Generative-AI Impact on Secondary CS Education *Today*

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Abstract

Generative AI (Gen-AI) has brought Software Engineering (SE) to a pivotal inflection point. Though significant change seems imminent, this is still very much evolving. In the meantime, as a current Computer Science (CS) student teacher I am asking myself, what should I teach **today** as all this plays out? This project became an opportunity to attempt to formulate a "point in time" answer to this question. To such extent, I ran a survey through my network of SE professionals, my small network of Educators and many friends, all of whom I have been having the "AI Conversation" with. Combining the survey results with many things I have read, talked and practiced over the last 2-3 years, I concluded my teaching today should include these four aims: 1) Build **Resilience** against the downside of this disruption and build **Adaptability** to its opportunities, 2) Truly teach CS end-to-end, **way beyond coding**, 3) Nurture broad **Technology Literacy**, especially for those not interested in SE careers, and perhaps most of all 4) Teach how Gen-AI works, to cultivate **Responsible AI Engineers**. Many questions remain, not to mention the fact that the "point in time" for this conclusion is expiring as I type. However, the idea of building resiliency against this type of change sticks with me to follow up on next.

Introduction

My experience teaching CS (mostly with Microsoft TEALS) has been significantly centered around computer programming, aka coding. Though it is hard to predict which specific ways and how soon, it seems clear that Gen-AI will transform coding drastically. As a result, we find

ourselves at this moment when it might be too early to change too much, and at the same time, too late not to change anything. Yet we are all teaching ***today***.

What makes this most challenging and most fascinating is this is going on through every single aspect of CS. From the industry all the way to the classroom. Furthermore, I think it's a fact that the impact, permeation and proliferation of "things" controlled by software continues to explode exponentially. **This is bound to have very deep impact on all aspects of human life**, certainly including **Social Justice, Equity and Responsibility**, which are core pillars in education.

My goal for this project is to capture a "point in time" action research reflection about this situation. This issue doesn't have one single or simple answer. In fact, questions and answers will continue to evolve quite rapidly. Nonetheless, I ask myself, what should I do for my next class?

Literature Review

A lot is getting written, said and speculated about AI. In my experience, Fear, Uncertainty and Doubt (FUD) seem to dominate many conversations. I have no use for this.

On the other hand, I love reading about and hearing from people with know-how experiences. Those who have tried to solve real life problems in their lives and jobs using Gen-AI. This is what I aspire to do and share. I'm not sure I'll fill any gaps. That wouldn't be my intent anyway. **I want to be part of the hands-on conversation** – I owe this way to describe it to Rodney Perez, a UW PhD student, the GOAT TA.

Additionally, I do get great inspiration and insight from research papers like Cady et al, 2024 who got me at the title: "***The AI imperative: On becoming quintessentially human****"!* You know, when they go low, we go high. What better way to respond to machines than to become quintessentially human?!

In their "scoping literature review", Folk et al, 2025 state that the current research is "… investigating primarily AI-generated content **instead of human participants**. This approach may hinder the adoption of a human-centered approach towards Gen-AI in education". This is so very inspiring to me. **We all should take a human-centered approach to this challenge**.
See more inspiring quotes from the literature in the References section.

Methods

I didn't know it and I didn't have the language for it, but now I feel I started working on this in early 2023. I have been talking about this close to daily at work at Microsoft, in my classroom, with my friends, and in STEP (Secondary Teacher Education Program), every chance I get. This doesn't make me an expert in any way. I have not been doing research. I have been just "living through it".

To bring this all together, to ground it or upend it in my head … I decided to run an anonymous survey for this project. I felt I could make it a continuation of the conversation, which would allow me to reach others who I haven't had the opportunity to ponder about AI with.

I ran my own brainstorming exercise listing all questions I could remember or think of. I narrowed it down to 12 questions. I ran this original list by my nephew, Hernando Bermudez, a math PhD and Microsoft alumni with whom I have had passionate debates about AI. I also run it by my mentor teacher, Adrianne Gifford, with whom we are having the "AI Conversation" since we met, and who has given me nothing but awesome and actionable feedback all along. From there I closed on the 8 final questions.

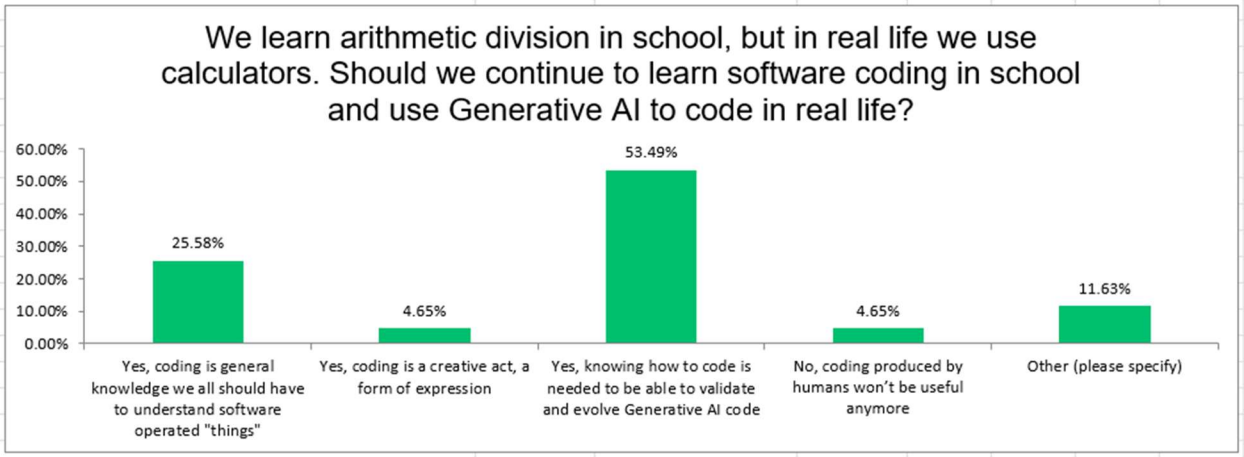
The entire survey and responses (43 at snapshot time) are included in the appendix. Due to my trajectory, my network is full of engineers. That's a bias I could have predicted; I suspect Linked

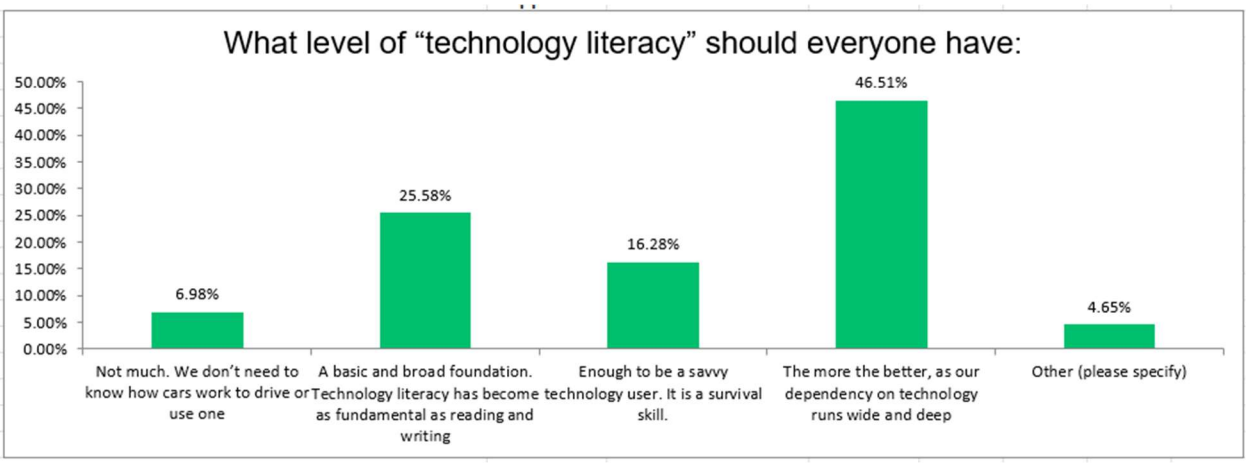
In produced the most responses. This is also a small data set to claim many statistically significant statements. So, I sliced and diced it to find the patterns, just like I do daily at work.

