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...But One Day Earlier: Confronting the Dragon-Tyrant in Saskatchewan Computer Science Education

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Abstract

This paper examines challenges and opportunities in computer science (CSC) education in Saskatchewan, emphasizing an urgent need for reform in teacher training and professional development. The author, a self-taught CSC educator, highlights the lack of formal support and training amid rapid technological advancements, particularly in AI. An experiment demonstrates AI's potential to enhance student learning and engagement. The findings underscore the need for immediate solutions to bridge the gap between teacher practice, training, and the evolving field of CSC. Adopting Rancière's (1991) egalitarian educational philosophy, the paper advocates for educators to facilitate rather than dictate learning, leveraging AI to empower students. The proposed approach involves AI-guided, individualized instruction, promoting critical thinking and peer collaboration. The paper calls for proactive measures to adapt to technological advancements, warning that delays will further hinder the preparedness of current and future CSC educators and students and serves as a localized exploration for CSC education stakeholders in Saskatchewan, as well as providing a rationale and blueprint for a larger project.

Keywords: Computer Science, Artificial Intelligence, Education, Teacher Training, Professional Development, Egalitarian Pedagogy, Technological Advancements, Saskatchewan Education

In the allegorical "Fable of the Dragon-Tyrant" by Nick Bostrom, a dragon demands human sacrifices. Humanity initially submits to what it assumes to be inevitable, but eventually unites, innovates, and prevails. The tale provokes us to question our acceptance of the status quo, urging us to use technology and collective will to conquer challenges. At its climax, Bostrom states, "had we started but one day earlier ... much suffering could have been prevented" (2005). In Saskatchewan, luddite CSC educators, teacher trainers, and students have a dragon-tyrant on their hands.

Introduction

While many educators in these early days of AI are handwringing in staffrooms and administrative offices about its perceived nuisance—and perhaps rightfully so, given early studies around literacy in the age of AI (Chaushi et al., 2024; Kohnke et al., 2024; Selwyn, 2024)—CSC teachers can view what others see as annoyances as exquisite opportunities. The field of CSC is where AI was born, and it is only natural to integrate AI into CSC classrooms instead of forbidding or gatekeeping its use. However, traditional teaching methodologies, teacher training programs, and a lack of professional development opportunities in Saskatchewan are increasingly inadequate. Contrasted with the exponential growth of technological advancements, integrating AI into classrooms presents a challenge for Saskatchewan CSC teachers that is as formidable as it is exquisite in opportunity.

Beginning by examining the author’s journey as a self-taught CSC educator in Saskatoon, Saskatchewan, this paper highlights the barriers faced and some innovative solutions implemented to bridge preparedness gaps. Following this, the paper delves into the theoretical underpinnings of CSC pedagogy, drawing on Jacques Rancière's (1991) educational philosophy to propose a shift towards a more facilitative teaching approach. In combining these two points of view, the paper suggests a methodological framework for incorporating AI in CSC education, followed by a discussion on the implications for future teacher training programs. By addressing these issues, this paper aims to motivate CSC education stakeholders in Saskatchewan to start “but one day earlier” (Bolstrom, 2005) by offering actionable insights that foster a more adaptive and future-ready CSC educational landscape for educators and policymakers.

Guiding Questions

- What are the most significant barriers currently faced by CSC educators in Saskatchewan, and how do these impact the integration of AI tools in classrooms?
- Considering exponential technological advances, what are the consequences of waiting to act on CSC teacher training in Saskatchewan?
- How can Rancière's (1991) egalitarian educational philosophy aid in transforming CSC teaching methodologies and empowering both educators and students in an AI-driven educational landscape?
- In what ways can AI-guided, individualized instruction promote critical thinking and peer collaboration among CSC students, and what are the potential challenges in implementing such a methodology?
- What are the implications of the experimental findings on AI integration in CSC education for future curriculum development and policy making in Saskatchewan?

Literature Review

The landscape of AI-driven CSC pedagogy is rapidly evolving. With a localized-to-Saskatchewan lens applied, academic literature becomes nonexistent. This paper aims to provoke and catalyze discussions and identify fault lines within current CSC educational frameworks.

