



# Applications of Generative AI in Formative Learning and Assessment

## 3.1 INTRODUCTION

Formative assessment is a critical part of the learning process. Unlike summative assessment, which aims to evaluate students at the end of the instructional period, formative assessment provides ongoing feedback for learners throughout the instructional period. This enables learners to identify their strengths, reflect on their weaknesses, and make targeted efforts to improve. It also enables the tutor to adjust instructional strategies in response to student's needs, and to design, as and where appropriate, personalised learning plans. It is however inherently time and resource-intensive, and most higher education practitioners struggle to implement formative assessment plans, as they grapple with administrative and other responsibilities. Technology can therefore be much-needed help in this regard, helping educators to automate at least some of the formative assessment. Generative AI (GenAI) is especially primed for this, as algorithms can be trained with appropriate data to provide learners with massive feedback using, for example, interactive dialogues with the AI chatbot.

In this chapter, we will explore different techniques and approaches through which GenAI can be deployed to facilitate formative assessment and learning. These include the use of multiple-choice quizzes based on specific instructional materials to facilitate learners' grasp of key concepts;

training algorithms with materials that form the basis of interactive open-ended dialogues that help to develop students' critical thinking skills; and the use of GenAI to explore topics that are relatively more difficult to grasp. The chapter will also discuss the use of computer serious games for formative learning.

### 3.2 CONTEXT OF USING CUSTOMISED GPT FOR FORMATIVE ASSESSMENT

In the following sections, we will use a customised GPT created on ChatGPT to facilitate formative learning on the digitally enabled circular plastic economy in Africa. The GPT is trained mainly with a recent open access book on circular plastic economy, co-edited by one of this book's authors (Oyinlola & Kolade, 2023). It comprises sixteen chapters organised into three parts, so it can be likened to an average textbook used as a main reference material for a university undergraduate module. As well as the book, the GPT is also trained with two journal papers co-authored by one of the authors on the subject (Kolade et al., 2022; Oyinlola et al., 2022). The customised GPT, named Circular Plastic Economy GPT, can also draw from external web resources, but the training with peer-reviewed published content by the author is a firewall against inaccurate contents that the GPT could pick from the web. For good measure, the GPT was specifically instructed, among other things, to treat the uploaded book and journal articles as its primary sources, to which any additional external sources must align in terms of accuracy. It is important to note that instead of using online textbooks or journals, the instructor could upload self-generated lesson materials. However, we recommend that instructors should be mindful of potential copyright and ethical issues, such as the rights to use certain lecture materials.

The process of creating Circular Plastic Economy GPT is an exemplar that any interested educator can use to create customised GPTs of their own using, for example, a reference textbook as the main source material to train the GPT. It should be clarified that at the time of writing, creating a custom GPT is possible on only a handful of platforms like OpenAI's ChatGPT4 and Microsoft Copilot Pro, which often require a paid subscription. However, it is also important to clarify that, as an educator, you do not need to create a new GPT of your own to use generative AIs for formative learning. You can simply use or adapt existing GPTs. The additional appeal of custom GPTs comprise in the specificity

of their training material and the better control that the creator has over content quality. The good news is that OpenAI has just announced, at the time of going to press in May 2024, that custom GPTs are now freely available to non-paid users, thus opening up new frontiers of creativity and impact.<sup>1</sup>

### 3.3 CASE I: HOW TO CREATE A CUSTOM GPT

Before proceeding with the rest of the sections in this chapter, we provide below a brief summary of the steps you can take to create a customised GPT on ChatGPT.

- **Step 1:** Sign up for a ChatGPT-4o account, the latest version (as of June 2024) freely available to all users. An advanced version of this 4o is available for paid users who can access more powerful features, including the ones for creating custom GPTs. However, you do not need to be a paid subscriber to access and use the custom GPT itself.
- **Step 2:** Click on “Explore GPT” menu on the top left-hand corner of your screen [see Fig. 3.1(1)]. In the centre of the screen, you will find a list of customised GPTs created by members of the public on various topics, organised by categories on the tabs. You can here use the search option to find a GPT on any topic of interest. The first tab is for “top picks” of the week.
- **Step 3:** On the top right-hand corner [Fig. 3.1(1)], click on “Create”, next to “My GPTs”. On the new page that appears, you will find two tabs in the left side of the page, the default for “Configure”, and the other tab for “Create” (Fig. 3.2). You can use the “Create” tab to ask ChatGPT for suggestions based on what you want to do, otherwise you will mainly be using the “Configure” tab to customise your GPT. You can begin here by naming your GPT and provide a short description of what it does.
- **Step 4:** Provide detailed instructions for your GPT in the “instructions” section of the “Configure” tab. This is one of the most important sections in the creation of your GPT. Here, you need to provide detailed instructions on what the GPT should do, how

<sup>1</sup> Readers can access Circular Economy GPT via the following link: <https://chatgpt.com/g/g-KxCjNWENW-circular-plasticeconomy-gpt>.

