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I. GENERAL INTRODUCTION

This report explores the practical application of artificial intelligence (AI) tools in teaching and learning environments, analyzing their potential as well as their limitations.

The project was approached from two perspectives: that of a professor designing a lecture using AI, and that of a student learning a topic independently through AI-generated content. The central question driving this exploration was whether AI can meaningfully assist or replace (even partially) traditional educational roles involving the creation and delivery of educational content.

With a zero-budget constraint, a variety of freely available tools were tested, including ChatGPT, Chalkie.ai, and Narakeet.ai, each selected for its unique contribution to the learning pipeline.

The following sections report the methodologies adopted, the specific tools employed, and the challenges encountered along the way, offering a dual perspective on AI's educational utility from creation and delivery to autonomous learning support.

1. WORKING AS A PROFESSOR

1.1 Approach and Work Methodology (working as a professor)

The goal of this perspective was to explore and experiment with various AI tools in order to deliver an entire lecture, without direct human preparation of the material. The working methodology involved searching for and testing different AI platforms, gradually identifying those most effective for generating educational content. The objective was to understand the strengths and weaknesses of using AI to conduct a lecture, and how it compares to a traditional lecture delivered by a professor who personally prepares the material.

1.2 Strengths and Weaknesses of AI

Strengths

- Saves time for professors by automating tedious or repetitive tasks, allowing them to focus on more creative, inspiring, or intellectually demanding aspects of their work.
- **Scalability:** AI-generated content can be easily produced for a large number of courses and, in the context of a single course, for a large number of course topics by easily adding or removing new content if needed.

- **Accessibility:** AI is itself accessible to anyone; this means also to the teacher of a course. Moreover, it can also make the content it produces accessible, by tailoring material for students with special needs (e.g., creating colorblind-friendly slides) quickly and automatically.
- **Cost-effective:** Once a proper AI setup is in place, the cost of producing new lessons can be very low.
- **Availability:** AI tools can be accessed at any time of the day, any day of the week. Moreover, AI-based lectures can be accessed on-demand anytime, regardless of time zones or schedules.

Weaknesses

- AI struggles to teach "how to think" rather than just "what to think," potentially reducing the educational depth and critical thinking development of students.
- **One-way communication:** AI cannot easily see or hear students, making it harder to adapt dynamically, provide feedback, or engage in meaningful dialogue.
- **Lacks emotional connection:** It's a lot harder for students to be inspired and motivated by AI rather than a human instructor.
- **Transition challenges:** A shift toward AI-driven lectures will likely be met with resistance from some students and professors, and will be hard to implement quickly.
- **Credibility and validation:** AI cannot assess the validity of its own outputs—external human verification (e.g., by a professor) is essential.
- **Quality inconsistencies:** For example, AI-generated slides (e.g., with Chalkie.ai) may contain irrelevant or low-quality images, factual inaccuracies, or shallow explanations. In this sense, AI cannot be trusted, as it fails to reliably self-assess itself.
- **Voice narration limitations:** Synthetic narrators may sound robotic or choppy, struggle with natural pacing, and fail to adapt delivery to content difficulty or student mood. This results in narrators quite often speeding through a tough section of the program and slowing down on intuitive stuff, resulting in the students (potentially) suffering from two opposite issues simultaneously: failing to understand tougher topics being shown very quickly, and lacking engagement and interest due to easier and more redundant sections being shown with excessive slowness.
- **Time-saving paradox:** When the AI makes mistakes (e.g., wrong answers to exercises), the time spent correcting them can outweigh the time saved.
- **Fragmentation of tools:** No single AI tool (at least no free AI tool) currently does everything at a high-quality standard, and using multiple platforms means managing

numerous accounts, interfaces, and limitations. This represents an obstacle to making the process smooth and easy to carry out, potentially requiring an “AI-tools expert” to be involved in the content generation phase. Finally, this potentially causes an increase in the cost of a budget-funded approach since you are not allowed to simply pay for a complete tool but rather a fraction of what you need. On a final note for this aspect, we did find some potential candidates for the convenient “all-in-one tool” but were unable to try them due to this project being carried out starting from a zero-budget assumption.