Results

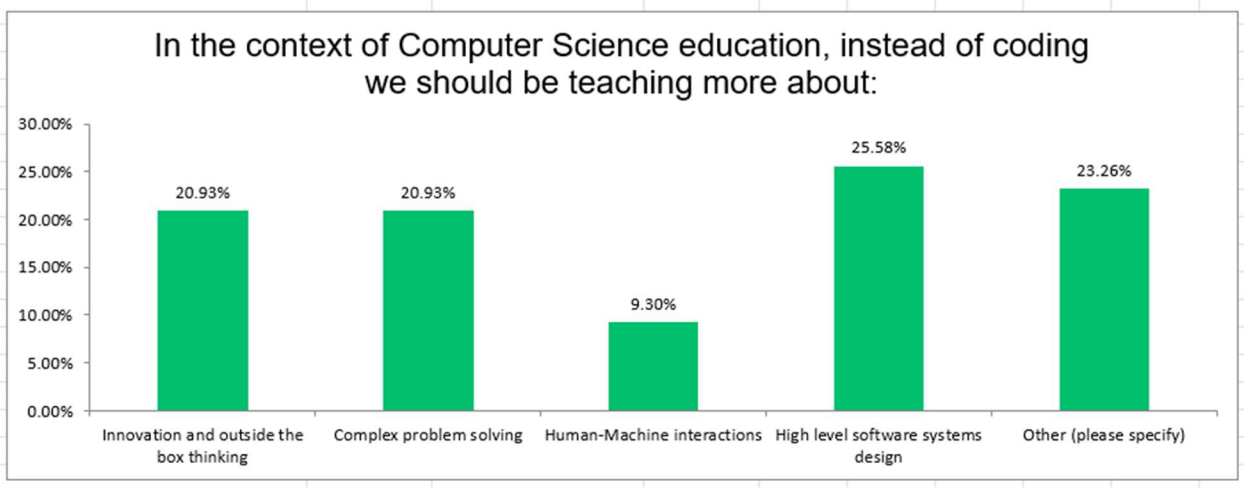
I think my first surprise was to find a message of **both hope and despair**. The word cloud is in general very disperse, but it has "concerned" as the most common word. Yet the single answer across the entire survey with most agreement, at 84%, was "[software engineering] will have to evolve but will continue to be needed". **We are here to stay!** (The next highest in the entire survey was at 55%)

Following this there were only two questions that managed to capture over 90% of the population with three (out of 5 possible) answers. One interesting thing is that in both cases, the top two answers were sort of on opposite ends of the spectrum, **hinting how dispersed our opinions are**:

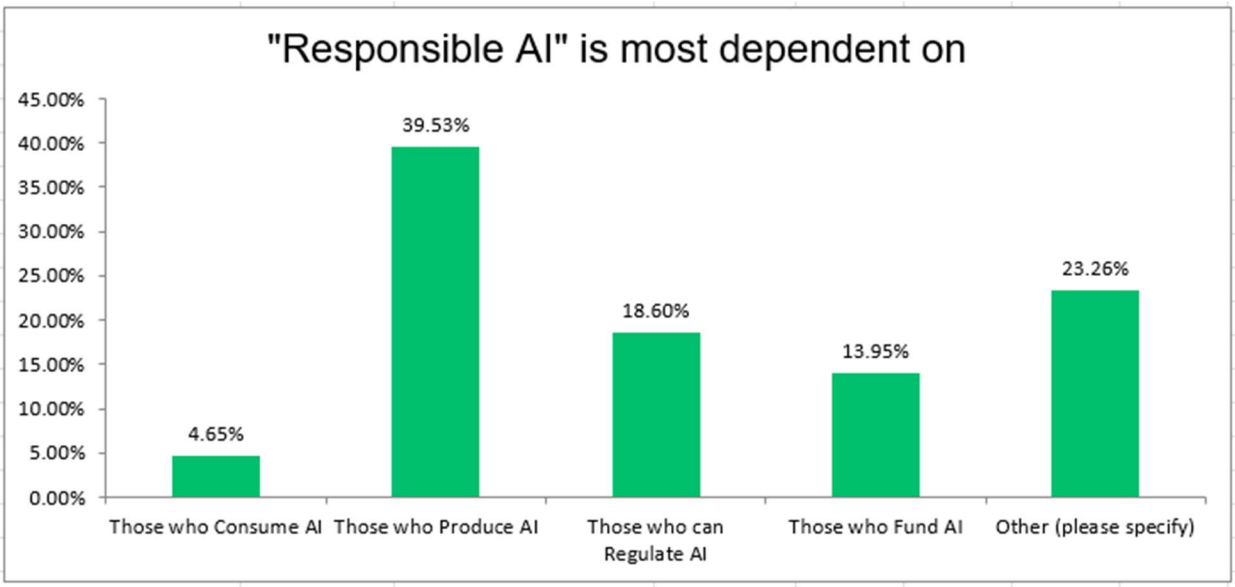




Perhaps not surprising was the question that had the most even spread of answers, **again showing a wide range of opinions**:



Similarly, a question about **Responsible AI** was highly dispersed as well. I was surprised to see the highest percentage go to "those who produce it", with 40%. My choice would have been "those who fund it", which got 14% only.



Findings

1) As the word cloud showed, we're somewhere in between hope and despair. This is when we need **adaptability** (Cady et al, 2024) **and resiliency** the most. Adaptability has always been critical for keeping up with technology. And who doesn't need resiliency in light of rapid and potentially unpredictable change? Whatever content I'm teaching today, in my classroom I must teach building resiliency against the negative side of technological change and adaptability to the positive side of it. (A few wrote in the survey about instability, even dystopia).
2) Despite the way we teach or interview, we have known for a long while that **coding is just one part of SE**. A critical must-have you might add, totally necessary, but nowhere near sufficient. *Perhaps the time to embrace this for real has come*. Code quality is crucial; it's

like human health. But if that is literally all we have got, we are not getting the most out of our potential. In my classroom, I must teach much more than coding.

3) I personally cannot think too much about the way technology will continue to proliferate and permeate human life. I'm sure my thinking is biased after so many years delivering software that so many people use daily around the world. That is probably why I have no question "**technology literacy"** will be increasingly crucial **to ensure Social Justice and Equity**. This responsibility is incredibly important. We used to go to schools to teach students to code hoping to inspire careers in SE. This is still important, but it's crucial now that we generate "technology literacy" as broad as possible. I deeply believe this is about basic survival skills. In my classroom, I must teach ~~CS~~ Technology Literacy with a wide lens. I'm so very happy to have learned about Washington state's FutureReady | SBE initiative, which inspired me to think this way.
4) Then of course, last but certainly not least, we need to teach about AI. I'm not sure about prompt engineering, the latest unbelievable AI tool, or entering the daily "new model rat race". Instead, **we need to teach how AI works** (someone wrote it this way in the survey). Most importantly, we need to teach about its strengths and its risks. This is the road to **Responsible AI**, as I've learned teaching the RAICA | MIT RAISE pilot to 5th graders! (I think their curriculum is not publicly available yet). Understanding how AI works will generate critical thinking around it. It is what we need to see past the FUD, to be able to see the real issues, and yes, the real opportunities. In my classroom, I must teach to nurture **Responsible Engineers**, *the only kind we need*. Thank you, Adrianne Gifford, for inspiring me to think this way.

Discussion and Implications

I don't think we are going to have an aha moment. Though things will evolve rapidly, I believe it is going to be an evolution of sorts. It won't take this long, but it took about 20 years from the first commercial cell phone to the iPhone. It took the internet about half that time to be recognized by most as must-have …

Yet this is happening. It is not too early to engage. It might be too early to bet the entire farm on it. I'm avoiding the extremes, and I think we all need to join the AI Conversation.