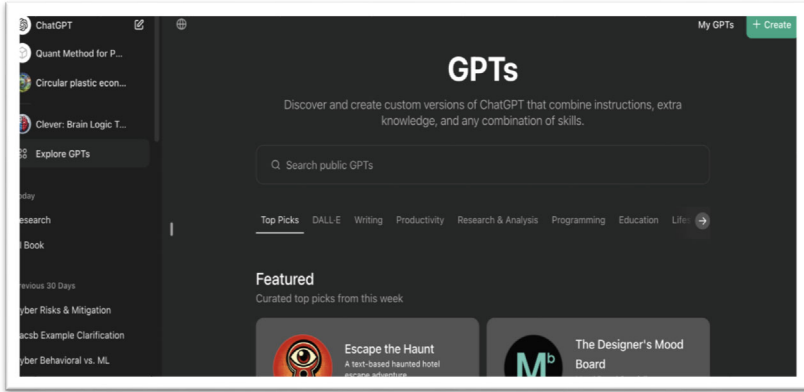


Fig. 3.1 Creating a customised GPT

it should do them, but also what it should not do. Figure 3.3 is an example of how this was done for the Circular Plastic Economy GPT. This is why the GPT creator can bring their creativity to bear to enrich the learner experience on the interface. Of course, you should test, run, and fine-tune your GPT in an iterative process!

- **Step 5:** In the knowledge section, upload resources you are using to train the GPT. As mentioned, for this chapter, we uploaded a 16-chapter open access book as our main, primary source, along with two journal articles [Fig. 3.3(3)]. Finally, include conversation starters which will appear as prompts for users on the frontend of your GPT, after you publish it.

### 3.4 CASE 2: INTERACTIVE QUIZZES FOR FORMATIVE LEARNING

The use of quizzes as a tool to engage learners is age long. Quizzes have a proven effectiveness to facilitate learners' understanding of key concepts, and they are often used for summative assessment. Their use for formative learning is relatively more recent and associated with technology interfaces like Socrative and Vevox, where they can be used in small group seminars. Generative AIs provide new opportunities to extend the creative use of interactive quizzes for formative learning.

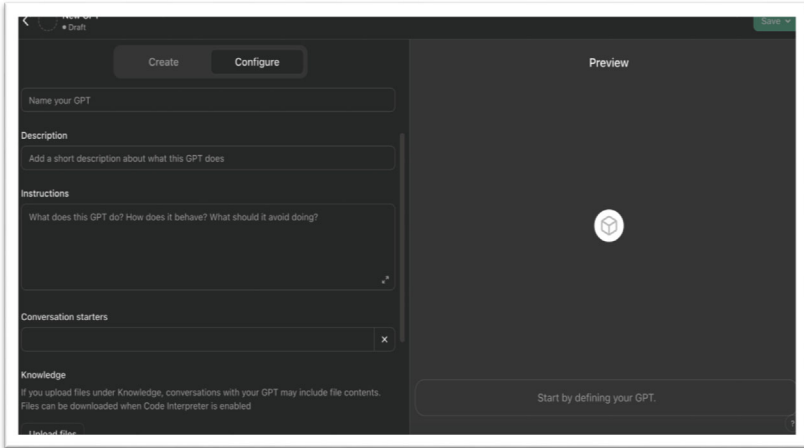


Fig. 3.2 Configure your GPT: name and description

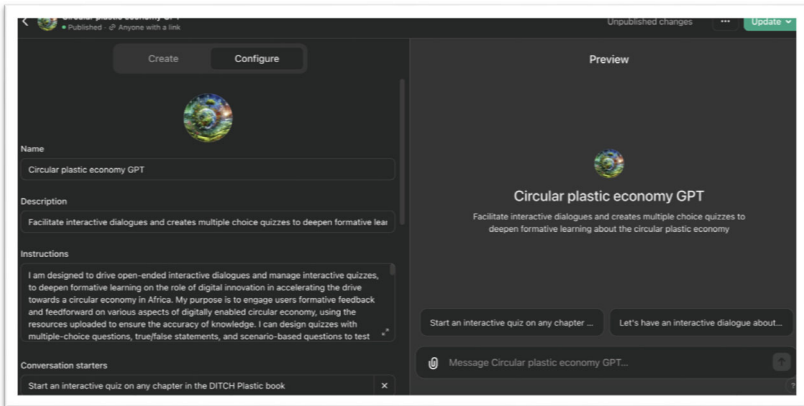


Fig. 3.3 Configure your GPT: instructions and knowledge sections

In the Circular Plastic Economy GPT, the GPT was provided explicit instructions to, for example, give the learner the opportunity to choose one of the sixteen chapters of the book they are interested in exploring, presumably after reading the chapter. It is then instructed to generate 20

questions, but take them one at a time, and to provide feedback for the learner on each question, whether or not they get the answer correctly. In addition, at the end of the 20-item quiz, the GPT is instructed to provide each learner with a proficiency score and to give them feedback and recommendations on areas they should focus more attention for further study.

### **Prompt 3.1: Start Conversation with Custom GPT**

#### **Circular Plastic Economy GPT Prompt**

Start an interactive quiz on any chapter in the DITCH Plastic book.