- **Free versions are limited:** As already extensively mentioned, many tools are behind paywalls or only offer free trials, making a completely zero-budget approach impractical for long-term or large-scale use.

1.3 Human Contribution to the Material

While the AI tools were used to generate content (slides, narrations, exercises), human oversight was crucial:

- **Validation:** All AI outputs required manual checking and correction. For example: completely wrong answers to exercise questions to test student understanding, Alberto (me) had to correct them manually, which makes the whole "save time trusting AI" advantage less valuable since time had to be spent finding and correcting the mistakes. We think testing the understanding through questions is one of the most essential bricks to a solid learning process, so this can't be overlooked.
- **Adaptation:** Materials were adjusted for tone, depth, and context, all things AI tools often inherently missed if not meticulously instructed and guided.
- **Customization:** Professors need to tailor material based on the students' level, background, and real-time feedback, which AI cannot yet do effectively on its own.

Despite the initial promise of AI autonomy, the professor remains essential, especially as a "quality gate" to filter and refine AI-produced content.

1.4 Conclusions

Slides generated entirely by Chalkie.ai aren't perfectly correct and ready to be delivered to students of a course, not only in technical terms but also in terms of simple things that are not otherwise (i.e., in a full professor approach) seen as a problem since humans are easily able to manage these things. As an instance, images aren't always very fitting (or relevant at all).

That being said, it's important to highlight that it still serves as a starting point for a professor. What cannot be prevented should be possible to manage, but how is this the case?

Since it's not possible so far to prevent AI from misunderstanding some instructions and failing to stay within the intended scope of the material, it is thanks to the human contribution that it's possible to manage the unwanted aspects of the generated material.

Often, starting from scratch is the most time-consuming and tiring thing; starting from an AI-generated sort of "template" is much faster, even if some modifications will be applied. This doesn't mean it is always more efficient and smarter to proceed in this way, since it could be (and it is) possible that it could turn into a difficulty as the amount of modifications made can easily make it not worth it anymore.

Finally, there is clearly some sort of threshold that separates this approach from being worth it and revolutionary from this being just a daunting and cumbersome process.

As a final note for this perspective of the project, and as previously mentioned, it is important to remember how some excellent tools (like AutoPPT) were not used due to the zero-budget constraint, although they would have added significant value.

2. WORKING AS A STUDENT

2.1 Approach and Methodology (working as a student)

While the previous part approached the task from the role of a professor designing a lesson for students, another approach was taken from the perspective of the student itself, specifically someone with no prior knowledge or access to material attempting to prepare independently for an upcoming in-person class.

The guiding question for this approach was:

Can a complete and meaningful lesson be created starting only with the name of the topic?

To explore this, a workflow was developed using a combination of text-based artificial intelligence and AI-powered presentation tools. The process was intentionally conducted as if encountering the subject for the first time, without any existing understanding of key concepts or familiarity with how the topic might typically be structured in an academic setting.

The process involved several key steps:

1. **ChatGPT** was used to generate a detailed lesson plan based solely on the topic title. This included identifying essential subtopics and organizing them into a coherent structure suitable for a lesson.
2. With this outline, **Chalkie.ai** was used to automatically generate a PowerPoint presentation. It became clear that Chalkie requires a detailed and specific prompt to produce effective slides, so ChatGPT was again used to craft that prompt.

3. Once the presentation was created, ChatGPT was used to develop a voiceover script to accompany each slide, emulating a professor's explanation with examples and deeper insights.
4. This script was then added as speaker notes within the PowerPoint file using ChatGPT to avoid copying and pasting for each slide.
5. Finally, the completed presentation and speaker notes were uploaded to **Narakeet.ai**, which converted the materials into a fully narrated video lesson.

This workflow demonstrated that, starting with nothing more than a topic title, it is possible to generate a structured, informative, and engaging lesson using only AI tools, without requiring any prior knowledge of the subject matter.