In the context of middle and high school education, it is hard to avoid thinking how many of these students might eventually not remember much about life before AI … just like my young adult kids don't remember much about life without cell phones and internet …

There are so many questions, but I'm going to follow up with one: How do I teach resiliency in this context?

Conclusion

I chose an impossible topic for this project, yet it was the topic I couldn't escape. I knew I wasn't out to "find the answer". At the same time, I knew this was going to force me to crystallize some ideas. I cannot claim to have done that, or that my thoughts are any good. I just know someday I'll be reading this again and going "wow, that's where my head was at as I was finishing STEP … (I might laugh here)".

I'm so very glad I came to STEP which has made me think about all these things in more just, fair and responsible ways. STEP has changed me already. I know I will continue to teach but if this happened to be it, it would have been a great deal already. Thank You All for reading!

References

The AI Imperative: On Becoming Quintessentially Human - Steven H. Cady, Jari G. Willing, Deakon A. Cady, 2024

Cady, S. H., Willing, J. G., & Cady, D. A. (2024). *The AI imperative: On becoming quintessentially human*. **The Journal of Applied Behavioral Science**. https://doi.org/10.1177/00218863241284310

Volume 60, Issue 4, December 2024, Pages 721-731

> "… industrial-era education and management practices, with their emphasis on structured, repetitive environments, have historically prioritized crystallized intelligence over fluid intelligence. This focus limits **adaptability and innovation, which are essential human qualities in an AI-driven world**. Our recommendations include stimulating cognitive flexibility, reimagining strategic planning, optimizing team meetings, redesigning jobs, promoting experiential learning, and fostering human relations. …" -- Page 721
>
> "As a result, organizations are now facing an **urgent need to cultivate quintessentially human skills that AI cannot replicate—such as creativity, empathy, emotional intelligence, collaboration, and complex problem-solving**. …" – Page 722
>
> "... our focus must remain steadfast on nurturing the uniquely human qualities that AI cannot emulate. **By embracing this challenge as an opportunity for growth, we can transform the current imperative into a source of inspiration**. Realizing this, the evolutionary leap will require a collective commitment to cultivating environments that promote innovation, adaptability, and continuous learning, ensuring that humanity not only endures but flourishes in the age of AI." – Page 730

Generative artificial intelligence in secondary STEM education in the light of Human Flourishing: a scoping literature review

Fock, A., & Siller, H.-S. (2025). *Generative artificial intelligence in secondary STEM education in the light of Human Flourishing: A scoping literature review*. **International Journal of STEM Education, 12**, 67. https://doi.org/10.1186/s40594-025-00589-5

"Education for Human Flourishing aims to **empower students to develop their full potential to lead a meaningful, autonomous life to the benefit of themselves and society at large**" – Page 1

"… the focus of the current research lays on the performance of Gen-AI systems and on tool development, investigating primarily AI-generated content instead of human participants**. This approach may hinder the adoption of a human-centered approach towards Gen-AI in education**, not considering the impact of Gen-AI on the purpose students and teachers find in teaching and learning" – Page 22

Investigation of Gen-AI Adoption in IT-Focused Vocational Secondary School Programming Education

Annuš, N. (2025). *Investigation of Gen-AI adoption in IT-focused vocational secondary school programming education*. **Education Sciences, 15**(9), 1152. https://doi.org/10.3390/educsci15091152 (doi.org in Bing)

"One of the key conclusions of our study at the secondary level is that teacher guidance is essential-not only in terms of technical use but also in fostering a critical approach to AI. ... **Such structured reflection activities and teacher-facilitated discussions can help learners develop a more thoughtful stance toward AI-generated content, distinguishing between beneficial support and over-reliance that may hinder the development of independent problem-solving skills**" - - Page 20

"Another limitation lies in the rapidly evolving nature of AI tools and platforms, **with new models and updates emerging almost daily potentially rendering some findings outdated**

over time. This underlines the importance of continuous, adaptive research in this field." – Page 22

How ChatGPT Will Change Software Engineering Education

Daun, M., & Brings, J. (2023). *How ChatGPT will change software engineering education*. In **Proceedings of the 2023 Conference on Innovation and Technology in CS Education** (pp. 110–116). ACM. https://doi.org/10.1145/3587102.3588815

"**As AI-generated code becomes more prevalent, software engineers will need to have a deeper understanding of how to design and architect a software system**. This includes understanding how to properly define the problem and requirements, as well as how to validate and test the AI-generated code to ensure it meets the needs of the project. **Engineers will also need to have a good understanding of how AI algorithms** like ChatGPT **work**, in order to be able to adjust or fine-tune the generated code as needed." – Page 111

"… students will need to be trained in understanding how AI models work and how to tune them. The **current curriculum needs to be updated to include a more comprehensive understanding of these non-coding disciplines** in order to ensure that future software engineers are able to meet the demands of the industry" – Page 111

Implementing Gen-AI (GenAI) in higher education: A systematic review of case studies

Nguyen, T., Nguyen, H., Nguyen, A., & Nguyen, T. (2025). *Implementing Gen-AI (GenAI) in higher education: A systematic review of case studies*. **Discover Education**, 4, Article 475. https://doi.org/10.1016/j.xxxx.2025.00475

"To provide the description of the TPACK knowledge domains in the context of GenAI integration, we synthesized definitions from the Celik (2023) empirical study on the ethical integration of artificial intelligence (AI) and Mishra et al. (2023) research exploring TPACK in the age of ChatGPT and GenAI" – Page 10