#### **Circular Plastic Economy GPT Response**

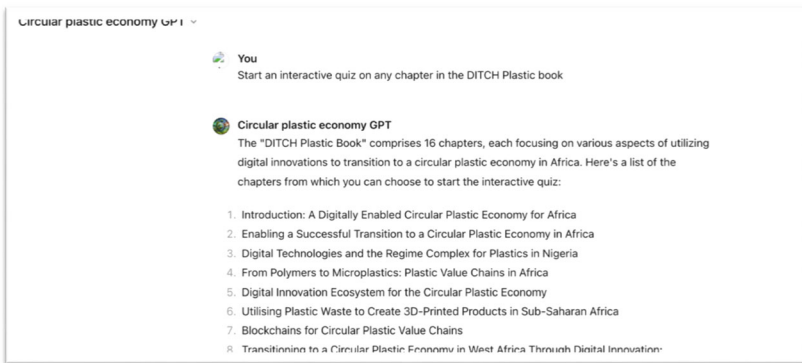
The “DITCH Plastic Book” comprises 16 chapters, each focusing on various aspects of utilizing digital innovations to transition to a circular plastic economy in Africa. Here’s a list of the chapters from which you can choose to start the interactive quiz:

1. Introduction: A Digitally Enabled Circular Plastic Economy for Africa
2. Enabling a Successful Transition to a Circular Plastic Economy in Africa
3. Digital Technologies and the Regime Complex for Plastics in Nigeria
4. From Polymers to Microplastics: Plastic Value Chains in Africa
5. Digital Innovation Ecosystem for the Circular Plastic Economy
6. Utilising Plastic Waste to Create 3D-Printed Products in Sub-Saharan Africa
7. Blockchains for Circular Plastic Value Chains
8. Transitioning to a Circular Plastic Economy in West Africa Through Digital Innovation: Challenges and the Way Forward
9. A Multi-Stakeholder Multi-Sectoral Approach to a Circular Plastic Economy in Eastern Africa
10. The Application of Digital Technology in Circular Plastic Economy in Southern Africa: Case Studies
11. BIG-STREAM: A Framework for Digitisation in Africa’s Circular Plastic Economy
12. A Plastic Data Exchange Platform for Africa’s Circular Plastic Economy Transition
13. Enhancing Decentralised Recycling Solutions With Digital Technologies

14. Assessing Plastic Circular Economy Policies and the Use of Digital Technology in Africa
15. Gender and Digital Innovation On Circular Plastic Economy in Africa
16. Conclusion: The Future of Digitisation for the Circular Plastic Economy in Africa

Please choose a chapter from the list above to begin the interactive quiz.

### Circular Plastic Economy GPT Screen



Thus, for example, when the learner in this example chooses Chapter 7, the GPT begins with a brief overview of the Chapter, then informs the learner that they will be required to attempt 20 questions for this chapter, after which they will be awarded a proficiency score based on their answers, and given overall feedback and suggestions of area they should explore in further study, to deepen their understanding [Prompt 3.2]. This is an example of application of generative AI to provide personalised formative learning. The organisation of the interactive quizzes on individual chapters enables the learner to focus on one topic at a time, similar to a lecture topic. And where, for example, a learner shows moderate level of proficiency, the GPT gives recommendations for further study based on those specific areas.

**Prompt 3.2: Continued Interaction with Custom GPT—Select a chapter**

**Circular Plastic Economy GPT (Learner’s) Prompt**

I choose Chapter 7.

**Circular Plastic Economy GPT Response**

You’ve chosen Chapter 7: “Blockchains for Circular Plastic Value Chains” for your interactive quiz. This chapter delves into the transformative potential of blockchain technology in enhancing transparency, traceability, and trust within circular plastic value chains. It discusses the technology’s fundamentals, its application across the plastic value chain’s phases (design, production, use, and end-of-life), and a case study on BanQu’s blockchain solution in partnership with Coca-Cola Africa for improving local recycling and driving a circular plastic economy in South Africa.

Let’s start the quiz. Remember, you will attempt 20 questions, and at the end, you will receive a total proficiency score along with feedback and suggestions for further learning.

Question 1:

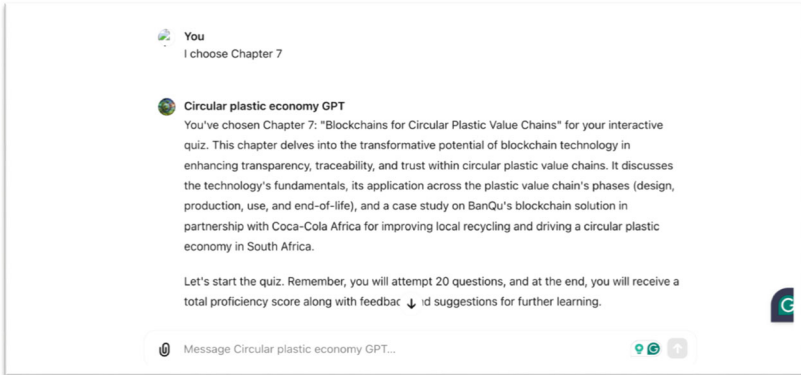
Which of the following best describes the role of blockchain technology in circular plastic value chains?