2.2 Strengths and Weaknesses of AI in This Process

Strengths:

- **Speed:** AI can generate lesson materials in minutes, which significantly reduces preparation time.
- **Accessibility:** These tools are mostly free and easy to use.
- **Immediate feedback:** AI can instantly answer follow-up questions or regenerate content.
- **Consistency:** Once you find the right prompt, the output is reliable and structured.

Weaknesses:

- **Lack of contextual understanding:** AI often misinterprets topic titles. For instance, when prompted with "dynamic memory in computer architecture," both ChatGPT and Chalkie initially focused on dynamic memory allocation in programming, instead of DRAM as intended. This can lead to inaccurate lessons if the user doesn't know how to refine the prompts.
- **No awareness of course scope:** AI may include unrelated information or omit critical content emphasized in class. For example:

It didn't stress how DRAM refresh timing impacts performance.

It did not place sufficient emphasis on the need for external verification in the context

of soft errors.

- **Surface-level teaching:** AI provides information but lacks the ability to highlight key concepts, focus on common student difficulties, or adapt explanations based on student needs.
- **Visual limitations:** While AI-generated slides may look clean, they lack meaningful visual aids (like logic gate diagrams or memory architecture sketches) that professors often use to enhance understanding.

(This point will be addressed again in the section related to Gemini)

2.3 Human Contribution

Since the role assumed was that of a student with no prior knowledge, the material was not altered or improved in any way. The only active contribution involved crafting effective prompts to guide the AI. The content received was used as-is. In this particular case, no factual inaccuracies were found in the output, likely because the topic (e.g., dynamic memory, soft errors) was conceptually straightforward. However, in other parts of the course, particularly with more technical subjects like hardware implementation, the AI would probably struggle or provide incorrect details.

At times, the AI also added information that was not part of the actual lessons. While this additional content could be useful, it was not always necessary and could potentially be confusing or overwhelming for students if not properly contextualized.

A key aspect of this project was the use of **multiple artificial intelligence tools**, each with its own strengths and weaknesses. Each AI had a specific role it could perform most effectively. Just as in the development of an application, or any large-scale project, it is unrealistic to expect a single tool to handle every task. Instead, various specialized tools must be used together, each serving a distinct purpose.

This mirrors how complex systems are built: different software solutions are combined, each contributing to a part of the whole. In this context, the true role of the human is to understand how to use these tools effectively and to integrate their outputs into a cohesive final product. **The human acts as the coordinator**, connecting the pieces and ensuring that they work together toward a common goal.

2.4 Conclusions

From my experience, this method is feasible for creating an introductory lesson, especially when no other material is available. The AI-generated lesson was clear and informative, though impersonal and lacking the depth or teaching instinct of a real professor.

Creating a PowerPoint with a voiceover script made the content easier to follow, but ultimately, the AI just delivers information, it doesn't teach. It lacks warmth, the ability to instill a method of study, and the awareness of how certain concepts connect to future topics in the course.

Another challenge is that students don't know how deep to go into the topic, which means AI might overshoot or undershoot the level of detail needed.

A major limitation is that AI works on a topic-by-topic basis, so it lacks the holistic view of a course. It cannot prioritize content that might be foundational for future lessons.

In conclusion, this method can be a helpful support tool for students working independently, especially when no other resources are available. However, it should not replace human instruction. AI-generated lessons are best seen as a starting point; they provide structure and surface-level information, but still require the student's effort to process, verify, and internalize what's presented.

Used wisely and critically, these tools can save time and help students prepare. But without human guidance, either from professors or students with some prior knowledge, there's a risk of building misleading or shallow understanding.

3. GENERAL OVERVIEW

3.1 AI Tools Used and Their Suitability

Tools:

- **ChatGPT:** Used for generating lesson structures, writing prompts, and creating voiceover scripts.
- **Chalkie.ai:** Used to automatically create PowerPoint slides based on prompts.
- **Narakeet.ai:** Used to turn PowerPoints into narrated video lessons.