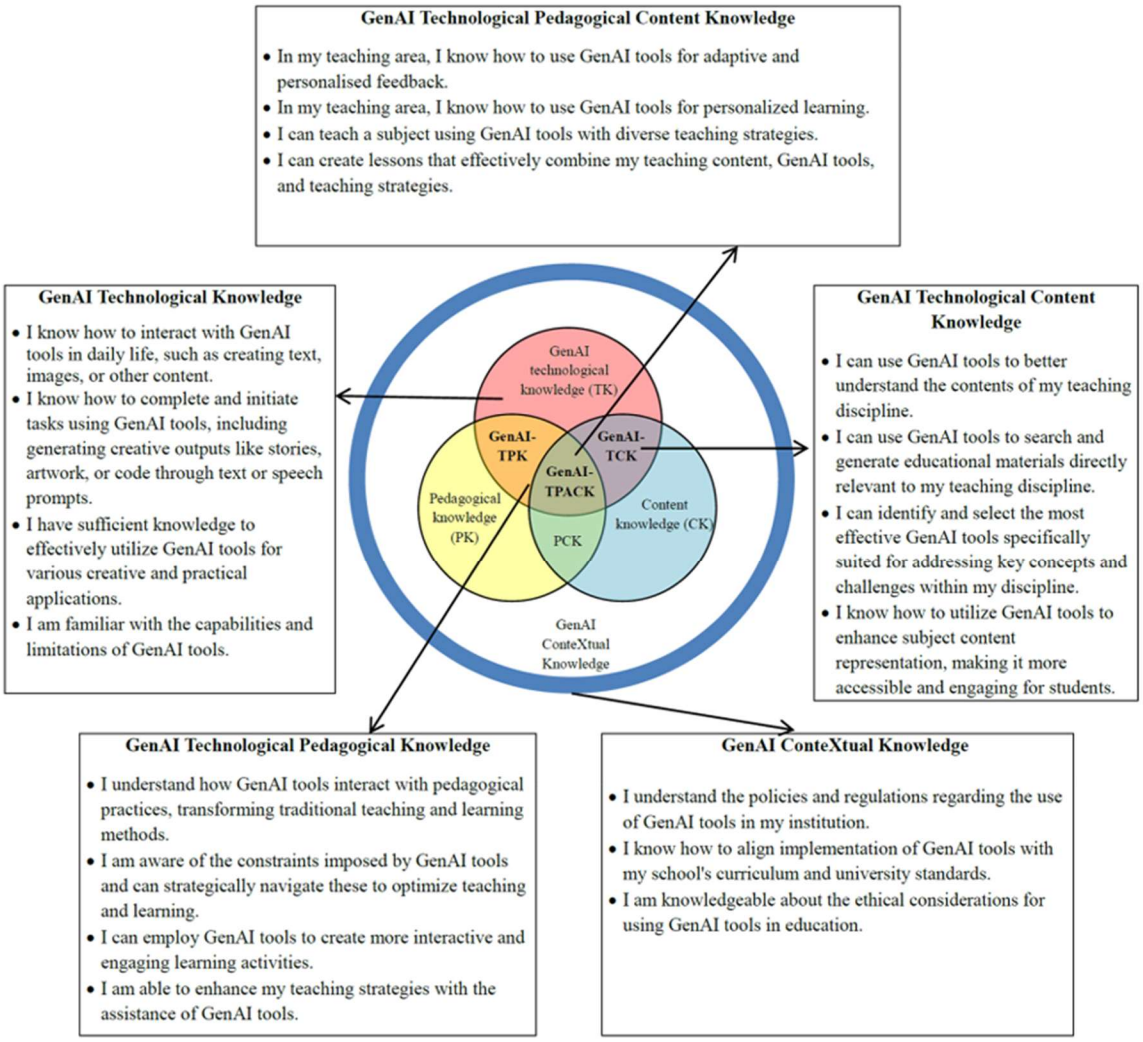


Fig. 4. GenAI-TPACK diagram with the key teacher skills and knowledge recommended for GenAI implementation.

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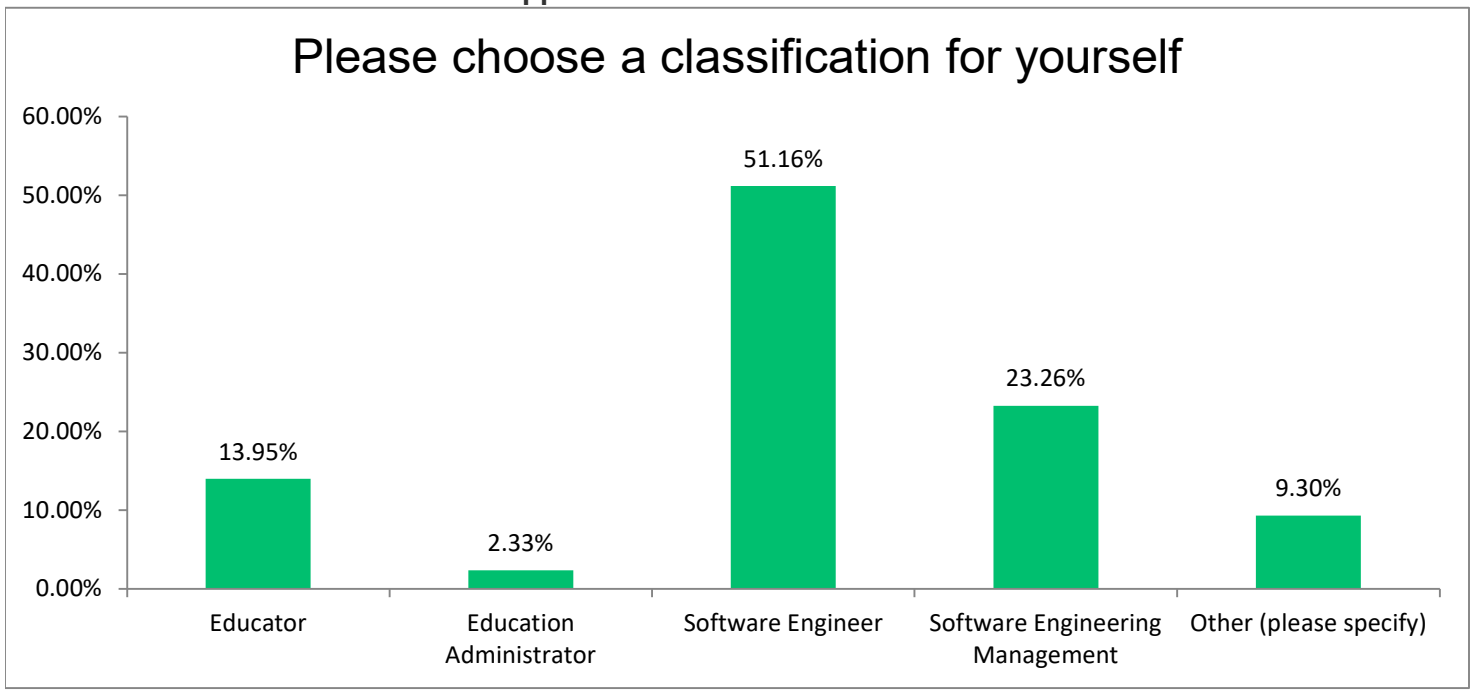
Survey

Generative AI Impact on Computer Science

Generative AI Impact on Computer Science Education *Today*

Please choose a classification for yourself

Answer Choices	Responses	
Educator	13.95%	6
Education Administrator	2.33%	1
Software Engineer	51.16%	22
Software Engineering Management	23.26%	10
Other (please specify)	9.30%	4
	Answered	**43**
	Skipped	**0**



• Other (please specify)

• CEO - services company

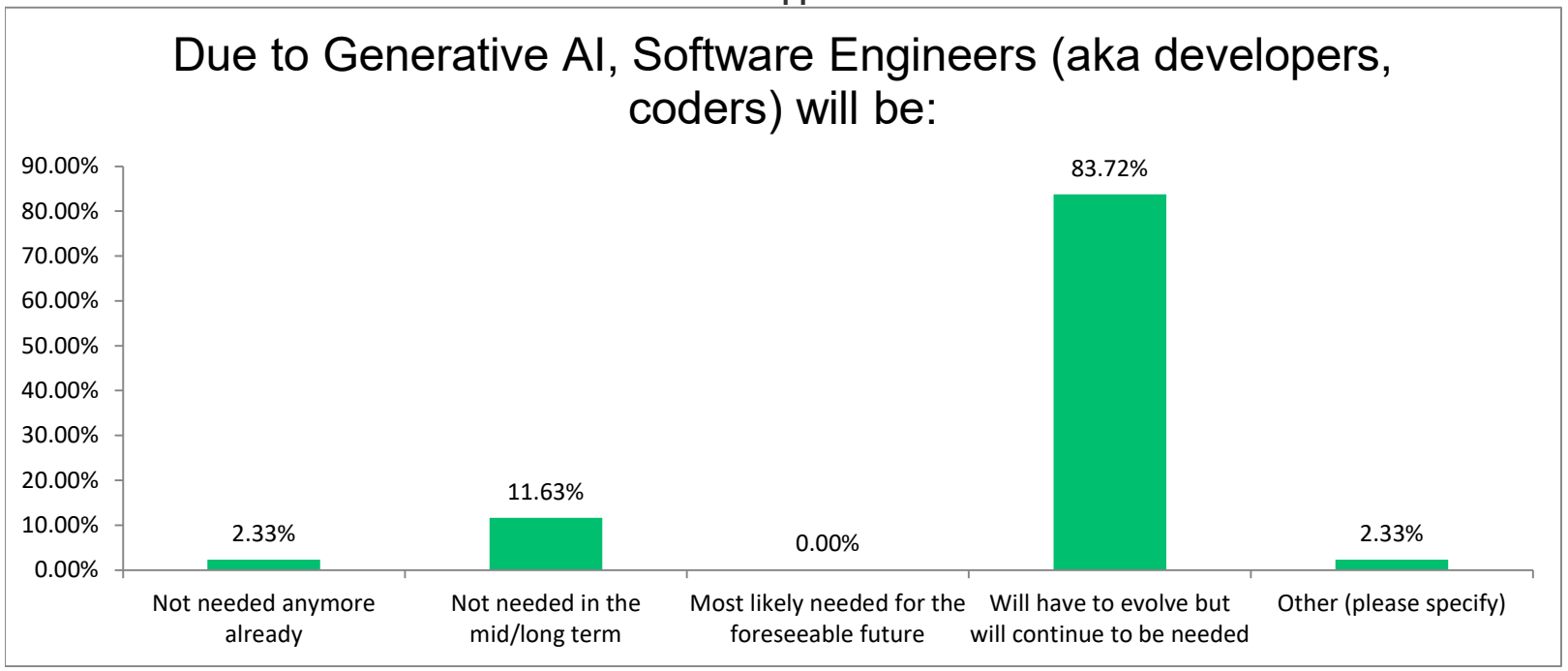
• Marketing product development

- Business Executive
- Retired. Taught CS in public high schools for 7 years after working in international computer industry for 28