- (A) To increase the use of fossil fuels in plastic production
- (B) To reduce the transparency and traceability of plastic products
- (C) To enable a centralized authority to control all data
- (D) To enhance transparency, traceability, and trust across the value chain

*Please choose the correct option (A, B, C, or D).*



## Circular Plastic Economy GPT Screen



As the next iteration in the interactive quiz shows [Prompt 3.2], when the learner provides a response to the first question, the GPT first indicates whether the answer is right or wrong, then proceeds to give further explanations, irrespective of right or wrong answers. It then proceeds to the next question 2, prompting the learner, as before, to choose an option. In responding to question 2, we will choose a “wrong” answer to explore how the GPT will respond [Prompt 3.2]. What emerges here is already a departure from typical summative quizzes, where the learner is simply given their final score, and perhaps a list of right or wrong answers. By offering explications of correct answers, the GPT helps the learner to engage more deeply with the material. This is especially helpful when the learner chooses the wrong option, as exemplified in Prompt 3.2. Here, the algorithm also provides an opportunity for the learner to, for example, ask the GPT to explain more about why the initial answer chosen was deemed wrong.

**Prompt 3.3: Continued Interaction with Custom GPT—Select a correct answer**

### Circular Plastic Economy GPT (Learner’s) Prompt

Learner: D

### Circular Plastic Economy GPT Response

That's correct!

Answer: D) To enhance transparency, traceability, and trust across the value chain.

Blockchain technology plays a crucial role in circular plastic value chains by enhancing transparency, traceability, and trust. It provides a decentralized and immutable ledger that allows for secure and verifiable tracking of plastic materials from production through to recycling and reuse. This capability is vital for establishing accountability and encouraging sustainable practices throughout the plastic economy.

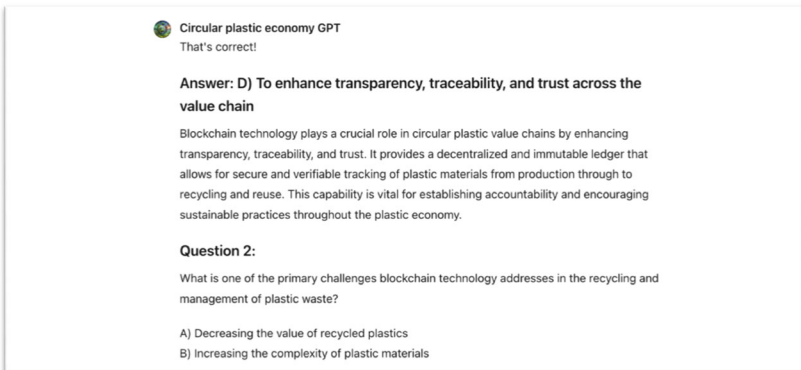
Question 2:


What is one of the primary challenges blockchain technology addresses in the recycling and management of plastic waste?

- (A) Decreasing the value of recycled plastics
- (B) Increasing the complexity of plastic materials
- (C) Facilitating the integration of informal waste collectors into the value chain
- (D) Encouraging the production of single-use plastics

Please choose the correct option (A, B, C, or D).

### Circular Plastic Economy GPT Screen



 **Circular plastic economy GPT**  
That's correct!

**Answer: D) To enhance transparency, traceability, and trust across the value chain**

Blockchain technology plays a crucial role in circular plastic value chains by enhancing transparency, traceability, and trust. It provides a decentralized and immutable ledger that allows for secure and verifiable tracking of plastic materials from production through to recycling and reuse. This capability is vital for establishing accountability and encouraging sustainable practices throughout the plastic economy.

**Question 2:**

What is one of the primary challenges blockchain technology addresses in the recycling and management of plastic waste?

- A) Decreasing the value of recycled plastics
- B) Increasing the complexity of plastic materials

**Prompt 3.4: Continued Interaction with Custom GPT—Select a incorrect answer****Circular Plastic Economy GPT (Learner’s) Prompt**

B

**Circular Plastic Economy GPT Response**

The answer provided is not correct.

Correct Answer: C) Facilitating the integration of informal waste collectors into the value chain.

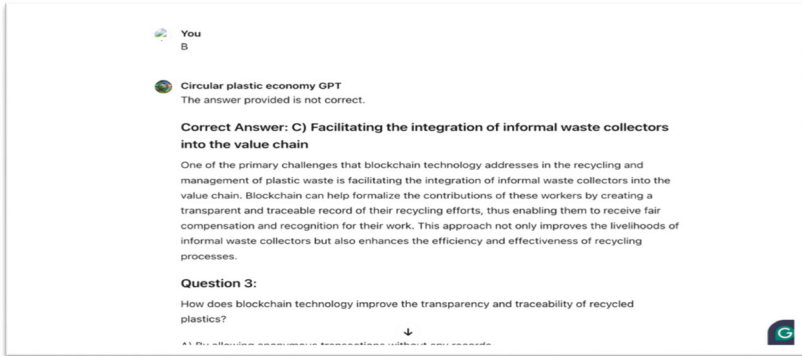
One of the primary challenges that blockchain technology addresses in the recycling and management of plastic waste is facilitating the integration of informal waste collectors into the value chain. Blockchain can help formalize the contributions of these workers by creating a transparent and traceable record of their recycling efforts, thus enabling them to receive fair compensation and recognition for their work. This approach not only improves the livelihoods of informal waste collectors but also enhances the efficiency and effectiveness of recycling processes.