This exploration of CSC education in Saskatchewan underscores a need for reform in teacher training and professional development amidst rapid technological advancements. Challenges faced by educators include technostress, as highlighted by Kohnke et al. (2024), and the limitations of AI in education, discussed by Selwyn (2024). In contrast, the application of Rancière's (1991) egalitarian educational philosophy emphasizes facilitation rather than dictation of learning, aligning a proposed use of AI to empower students through individualized instruction and critical thinking (Chaushi et al., 2024).

Bostrom's (2005) allegory, "The Fable of the Dragon-Tyrant," serves as a metaphor for the resistance to change in CSC education. The rapid pace of technological advancements, as outlined by Ceruzzi (2005) and Brenner (1997), exacerbates (through application of Moore's Law), the inadequacies of traditional teaching methods, curricula, and teacher training programs in Saskatchewan.

Implementation of AI in CSC classrooms can significantly improve learning outcomes, as evidenced by experimental findings (Balon, 2024); however, in response to the limited scholarly work related to CSC education and training, this paper draws heavily on unverified personal experiences and recent action research.

A Self-Taught Career Path

My challenging self-taught journey has taken me across a broad spectrum of school experiences. The collegiate where I first implemented a CSC program in 2012 had 400 students, with approximately 40 enrolled in CSC each year. The age range was 15 through 40, often in classes simultaneously. The student body faced numerous challenges, including low socioeconomic status, trauma, disabilities, language barriers, food insecurity, and attendance issues. Most students did not have a background in coding or access to a computer at home. Considering these barriers, my administration and I felt that having 10% of the school population enrolled in CSC was an achievement in the context of that school community.

That statistic transplanted to a more mainstream collegiate can and should be interpreted as insufficient; in the age of digitally interconnected everything, tech jobs in abundance, and AI changing the game, the need for young adults to be at least capable programmers has never been higher.

I was recently transferred to a more mainstream collegiate, and the enrolment statistics and dynamics in CSC were staggering. Before digging into that, I offer an observation about CSC teacher training gaps in Saskatchewan, which I surmise is less local than the scope of this paper.

Continuing Education and Need for Training

As a graduate student at the same university for 20+ years since my last undergraduate CSC course, I sought to find courses available to further my education in CSC pedagogy. Unfortunately, that system is not as nimble as I hoped. There is a need for a structured teacher training program in CSC education, and while the scope of this paper cannot address that issue directly, it can draw attention to it. To that end, let us do a thought experiment that paints this gap as a chasm that yawns when Moore's Law is applied.

Gordon Moore, co-founder of Intel, observed in 1965 that the number of transistors on a microchip doubles approximately every two years, while the cost of computers is halved (Brenner, 1997). Although an empirical observation rather than a physical law - much like the concept of dog years helps us relate to a dog's lifespan - Moore's Law provides a framework for understanding dynamic technological timelines. By applying Moore's Law, we can better grasp the lag in CSC teacher training, illustrating the situation in terms of computer years (CY). Traditionally approximated as a doubling of computational power every two years, CY perception has undoubtedly been accelerated by recent trends and breakthroughs, such as AI, quantum computing, blockchain, cryptocurrency, et al. Today, technology may advance at a rate of 3-5 times the speed of real-world years (Brenner, 1997; Ceruzzi, 2005; Cumming et al., 2014). I write only as a Saskatchewan CSC teacher in the trenches with limited support and an arbitrary benchmark of the last time I took an undergraduate CSC course in 2003. In this context, and as a thought experiment conservatively assuming Moore's law as 1:4, let it be assumed in this paper that teacher training in Saskatchewan for CSC is 100 CY behind.

The skillset I have been able to develop on my own has been a mediocre grasp of the mid-1980's programming language qBASIC. The reality of an CSC educator trying to turn the AI tide with only qBASIC at their disposal is comical and absurd. Developing a teacher training mechanism for CSC educators in Saskatchewan should be embarked upon right away.

These are empirical calculations with arbitrary benchmark points presented to illustrate a time horizon. We need dynamic and readily deployable solutions as part of both the response to exponential technology growth and undergraduate program development. The demand for CSC skills is growing exponentially, opening novel career pathways that should be invested in. The economic benefits of a well-trained CSC workforce are substantial, and by investing in CSC education, Saskatchewan can position itself as a leader in technology and innovation—building on existing strengths like the Synchrotron but also training teachers to sustain that innovation. Does Saskatchewan aim to be globally competitive, and what the world needs? If so, delaying investment will only widen gaps, making it more challenging to catch up in the future.