Generative AI Impact on Computer Science Education *Today*

Due to Generative AI, Software Engineers (aka developers, coders) will be:

Answer Choices	Responses	
Not needed anymore already	2.33%	1
Not needed in the mid/long term	11.63%	5
Most likely needed for the foreseeable future	0.00%	0
Will have to evolve but will continue to be needed	83.72%	36
Other (please specify)	2.33%	1
	Answered	**43**
	Skipped	**0**



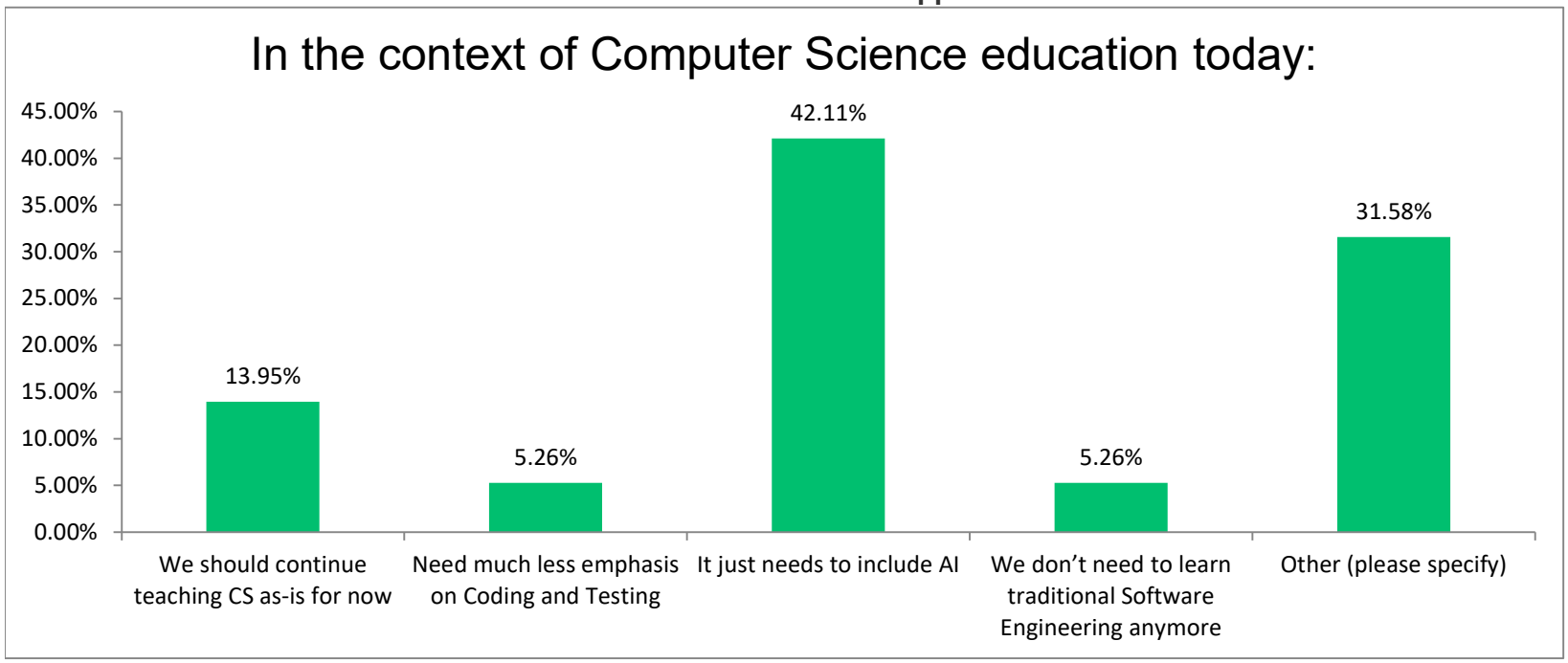
• Other (please specify)

• My value is at business needs and architecture. Gen AI lets me build faster

Generative AI Impact on Computer Science Education *Today*

In the context of Computer Science education today:

Answer Choices	Responses	
We should continue teaching CS as-is for now	13.95%	6
Need much less emphasis on Coding and Testing	5.26%	3
It just needs to include AI	42.11%	17
We don’t need to learn traditional Software Engineering anymore	5.26%	2
Other (please specify)	31.58%	15
	Answered	**43**
	Skipped	**0**



• Other (please specify)

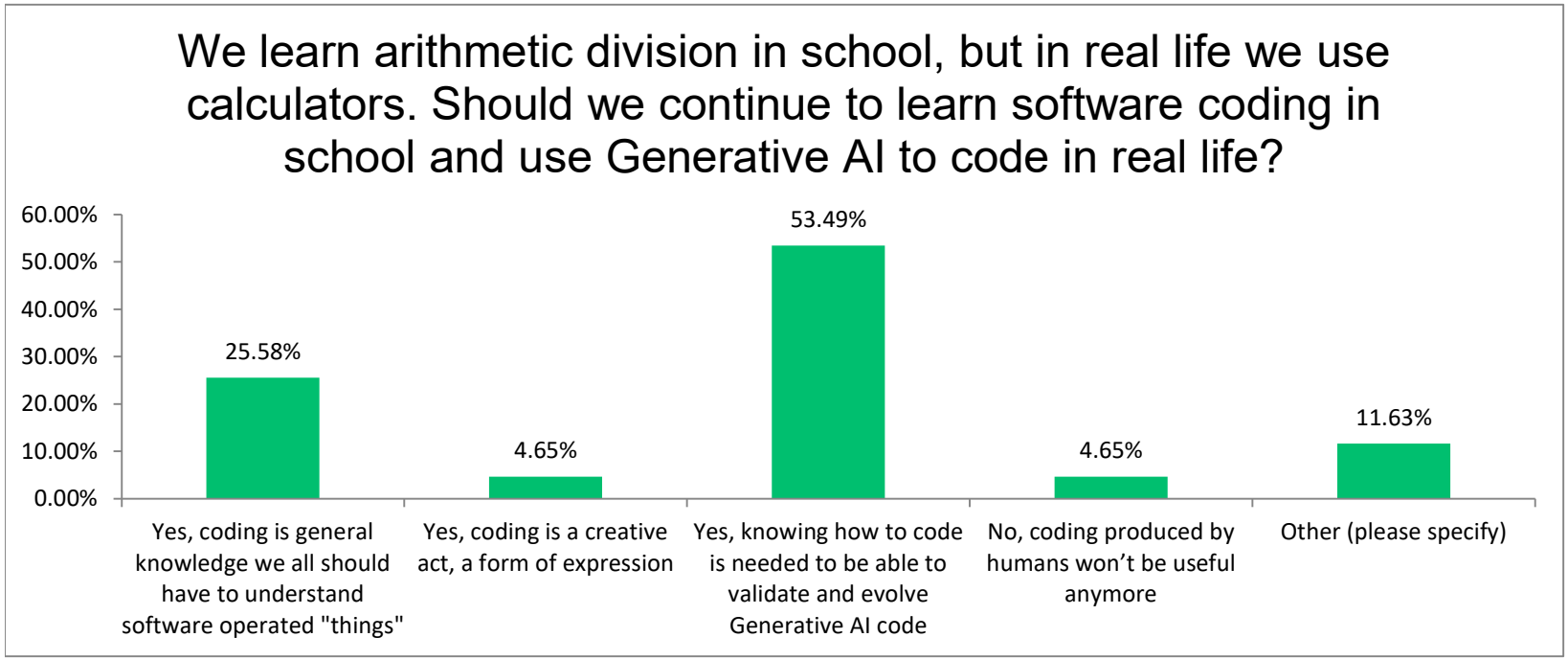
• Computer science education should incorporate AI into the curriculum teach how to reason about AI and how it can be enhanced to help society. For software engineering curriculum, AI should be taught as a tool in the sense of how to adapt and apply current and future AI offerings in order to build better systems.