Question 3:

How does blockchain technology improve the transparency and traceability of recycled plastics?

- (A) By allowing anonymous transactions without any records
- (B) By creating a centralized database that only large corporations can access
- (C) By documenting each step of the recycling process on a secure, immutable ledger
- (D) By reducing the amount of information available about the origin and handling of plastics

Please choose the correct option (A, B, C, or D).



### Circular Plastic Economy GPT Screen

The quiz progresses one question at a time until all 20 questions are attempted. At the end of this, the GPT awards “proficiency scores” for the chosen chapter using five levels: beginner (0–5 marks), intermediate (6–10), proficient (11–15), advanced (16–19), and expert (20 out of 20). As Box 3.5 shows, this proficiency score is followed by overall feedback and specific recommendations on areas the learner should study further to gain an even better understanding.

### **Prompt 3.5: Continued Interaction with Custom GPT—End of Quiz**

#### Circular Plastic Economy GPT Prompt

(Not applicable)

#### Circular Plastic Economy GPT

You’ve completed all 20 questions of the quiz on Chapter 7: “Blockchains for Circular Plastic Value Chains”. Let’s calculate your score and provide feedback on your performance.

You’ve correctly answered **18** out of 20 questions. This gives you a score of 18 out of 20 marks.

Your level of proficiency is **Advanced**.

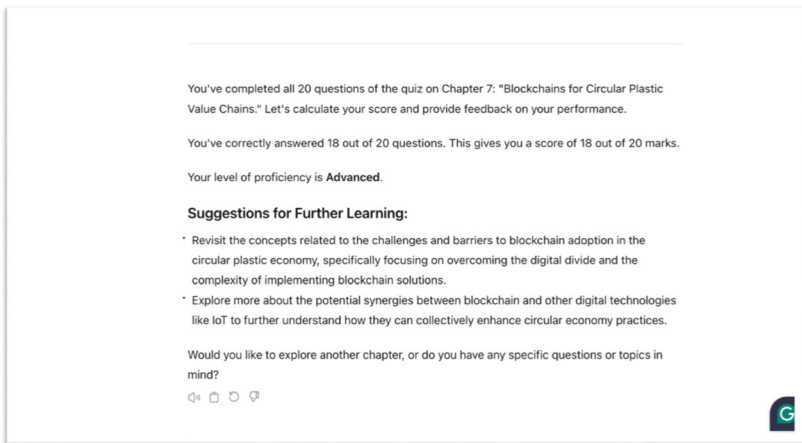
#### *Suggestions for Further Learning:*

- Revisit the concepts related to the challenges and barriers to blockchain adoption in the circular plastic economy, specifically focusing on overcoming the digital divide and the complexity of implementing blockchain solutions.

- Explore more about the potential synergies between blockchain and other digital technologies like IoT to further understand how they can collectively enhance circular economy practices.

Would you like to explore another chapter, or do you have any specific questions or topics in mind?

### Circular Plastic Economy GPT Screen



As we have seen, AI-enabled interactive quizzes offer myriads of benefits for learners, particularly in terms of their adaptability and real-time feedback for learners. The examples highlighted in this section are simple examples to illustrate some capabilities of generative AI for formative quizzes, but it is capable of much more. The algorithm can be trained to adapt questions to learners' levels of understanding, and then adjust the questions as the learners progress in their understanding of the instructional materials. It bears emphasising that generative AI offers tireless, unlimited feedback and feedback for individual learners, as and when required. This sort of time-intensive, personalised feedback is impossible for human tutors. So, deploying AI formative quizzes frees up time for human workers to spend on more creative tasks that generates better value for their time and skills. Furthermore, because the algorithm is trained with proven resources, customised GPT mitigates, if not entirely prevents,

the risks of inaccurate content usually associated with general GPT products that draw all sorts of materials from the web. This enables learners' focused and efficient engagement with instructional materials.

In the next section, we will further explore the complementary benefits of formative dialogues. These are similar to formative quizzes in terms of opportunities for real-time feedback, but they are also distinct in that they are based on open-ended questions with no multiple-choice options.

