[21]**. Screen time has also been linked to Increased aggressive behaviour. The Long-term Effects of screen addiction inability to articulate thoughts, Cognitive impairment, and difficulty with problem-solving and creative thinking among other serious issues. Given that the digital world gives entertainment of one's choice at the click of a tab and can help resolve or provide information on practically everything under the sun, it makes students accustomed to instant gratification and this reduces their patience for research and analysis, an integral part of problem solving. The younger generation are getting accustomed to being served readymade answers and hence get frustrated when they must face any challenge which requires their patient understanding and resolution. They get frustrated a lot more easily and are not motivated to work hard. The findings of the Healthy Active Living and Obesity Research Group (HALO) at the CHEO Research Institute in Ottawa reveal "that children and youth who do not sleep enough and use screens more than recommended are more likely to act impulsively and make poorer decisions" **[22]**.

Studies are now revealing the impact ofDigital technology on empathy in children and adolescents. Digital content can increase the empathy only when the content is very prosocial. However, Digital technology has the opposite effect when the screen time reduces face to face interactions which are essential to inculcate appropriate social skills. Choosing violent media content (movies and series), playing violent video games, or engaging in bullying and discriminatory actions can exacerbate aggressive attitudes, emotions and behaviours and desensitise participants that makes them less empathetic. The perils of cyberbullying are also known to relate to declining empathy among children and adolescents **[23].**

Empathy is a key skill in problem solving. Empathy contributes to positive relationships and has a direct in problem solving. To solve a problem, you need to empathize with those impacted by it. Empathy is required to get to the problem's root and consider each group's perspective **[24].** To solve a problem, you need to empathize with those impacted by it. It is the ability to understand others' emotions and experiences **[25].**

Goleman (2013) refers to the concept of the 'empathy triad' of the following:
- Cognitive empathy allows us to understand the other person's perspective.
- Emotional empathy allows us to understand what another person may feel.
- Empathic concern allows us to understand what another person needs us to do **[26].**

All three elements are crucial for a person to be a proficient problem solver.

A study conducted by Twenge's and Campbell (2018) **[27]** found that spending more than one hour each day using screen-based devices was associated with low psychological well-being among children and adolescents, as well as increased difficulty in making friends, among other effects. These findings resonate those of Prot and colleagues (2014), who concluded that time spent online prevents adolescents from learning empathy from others in real-life contexts [28].

According to research by Patricia Greenfield, professor of psychology at UCLA and director of the Children's Digital Media Center, Los Angeles "As technology has played a bigger role in our lives, our skills in critical thinking and analysis have declined, while our visual skills have improved" **[29]**. She also emphasised on the importance or reading as it enhances thinking capacity and stirs the imagination in a way not possible by visual media alone. "By using more visual media, students will process information better," she said. "However, most visual media are real-time media that do not allow time for reflection, analysis or imagination — those do not get developed by real-time media such as television or video games" **[29]**.