"...but one day earlier..." (Bolstom, 2005)

Implementation of AI in CSC 20/30

Let us return to the mainstream collegiate I recently joined. Saturated with privilege, this school had 31 out of 750 students in CSC. This 4.1% was a contrast from my previous experiences. Recall that the barrier-laden previous school had 10% enrolment in CSC. Two of those students were in CSC 30, amounting to 0.27% of the school's graduating class. This was disheartening, but gaps like this are where program-building opportunities live, and opportunity presented itself in the form of ChatGPT 3.5.

As part of a graduate course in AI ethics, I conducted an experiment with my CSC 30 students, tasking them with using ChatGPT 3.5 to complete the entirety of my CSC 20 course within three days and a minimum grade of 80%. The students were not aware that ChatGPT could generate code, but they had used it in other aspects of their lives. The outcomes of the experiment:

> *Student 1: 78% coding; 90% written work; 81.73% total; 1.7 hours of work.*
> *Student 2: 96.67% coding; 90% written work; 94.67% total; 1.7 hours of work.*
> *Student 3: 80.45% coding; 90% written work; 85.23% total; 0.9 hours of work.*
> (Balon, 2024)

You might not find these results remarkable. However, when I checked the submission folder after the deadline, I discovered that the students had also accessed the CSC 30 assignments and applied the same approach[1].

I intentionally misrepresented the total hours of work calculations above to try to give you the same reaction that I had to their unprovoked double-duty; in roughly 1.5 hours per student, they completed both CS20 and CS30, with higher scores at the CS30 level:

> *Student 1: 98.9% total*
> *Student 2: 99.1% total*
> *Student 3: 97.8% total*
> (Balon, 2024)

As the content became more challenging, GPT 3.5 performed better and faster. When they presented their findings to CSC 20 students, jaws were on the floor. Post-experiment, I actively encouraged both CSC20 and CSC30 students to use AI to augment their work. The results were astounding. A 15-year-old student started training a large language model for image recognition, eventually achieving a 30% success rate—a significant accomplishment[2]. Although such image recognition technology already exists, this student essentially developed their own AI tool from scratch at less than half the age of the alleged average professional developer at OpenAI (Gates, 2024; Krithika, 2024). This is but one example; all students produced projects that far surpassed the quality of my previous students' work over the last decade. Once allowed to use AI in the classroom without the fear of being accused of cheating, all excelled remarkably.

News of these achievements began to spread across the school, leading to a significant increase in enrolment numbers for the next year. Currently, I have 100 students enrolled in CSC for next year, a 233.33% increase and representing 13% of the school population. I predict this trend will continue. If students maintain strong interest in this subject area, and we assume this 233% growth is exponential rather than logarithmic, it is likely that some professionals will need to teach CSC courses without prior experience[3], given that teacher training programs in Saskatchewan are roughly a computer century behind.

To summarize, at a mainstream collegiate, enrolment numbers in CSC at a privileged collegiate were initially low but after conducting an AI-based assignment-experiment, enrolment numbers surged. This experiment might be valid, but it is more likely timely; it is not a stretch to think that teenagers can see the rapid developments in AI and make science pathway choices accordingly. Consequently, the Saskatchewan education system may face challenges in recruiting, training, and retaining CSC teachers to meet growing demands. This situation is likely common across Saskatchewan, underscoring a need for innovative approaches to address the dragon-tyrant. One such approach is to

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[1] They cited both boredom and fascination for this initiative. While hearts were in the right place, they did technically cheat on their remaining CSC30 assignments. I am glad they did as I got twice the amount of data that I expected, which is the impetus for this paper and proceeding project.

[2] This student brought that LLM from a 3% success rate to 30% over one month.

[3] Experience and qualifications are not always prioritized in human resource staffing decisions in Saskatchewan.

acknowledge and embrace the fact that no CSC stakeholder knows what they are doing or what is happening next.

A Rancièrian Philosophical Provocation

Jacques Rancière's “The Ignorant Schoolmaster: Five Lessons in Intellectual Emancipation” (1991), presents a radical philosophy of education based on the true story of Joseph Jacotot, a 19th-century French teacher mistakenly assigned to teach Flemish, who in turn discovered he could teach subjects he did not understand.