• The engineering aspect is needed but maybe less about implementation
• Needs more emphasis on fundamentals; thinking and coding... less on frameworks, hype, and AI -- they are just tools.
• redefine CS with AI at the center and establish a new profession where "CS" evolves to AI Engineering
• It repeats the calculators in math classes question. How much do you need to understand down to assembler and microcode levels now?
• Foundamentals are important but I think we need to teach them in the context of real problems with help of AI tools
• Don’t know, seems we entered a positive feedback unstable system and don’t know what will slow its speed and reach
• More emphasis on how to create an accurate specification
• Education should place focus on how things work - system/software internals; areas that impact taste in software design so engineers can steer the coding agents in the right direction
• It certainly needs to evolve to include AI, but not at the expense of the engineering rigor, problem solving, and debugging
• More than "just include it" it should be "embrace it"
• I would uplevel much more to be able to have the skills necessary to scale AI: architecture, testing and evsls, code but focused on quality, evolutions, test harnes so AI can check, communication and prompting towards it
• Start the basics without AI support (editor like jGrasp) but create lessons that use AI (visual studio code) where students debug/modify/adjust to a specific prompt
• We should continue teaching the fundamentals so that students will be able to properly use AI when they are skilled enough
• We need more emphasis on problem decomposition and testing.

Generative AI Impact on Computer Science Education *Today*

We learn arithmetic division in school, but in real life we use calculators. Should we continue to learn software coding in school and use Generative AI to code in real life?

Answer Choices	Responses	
Yes, coding is general knowledge we all should have to understand software operated "things"	25.58%	11
Yes, coding is a creative act, a form of expression	4.65%	2
Yes, knowing how to code is needed to be able to validate and evolve Generative AI code	53.49%	23
No, coding produced by humans won't be useful anymore	4.65%	2
Other (please specify)	11.63%	5
	Answered	**43**
	Skipped	**0**



• Other (please specify)

• You need to teach people how to learn and how to specialize. Someone has to be there to understand how to unravel the mess that AI will create.
• We need to develop the creativity aspect of coding but not coding.

• Funny my answer above before reading this question. I think we don't know the answer yet.

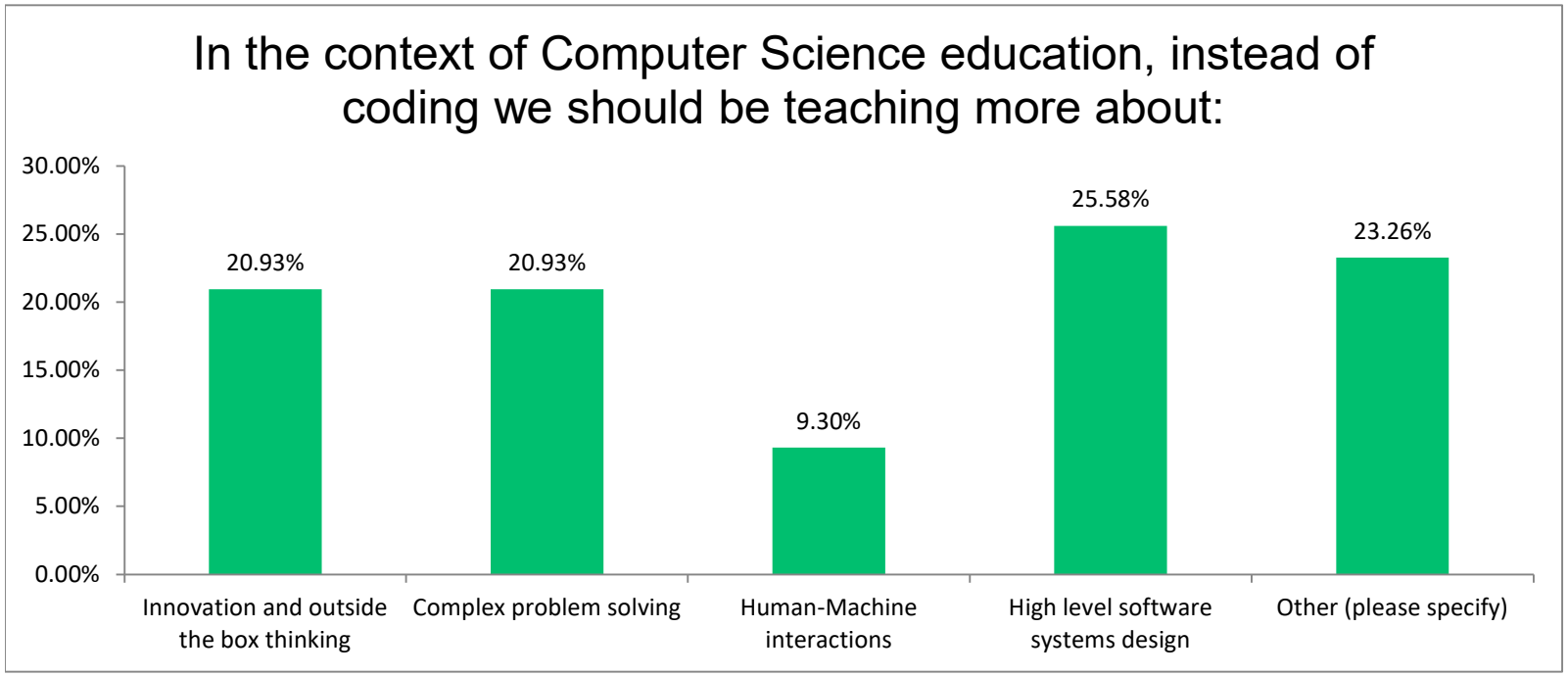
• Similar but not 100% the same as I think about assembly code, understanding the behind the scenes is important. I would teach it, but different and not as we do today, and would have both "code without AI" spaces and lots of code with AI ones

• There will always be coding humans will have to do. The abstractions will be much higher. For example today nobody writes a sort method but 30 years ago they did.

Generative AI Impact on Computer Science Education *Today*

In the context of Computer Science education, instead of coding we should be teaching more about:

Answer Choices	Responses	
Innovation and outside the box thinking	20.93%	9
Complex problem solving	20.93%	9
Human-Machine interactions	9.30%	4
High level software systems design	25.58%	11
Other (please specify)	23.26%	10
	Answered	**43**
	Skipped	**0**



• Other (please specify)

• The mathematical basis for data analysis and processing

• simplicity and composability; don't promote complexity
• All 4 above

• business business business and how to organize the building of complex systems across a complex organization
• Requirements engineering & code quality