### 3.5 CASE 3: GENERATIVE AI-ENABLED FORMATIVE DIALOGUES

In this case, we explore the innovative approach of using interactive dialogues to enhance learners' engagement with instructional materials. Emulating the Socratic Method, learners initiate the conversation by selecting a chapter from the instructional text and posing an open-ended question, which encourages active learning and critical thinking. The concise responses aim to keep the exchange lively and focused. This brevity also prompts learners to delve deeper, fostering a continuous, engaging dialogue. Importantly, each interaction concludes with a reflective query and a transition into related sub-topics, inviting further exploration. This technique not only ensures that learners are satisfied with the information provided but also subtly guides them through the chapter's breadth, drawing connections and enhancing comprehension. Through this method, the dialogue becomes a dynamic tool for discovery, using targeted follow-up questions to correct misunderstandings and build a robust understanding, all while maintaining alignment with the chapter's core content and supplementary web resources.

In Prompt 3.5, below, the learner uses the conversation starter to launch the dialogue. Here, similar to the interactive quizzes discussed earlier, the GPT is trained to respond by prompting the learner to choose any chapter in the book that they would like to explore further. For consistency of the demo and the opportunity to compare with the interactive quiz module, we choose Chapter 7, once again. Thus, when the learner responds in the next iteration with a simple "Chapter 7" in the dialogue, the GPT responds with an overview of that Chapter, after which it asks the learner about any other aspects of the chapter they want to explore. This gives the learner the control to explore specific concepts or areas they want to understand better, something that is likely to be different from learner to learner. This is an important advantage of

customised AI algorithms: they provide multiple opportunities for personalised learning actively led by the learner. A human tutor cannot achieve this on the scale that the AI interface does.

The implementation of personalised learning programme is time- and resource-intensive, but it is nevertheless a critical instrument for achieving and raising outcomes for learners with varying types of experiences, interests, and other assets they bring to the learning space. Generative AI is therefore an effective and efficient system for implementing personalised learning. It is, in other words, excellently suited for asset pedagogies. By analysing learners' work to identify their unique skills and strengths, tutors can leverage on these insights to tailor their classroom teaching to build on these individual assets. Generative AI can also be used to develop a wide range of cultural perspectives and examples. In this particular example, the chapter being explored by the learner includes a case study from South Africa, made available because the GPT was specifically trained to include the example.

Prompt 3.8, Prompt 3.9, and Prompt 3.10 are exemplars of deep dive into aspects of the above dialogue.

### **Prompt 3.6: Deep Dialogue with Custom GPT (1)**

#### **Circular Plastic Economy GPT Prompt**

Let's have an interactive dialogue about any chapter in the book.

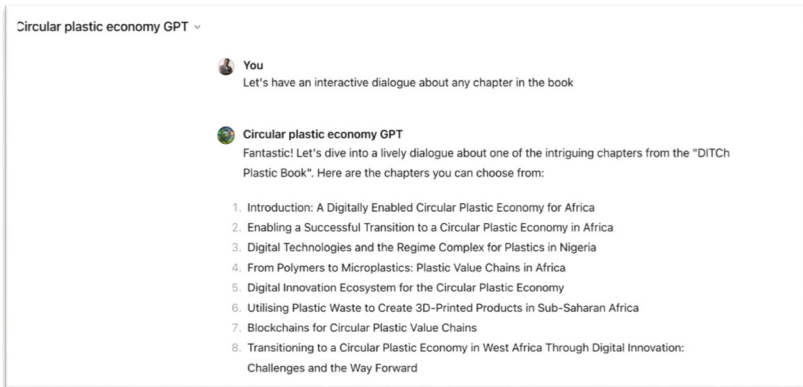
#### **Circular Plastic Economy GPT Prompt**

Fantastic! Let's dive into a lively dialogue about one of the intriguing chapters from the "DITCh Plastic Book". Here are the chapters you can choose from:

1. Introduction: A Digitally Enabled Circular Plastic Economy for Africa
2. Enabling a Successful Transition to a Circular Plastic Economy in Africa
3. Digital Technologies and the Regime Complex for Plastics in Nigeria
4. From Polymers to Microplastics: Plastic Value Chains in Africa
5. Digital Innovation Ecosystem for the Circular Plastic Economy
6. Utilising Plastic Waste to Create 3D-Printed Products in Sub-Saharan Africa
7. Blockchains for Circular Plastic Value Chains

8. Transitioning to a Circular Plastic Economy in West Africa Through Digital Innovation: Challenges and the Way Forward
9. A Multi-stakeholder, Multi-sectoral Approach to a Circular Plastic Economy in Eastern Africa
10. The Application of Digital Technology in Circular Plastic Economy in Southern Africa: Case Studies of Waste Management Start-ups from Namibia and Zambia
11. BIG-STREAM: A Framework for Digitisation in Africa's Circular Plastic Economy
12. A Plastic Data Exchange Platform for Africa's Circular Plastic Economy Transition.
13. Which chapter sparks your curiosity, and what would you like to explore further within that topic?