Rancière (1991) argues for the equality of intelligence. Education should not be about transferring knowledge from teacher to student but about recognizing and activating intelligence. Jacotot's method, albeit forced, involved giving students a book in a language they did not understand and asking them to learn it independently, demonstrating that students could teach themselves through effort, thus challenging the traditional teacher-student hierarchy. This becomes relevant here in filling the gap between increasing numbers in CSC classes in Saskatchewan and the lack of experienced or knowledgeable CSC educators for, potentially, another 9-25 CY. Rancière’s egalitarian teaching philosophy suggests that everyone has equal intelligence and can learn from each other, positioning the teacher as a facilitator of students leading their own learning. In CSC education, AI can be the tool for teachers to adopt this philosophy.

One does not need to be a proficient coder, nor can one be, given the rapid pace of technological advancement. Educators should acknowledge that we do not know what will happen next with AI. We might find ourselves guiding young people through these nascent waters, and it is better not to pretend to have all the answers. We should be prepared to enter a CSC classroom armed not with expertise but with a belief in the boundless potential of our students, and position ourselves as a Rancièrian ignorant schoolmaster, guiding students to explore, question, and discover the subject in tandem.

Rancière (1991) writes, “the pedagogical myth […] divides the world into two. More precisely, it divides intelligence into two. It says that there is an inferior intelligence and a superior one” (1991, p.7). In the age of AI, teachers cannot presume that they are of superior intellect to young digital natives. This provocation reimagines the classroom as a place where everyone embarks on a shared journey of discovery and learning.

Suggested Methodological Approach and Critical Lens

The development of a course model guided by AI, with individualized instruction and evaluations, presents a significant opportunity. My goal is to implement this as a pilot in my classrooms by September of 2024 and fully integrate it by the end of the academic year. Critical thinking, process over product, self-evaluation, and peer review are essential components. In a brief overview, here is my approach.

The student would select an outcome from the Saskatchewan CSC curriculum. For example: *CS20-FP1: Utilize different data types, including integer, floating point, Boolean, and string, to solve programming problems* (2018). The student would then ask a free AI to develop three assignments of increasing difficulty in the programming language of their choice. Utilizing online resources such as CodingBat, cs20.ca, Codecademy, and Chortle, the student would learn the fundamentals of their chosen language and attempt the assignments. Before using AI to generate any code, the student would ask the AI for assistance when troubleshooting problems. Once the assignment is complete, the

student would ask the AI to evaluate the work based on a provided rubric and attach the chat for evaluation. This process would be conducted in pairs to maintain accountability, ensuring that AI is used to generate assignments and assistance, not the final code. After completing all outcomes, students could embark on a self-guided capstone project independently or in groups.

All of this, ideally, would be executed in a standalone web-based platform. That platform would be clipboard-disabled to prevent academic integrity issues, for AI tools can generate code and easily be copy-pasted. The tool must also have a timer integrated to inform the instructor if the student is spending amounts of time on a given assignment that might warrant inspection, intervention, or adaptation. The platform must also be multi-lingual, multi-programming language capable, and accessible through Saskatchewan school division webservices to prevent student data from crossing international boundaries. Also, this tool should be multi-generational friendly and be able to be used by an instructor in a secondary collegiate as both a Rancierian tool as well as a professional development tool. The modality of the results of this project could spiderweb across all domains.

There are valid concerns about the accountability of evaluations and the enabling of academic dishonesty in this methodology that merit serious attention. These concerns will be addressed in the project, although there may remain an element of unquantifiable evaluation. In my experience as a music educator, I have found that most evaluations are influenced by the educator's bias or opinion, rendering them inaccurate or invalid. Self and peer evaluations have often yielded more accurate, favorable, equitable, satisfying, and understandable results for students. There may be potential to implement this concept in a more quantifiable manner within a CSC course.

Key Takeaways

- Outdated methodologies, lack of support, and inadequate professional development hinder AI integration in Saskatchewan CSC education; immediate reforms are needed.
- Applying Rancière's (1991) egalitarian philosophy can transform CSC teaching.
- Development of professional development programs is essential.
- Experimental findings demonstrate that AI tools in the CSC classroom can significantly improve learning outcomes.
- AI-guided individualized instruction enhances critical thinking and collaboration but requires careful management of accountability and academic integrity challenges.
- Delaying investment in this sector of education has measurable consequences for Saskatchewan.