• All of the above; they are all important in their different ways

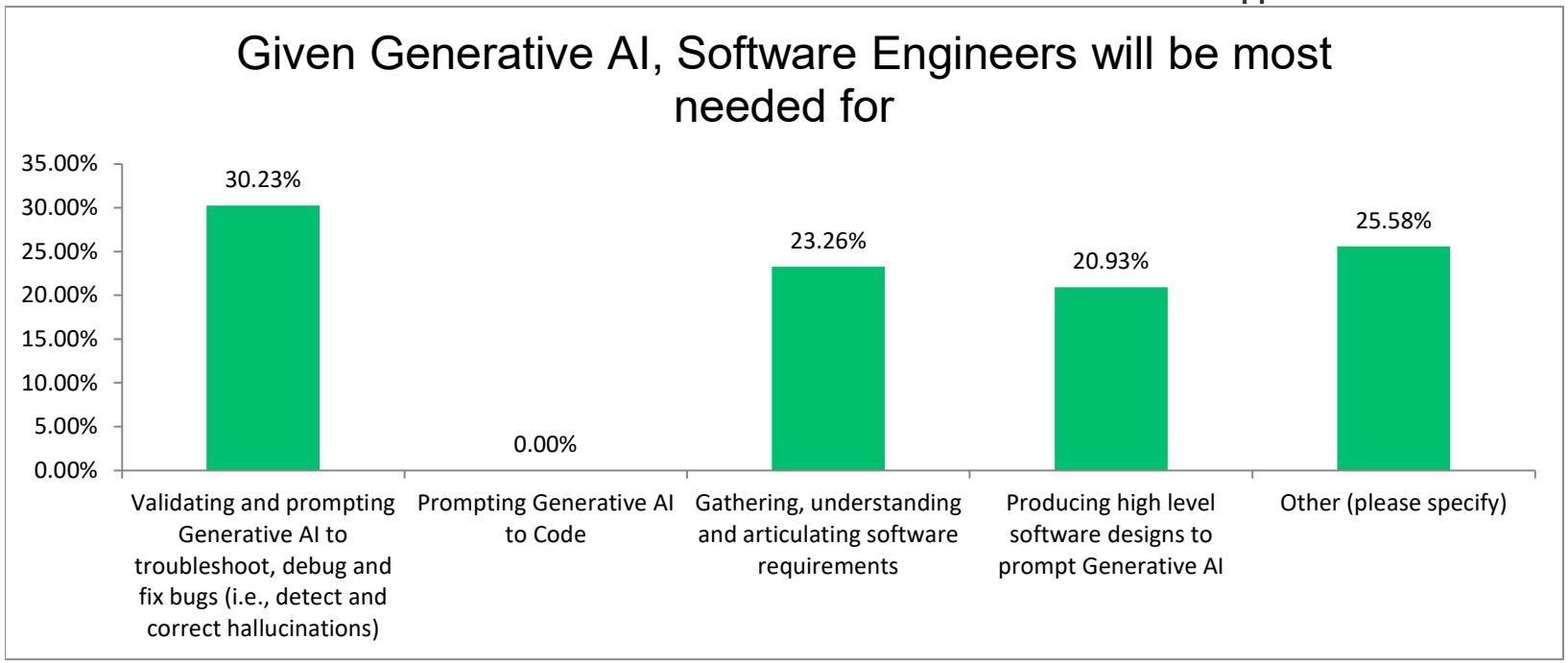
• All of the above. In fact learning how to think and solve problems is more important than what to think.

• All of the above. And not instead, just different balance
• We should still teach coding.
• All of the above

Generative AI Impact on Computer Science Education *Today*

Given Generative AI, Software Engineers will be most needed for

Answer Choices	Responses	
Validating and prompting Generative AI to troubleshoot, debug and fix bugs (i.e., detect and correct hallucinations)	30.23%	13
Prompting Generative AI to Code	0.00%	0
Gathering, understanding and articulating software requirements	23.26%	10
Producing high level software designs to prompt Generative AI	20.93%	9
Other (please specify)	25.58%	11
	Answered	**43**
	Skipped	**0**



• Other (please specify)

• All of the above.

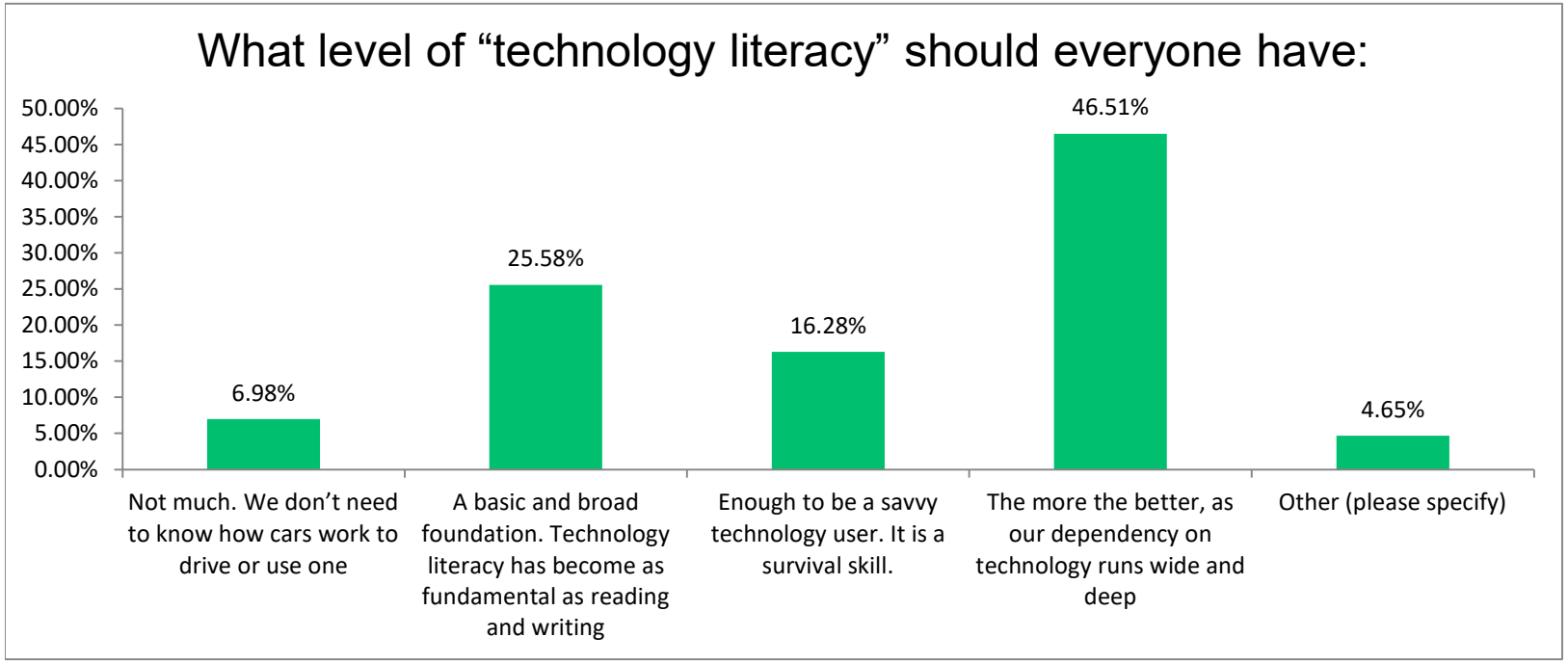
• doing the thinking; not abdicating responsibility to a slot machine
• //
• Turning the grinders
• All of above

• focusing on high level, managing a team of AI agents to divide and conquer
• All of the above
• all of the above
• In some form, all of the above
• All except producing designs. Will be reviewing designs
• Making sure that everything works as required

Generative AI Impact on Computer Science Education *Today*

What level of "technology literacy" should everyone have:

Answer Choices	Responses	
Not much. We don't need to know how cars work to drive or use one	6.98%	3
A basic and broad foundation. Technology literacy has become as fundamental as reading and writing	25.58%	11
Enough to be a savvy technology user. It is a survival skill.	16.28%	7
The more the better, as our dependency on technology runs wide and deep	46.51%	20
Other (please specify)	4.65%	2
	Answered	**43**
	Skipped	**0**



• Other (please specify)