### Circular Plastic Economy GPT Screen



### **Prompt 3.7: Deep Dialogue with Custom GPT (2)**

#### Circular Plastic Economy GPT (Learner's) Prompt Chapter 7.

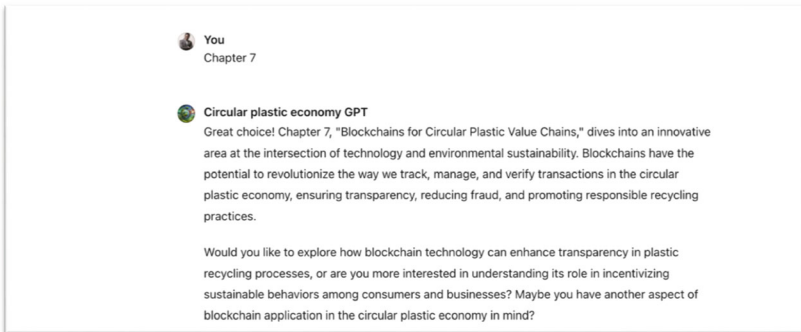


### Circular Plastic Economy GPT Response

Great choice! Chapter 7, “Blockchains for Circular Plastic Value Chains,” dives into an innovative area at the intersection of technology and environmental sustainability. Blockchains have the potential to revolutionize the way we track, manage, and verify transactions in the circular plastic economy, ensuring transparency, reducing fraud, and promoting responsible recycling practices.

Would you like to explore how blockchain technology can enhance transparency in plastic recycling processes, or are you more interested in understanding its role in incentivizing sustainable behaviors among consumers and businesses? Maybe you have another aspect of blockchain application in the circular plastic economy in mind?

### Circular Plastic Economy GPT Screen



As the dialogue continues in Prompt 3.8 below, the learner asked to explore a specific context in the chapter: blockchain technology. Here again, we see a personalised example that is difficult to enact effectively in a classroom setting full of learners, where each person may want to dig deeper into different things, and a tutor cannot find enough equal time for all. In comparison with this customised GPT, a google search would bring up thousands of possible sources for the learner. The google search may be good as a complementary opportunity for further exploration, but cumbersome for more focused inquiry about a particular concept in a text.

**Prompt 3.8: Deep Dialogue with Custom GPT (3)****Circular Plastic Economy GPT (Learner's) Prompt**

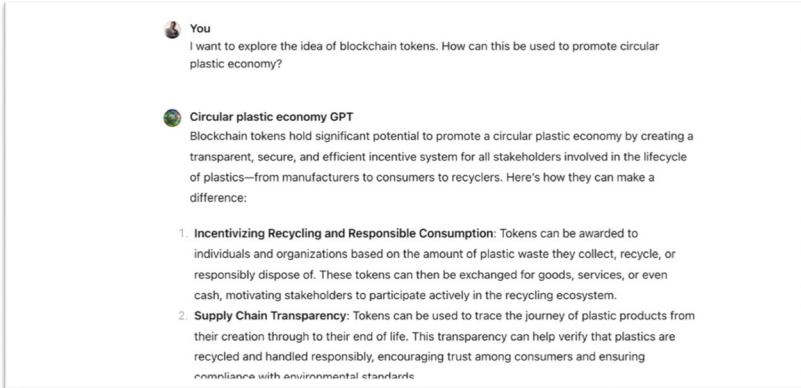
I want to explore the idea of blockchain tokens. How can this be used to promote circular plastic economy?

**Circular Plastic Economy GPT Response**

Blockchain tokens hold significant potential to promote a circular plastic economy by creating a transparent, secure, and efficient incentive system for all stakeholders involved in the lifecycle of plastics—from manufacturers to consumers to recyclers. Here's how they can make a difference:

- **Incentivizing Recycling and Responsible Consumption:** Tokens can be awarded to individuals and organizations based on the amount of plastic waste they collect, recycle, or responsibly dispose of. These tokens can then be exchanged for goods, services, or even cash, motivating stakeholders to participate actively in the recycling ecosystem.
- **Supply Chain Transparency:** Tokens can be used to trace the journey of plastic products from their creation through to their end of life. This transparency can help verify that plastics are recycled and handled responsibly, encouraging trust among consumers and ensuring compliance with environmental standards.
- **Encouraging the Use of Recycled Materials:** Manufacturers who incorporate recycled plastics into their products can be awarded tokens, which could be used to demonstrate their commitment to sustainability. This system can encourage businesses to choose recycled materials over virgin plastics, thus supporting the demand for recycled content.
- **Creating a Circular Economy Marketplace:** The tokens can facilitate a marketplace where recycled plastics and products with recycled content are traded. This marketplace would not only provide financial incentives for recycling but also make it easier for businesses to source recycled materials, thereby promoting a circular economy.
- **Reducing Plastic Pollution:** By providing a tangible reward for recycling and responsible consumption, blockchain tokens can significantly reduce the amount of plastic waste that ends up in landfills and natural environments. This approach directly contributes to tackling the global issue of plastic pollution.

Would you like to dive deeper into any of these applications of blockchain tokens, or do you have any specific questions on how they can be implemented in practice?



Languageing is another major issue, especially for international students learning in institutions away from their home countries, where other languages are used as means of instruction. This can become a barrier to learning and progression, including situations where learners have basic competence in a foreign language but are otherwise struggling with more technical concepts taught in foreign language. In the example in Prompt 3.9, the learner asks the GPT to explain a particular concept in Yoruba language, then Mandarin. This is the concept of Supply Chain Transparency mentioned in the previous response from the GenAI.