Conclusion

Proactive and transformative measures are necessary to equip CSC educators for an AI-driven world in which students may elect CSC pathways for their secondary studies in droves. Change is traditionally top-down, but AI's unprecedented impact necessitates rapid classroom adaptation. While developing an undergraduate teacher training program is crucial, immediate action is necessary to prepare our youth for the emerging future. To wait one year is to wait 3-5 computer years. We must empower many more secondary educators to teach CSC, even without prior experience, and current CSC educators must become change-makers.

Had we started but one day earlier, or one hundred computer years earlier...

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Avoiding using AI would have been hypocritical in writing this paper. All chats I have used can be found below.

https://chatgpt.com/share/33ece795-a148-470b-9638-3d0023a4add0
https://chatgpt.com/share/946a5627-c5c5-4fe9-86c5-1d9517702935
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Conflict of Interest

The author does not declare any conflict of interest.

References

Balon, B. (2004). *AI integration project for ETAD 898* [Video]. YouTube. https://www.youtube.com/watch?v=HSloB20dL7U

Bostrom, N. (2005). The fable of the dragon tyrant. *Journal of Medical Ethics, 31*(5), 273-277. https://philpapers.org/rec/NBOTFO

Brenner, A. E. (1997). Moore's law. *Science, 275*(5306), 1551. American Association for the Advancement of Science. https://www.jstor.org/stable/2893682

Ceruzzi, P. E. (2005). Moore's law and technological determinism: Reflections on the history of technology. *Technology and Culture, 46*(3), 584-593. The Johns Hopkins University Press. https://www.jstor.org/stable/40060905

Chaushi, A., Chaushi, B. A., & Ismaili, F. (2024). Pros and cons of artificial intelligence in education. *International Journal of Advanced Natural Sciences and Engineering Researches, 8*(2), 51-57.

Cumming, D. R. S., Furber, S. B., & Paul, D. J. (2014). Preface: Beyond Moore's law. *Philosophical Transactions: Mathematical, Physical and Engineering Sciences, 372*(2012), 1-2. Royal Society. https://www.jstor.org/stable/24502743

Gates, B. (2024, January 11). *Episode 6: Sam Altman* [Video]. Unconfuse Me with Bill Gates. YouTube. https://www.youtube.com/watch?v=PkXELH6Y2IM

Krithika, K. L. (2024, January 16). *OpenAI is not built by 24-year-old programmers*. Analytics India Magazine. Retrieved from https://analyticsindiamag.com/ai-origins-evolution/openai-is-not-built-by-24-year-old-programmers/

Kohnke, L., Moorhouse, B. L., & Zou, D. (2024). Technostress and English language teaching in the age of generative AI. *Educational Technology & Society, 27*(2), 306-320. International Forum of Educational Technology & Society, National Taiwan Normal University, Taiwan. https://www.jstor.org/stable/48766177

McClanahan, E. D. (n.d.). *Programmed lessons in QBasic*. Retrieved from https://chortle.ccsu.edu/qbasic/index.html

Olajide, O. A. (2017). *Intro to programming - QBASIC*. doi.org/10.13140/RG.2.2.20941.44002

Rancière, J. (1981991). *The ignorant schoolmaster: Five lessons in intellectual emancipation*. Stanford University Press. http://www.sup.org/books/title/?id=3009

Saskatchewan Ministry of Education. (2018, January). *Computer Science 20 curriculum*. Retrieved from https://curriculum.gov.sk.ca/CurriculumHome?id=446

Saskatchewan Ministry of Education. (2018, January). *Computer Science 30 curriculum*. Retrieved from https://curriculum.gov.sk.ca/CurriculumHome?id=444

Schellenberg, D. (2018). *Computer Science 20 - Saskatchewan*. Retrieved from https://cs20.ca

Selwyn, N. (2024). On the limits of artificial intelligence (AI) in education. *Nordisk tidsskrift for pedagogikk og kritikk*. https://doi.org/10.10.23865/ntpk.v10.6062

Tufts University Office of the Provost and Senior Vice President. (2024). *Guidelines for proposing new academic programs*. Tufts University. Retrieved from https://provost.tufts.edu/policies/guidelines-for-proposing-new-academic-programs/

University of the Fraser Valley. (2020, September). *Program and course approval procedures*. Retrieved from https://www.ufv.ca/media/assets/secretariat/policies/Program-and-Course-Approval-Procedures-(September-2020).pdf

University of Saskatchewan. (2023, August). *New program or curricular change form*. Retrieved from https://governance.usask.ca/documents/proposals/curricular-changes/new-program-or-curricular-change-form.pdf