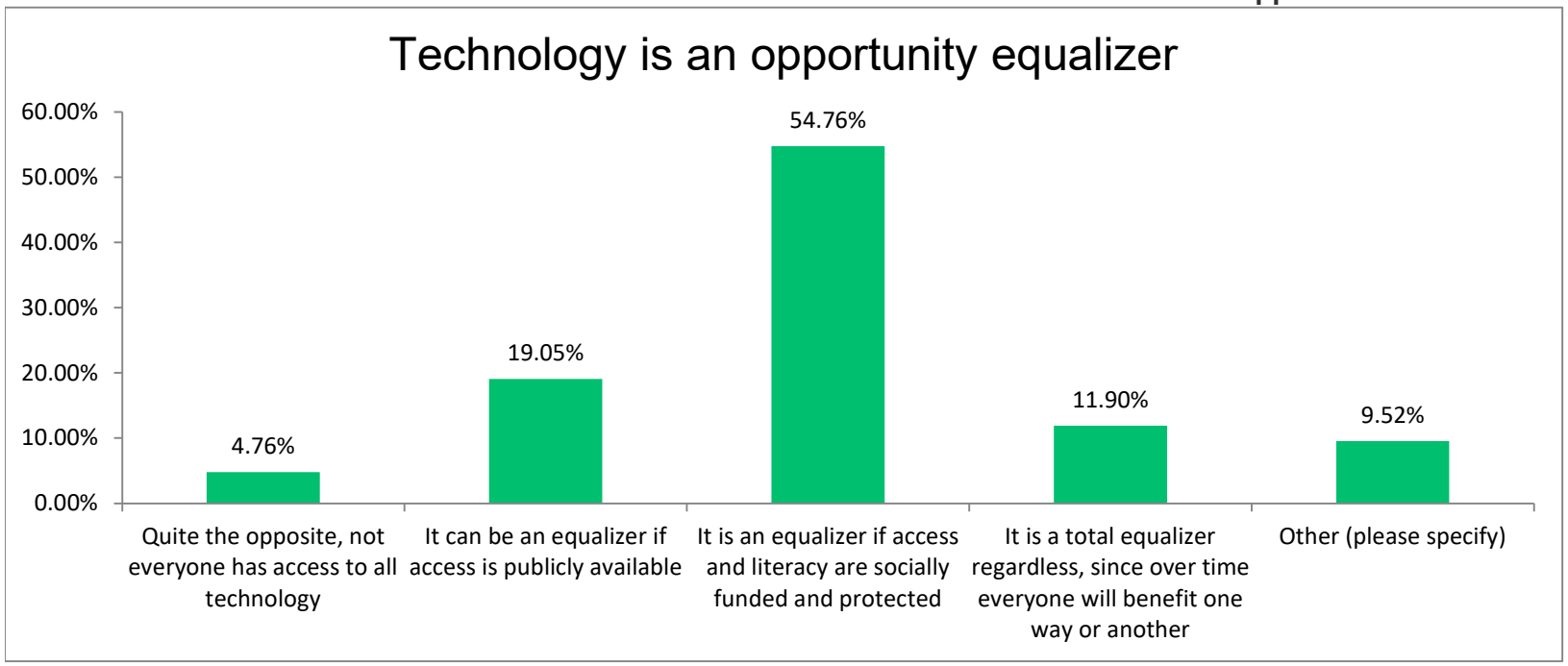
• //

- Random coverage of foundational skills -- we don't know which

Generative AI Impact on Computer Science Education *Today*

Technology is an opportunity equalizer

Answer Choices	Responses	
Quite the opposite, not everyone has access to all technology	4.76%	2
It can be an equalizer if access is publicly available	19.05%	8
It is an equalizer if access and literacy are socially funded and protected	54.76%	23
It is a total equalizer regardless, since over time everyone will benefit one way or another	11.90%	5
Other (please specify)	9.52%	4
	Answered	**42**
	Skipped	**1**



• Other (please specify)

• technology lets those who understand it manipulate those who don't

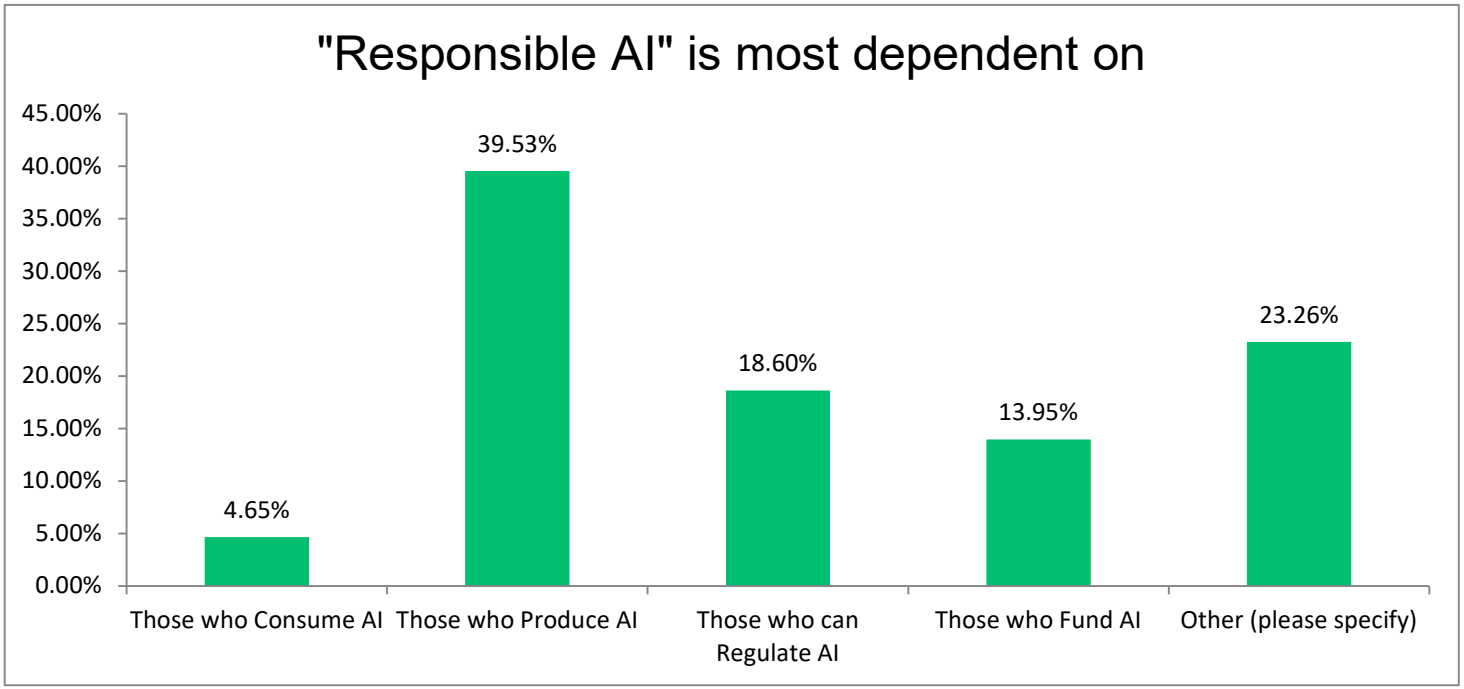
• //
• Equalize to the bottom

• Of publicly available, I don't think is a full equalizer, but it reduces the gap

Generative AI Impact on Computer Science Education *Today*

"Responsible AI" is most dependent on

Answer Choices	Responses	
Those who Consume AI	4.65%	2
Those who Produce AI	39.53%	17
Those who can Regulate AI	18.60%	8
Those who Fund AI	13.95%	6
Other (please specify)	23.26%	10
	Answered	**43**
	Skipped	**0**



• Other (please specify)

• All of the above.

• All of above

• //

• Those who resist and impede AI
• All of above

• All of the above have a part to play
• all the above
• All of the above.
• All of the above
• B and C

Generative AI Impact on Computer Science Education *Today*

Write one word that comes to mind after completing this survey

Answered	**31**
Skipped	**7**

Responses	Tags
ambiguity	
apt	
Behind the times	
Broad	
Change	
Complex	
Complexities	
Concerned	
Concerned	
Concerned.	
Dilemma	
doom	
Dynamic	
Dystopia	
Education	
Engaging	
equity	
evolve	
Evolve	
Excellent forward-looking questions regarding AI	
Hope	
Including this question, limiting. The problems are much more profound than the answer options available.	
Inflection	
lead	
LLM	
Misunderstood	
Opportunity	
Quality	
Reflective	
Sadness	
Scared	

Scary times
uncertainty
Unemployable