3.2 Differences Between AI and Human Professors

Aspect	AI Tools	Human Professors
Scalability	High, can generate countless lessons instantly	Limited to one class at a time
Availability	24/7	Limited by schedule and workload
Cost	Mostly free	High (salary, resources, facilities)
Time efficiency	Extremely fast	Preparation and delivery take time
Feasibility	Easy to implement	Requires long-term planning
Flexibility	Can adapt format instantly	Adapts explanations in real time based on students' reactions

Despite these strengths, **AI cannot replace the human aspect of teaching:**

- Professors understand the learning journey and emphasize key points.
- They provide context, intuitive examples, and reassurance.
- They can adapt on the fly if students are confused, something AI cannot detect or respond to

3.3 Gemini and visual aids

The lack of visual aids resulting from the workflow described in the previous section can likely be addressed by the newly released Gemini 2.5 Pro, which represents a significant breakthrough. This latest version excels at creating animations and even interactive applications from simple prompts, making it an ideal tool to support interactive learning and complement the gaps in the previous work.

Interactive tools have always been powerful for reinforcing students' understanding, as they help visualize theoretical concepts clearly and intuitively. Integrating such tools into everyday university teaching, especially by professors during lectures, could greatly enhance the educational experience.

To illustrate this potential, we provide a simple example related to the parity bit in computer architecture. Using the following prompt with Gemini:

“Can you make a simple and elegant animation on the use of a parity bit to transmit information and check for errors?”

The AI quickly generated an HTML-based interactive app demonstrating the concept. This app allows users to generate random bit strings, select either even or odd parity bits, decide whether to introduce errors in transmission, and simulate sending data to a receiver. The app then provides immediate feedback on whether an error occurred and even identifies which bit changed, helping users understand why the code is correct or incorrect.

The animation can be experienced here:

https://cristianditucci.github.io/paritybit_animation/

(Note: The page is vertically oriented; be sure to scroll down to explore the full app.)

The possibilities with this tool are endless. We can create numerous interactive apps tailored to specific cases that are otherwise hard to visualize or require deeper understanding, and we believe it's truly exciting.

4. Final Conclusion and Comment

4.1 Summary of Findings

This project dug into how practical free AI tools really are for teaching and learning. We looked at it from two sides: first, from the perspective of a professor trying to create a lecture using AI, and second, from the viewpoint of a student using AI to learn something new from scratch.

Looking at it from **a professor's angle**, AI tools like ChatGPT and Chalkie.ai definitely showed they could help get lecture materials started, acting like a useful "template." The upside was clear: speed for initial drafts, easy scalability, and tools being available anytime. That being said, some serious weaknesses popped up. AI just isn't good at teaching "how to think," and it misses that human touch and deep understanding a professor brings. We saw issues like factual mistakes, off-topic images, and clunky delivery, like robotic voiceovers. This sometimes led to a "time-saving paradox" – the time spent fixing AI mistakes could wipe out any time saved. So, it became obvious that a human professor is still vital as a "quality gate" to check and fix things. Working with a zero budget also meant dealing with free tools that were often limited and didn't always play well together, making it tough to create top-notch lessons without a lot of human effort.

Then, from **the perspective of a student** trying to learn independently, AI tools were pretty good for quickly getting a basic grasp of a new subject, especially if no other materials were handy. Just by giving AI a topic name, it could whip up a structured lesson with slides and a script. Speed and ease of use were definite pluses. However, the lessons AI created were often just scratching the surface. They missed the kind of context you'd get in an actual course, sometimes leaving out important details or adding stuff that wasn't really needed. The big takeaway here was that AI is more about "delivering information" than actually "teaching." It couldn't really pick out the most important ideas, explain tricky parts well, or help connect the dots like a human teacher can. And getting good visuals was a real challenge, though newer tools like Gemini show some promise there.

So, what's the bottom line from both experiences? It seems pretty clear that right now, free AI tools work best as helpers, not replacements. They need a human in charge to make

sense of it all. We found that there wasn't one single free AI tool that could do everything well from start to finish. Instead, it was like having a bunch of different tools that didn't always connect smoothly, meaning a human had to be the one to string it all together. While AI can certainly speed up some parts of creating and finding information, it just can't match a human teacher when it comes to deep understanding, critical thinking, adapting to students, or really knowing how to teach effectively. Or at least not yet.

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