Some researched draw the analogy of calculators to emphasis their point. While some academics favoured calculators as it could speed up calculations and save time and effort, others felt that it would impair the development of quantitative/arithmetic skills in students hindering their ability to develop basic arithmetic skills. While some educators believe that AI can revolutionise education, there are other like Andre Perry and Nicol Turner Lee who have expressed reservations about widespread use of AI tools in education pointing that its algorithms can perpetuate bias and discrimination **[30].** There are others that talk about AI encouraging cheating and plagiarism that could go undetected and impair a student's critical thinking and analytical skills making them ill prepared for problem solving in later life. It is a well-known fact that Cognitive biases impact our judgments and decision-making processes. It does not allow objectivity in how we comprehend the problem and make efforts to resolve it. Red flags are already being raised on how AI tools pose a huge risk to academic integrity. Studies have been consistent in their findings which show that Participants with a low exposure to smartphones are more reflective than participants with higher usage. Findings of Pérez-Rodríguez et al. **[31]** reinforce this by showing how exposure to media content reinforces heuristic-based reasoning, which is negatively associated with Critical thinking skills **[32]**. Overdependence of digital tools and "a high level of media exposure decreases working memory performance, leaving few cognitive resources available for Critical thinking **[33]**. Lack of critical thinking skills can seriously impair problem solving skills. Critical thinking abilities are crucial and invaluable cognitive process of problem solving as they help individuals overcome biases, reduce errors in judgement and in processes involved in resolving problems and ensure a more objective understanding of reality **[34,35,36]**. The Some studies have shown that the benefits in cognitive development which is achieved through writing and reading printed books and magazines may be at risk due to excessive use of digital devices. Carr (2011) blames technology for making our minds shallow in terms of processing information and asserts that "students who read linear texts have better understanding and a stronger memory than those who read via the internet. When we go online, we enter an environment that promotes cursory reading, hurried and distracted thinking, and superficial learning. It also influences the degree of attention we devote to it and the depth of our immersion in it' **[37]**. Moreover the access to process multiple actions at the same time on a single machine isn't necessarily a positive skill this early in life**[38]**. A reduced attention span has a direct impact on problem solving as it requires the individual to have the eye for detail to be able to make error free decisions.Furthermore, digital technology offers shortcuts to everything and offers information readily without students having to seek it. "Rather than having to take the time to process, visualize, and exert mental effort, kids who rely on their digital devices get lazy. The device does the thinking for them and as a result, their own cognitive muscles remain weak"**[38],** weakening the foundation for cognitive development in later years and compromising them forever.

4. Conclusion

Studies have clearly shown that cognitive development and problem-solving skills start developing in the formative years. An early competency pays rich dividends later and prepares the youngsters for bigger challenges as they mature. Problem solving helps individuals to overcome all challenges that might appear in their personal and professional lives by equipping them with the ability to make the right choices to get past them and adapt to changing circumstances. In a business or leadership perspective it helps the individual be a more proficient and innovative decision maker leading to more desirable and productive outcomes. Problem solving skills are not about decisions and resolving problems only, these cognitive skills have a direct impact on the efficiency, adaptability and resilience of individuals, virtues that are crucial for personal growth, career success, and overall well-being enabling an individual to live to his optimum potential both, at the personal and professional level.

It is pertinent to note that the current generation will be entering a work force which is becoming increasingly unpredictable with unprecedented impact of technology requiring skills of a much higher level. The job and the business market are driven by innovation as they are left with very few choices and in such an environment, problem solving skills become an essential requirement and not a preferred one. In fact, Problem-solving skills are the most sought-after soft skill of 2022 according to the National Association of Colleges and Employers Job Outlook 2022 survey. "I think, therefore I am" a quote of mathematician and philosopher Descartes which talks about finding truth amid doubt and uncertainty could well have been talking about this essential skill which is more valuable today than it ever was.

Digital technology an integral part of our lives and that of our children and cannot be wished away. Since technology can't be wished away, using it to the advantage of our younger generation would be the more prudent objective. Parents, academicians, and all other stake holders that directly influence the life of our children and adolescents should be made aware of excessive use of digital devices by setting a personal example of their own as studies show that even adults are struggling with their screen time. There must be more awareness campaigns to alert people about the negative impact of excessive use of these devices on the physical and mental wellbeing. The effort should be like campaigns for all addictive habits like alcohol.

The US Department of Health and Human Services reports that students spend over seven hours a day in front of some type of electronic media, and children as young as two years old have access to iPads or toys with touch screens. This trend is fast catching up across the world with some countries going way past this average. With enough evidence to connect delayed or lowered cognitive development in children with extended exposure to digital technology, it is time that this problem be addressed on an urgent footing before it creates a generation with compromised cognitive skills. The world should take heed to the advice of the UNICEF (2017) to technology users to

"Harness the good" and "limit the harm." Wilkins (2014) suggestions of ensuring that face to face interaction and engagement by planning and implementing activities that promote communication and collaboration at all levels of learning may help students handle technology in a way that doesn't harm their wellbeing [39]. The academic institutions who play the most significant role in fostering these essential cognitive skills should make a note of the observations of Laurillard (2002) who argued that to be effective, the use of technology-based devices must be accompanied by appropriate pedagogical approaches that mitigate their harmful effects and limitations [40].

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