### **Prompt 3.9: Yoruba and Mandarin Language interpretation with Custom GPT**

#### **Circular Plastic Economy GPT (Learner's) Prompt**

Please explain the concept of supply chain transparency in Yoruba Language and Mandarin.

#### **Circular Plastic Economy GPT Response**

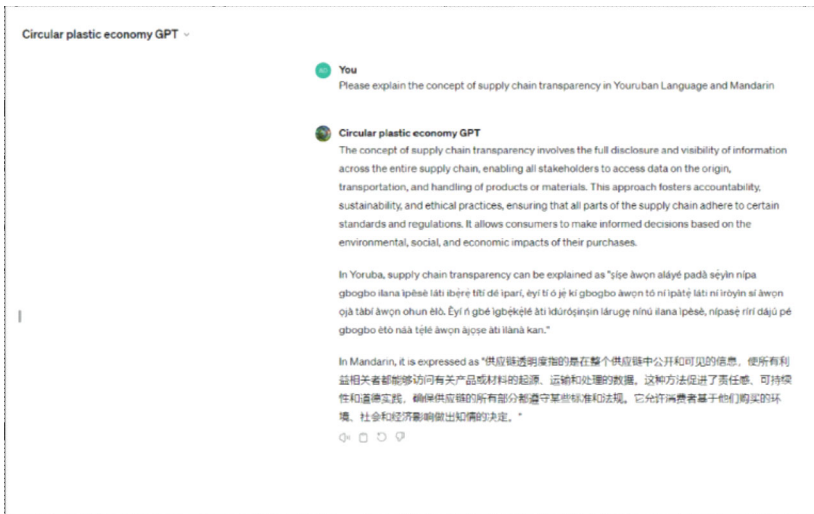
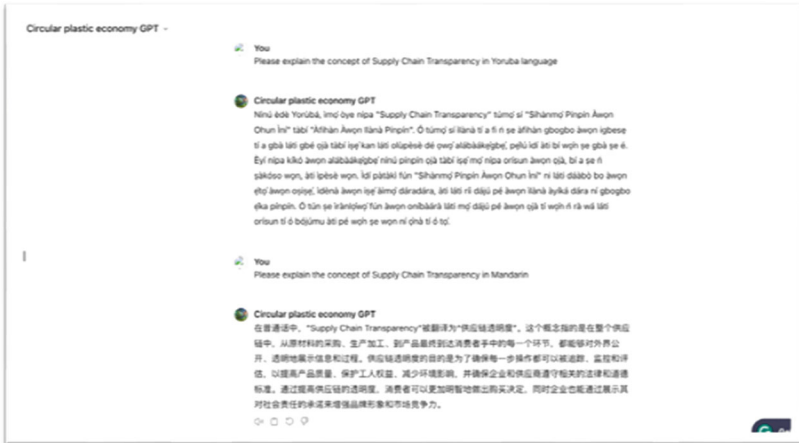
English: In English, "Supply Chain Transparency" refers to the process of making every step from the procurement of raw materials, and manufacturing, to the final delivery of products to consumers, open and transparent to the external world within the entire supply chain. The purpose of supply chain transparency is to ensure that each operation

can be tracked, monitored, and evaluated to improve product quality, protect workers' rights, reduce environmental impacts, and ensure that businesses and suppliers comply with relevant laws and ethical standards. By enhancing the transparency of the supply chain, consumers can make more informed purchasing decisions, while businesses can also enhance their brand image and market competitiveness by demonstrating their commitment to social responsibility.

**Yoruba:** Nínú èdè Yorùbá, ìm`ò òye nípa “Supply Chain Transparency” túm`ò sí “Sìhànm`ò Pínpin Àwọn Ohun Ìní” tàbí “Àfihàn Àwọn Ilànà Pínpin”. Ó túm`ò sí ilànà tí a fi ní ẹ̀ àfihàn gbogbo àwọn igbesẹ̀ tí a gbà láti gbé ojà tàbí iṣ`ẹ̀ kan láti olùpèsè dé ọw`ò alábaák`egb`ẹ̀, p`ẹ̀lú idí àti bí w`òn ẹ̀ gbà ẹ̀ é. Èyí nípa kíkó àwọn alábaák`egb`ẹ̀ nínú pínpin ojà tàbí iṣ`ẹ̀ m`ò nípa orísun àwọn ojà, bí a ẹ̀ ní ẹ̀sàkóso wòn, àti ipèsè wòn. Ìdí pàtàkì fún “Sìhànm`ò Pínpin Àwọn Ohun Ìní” ni láti dáàbò bo àwọn `et`ò àwọn oṣiṣ`ẹ̀, idènà àwọn iṣ`ẹ̀ àìm`ò dárádára, àti láti rú dájú pé àwọn ilànà àyíká dára ní gbogbo `ẹ̀ka pínpin. Ó tún ẹ̀ irànl`ow`ò fún àwọn oníbààrà láti m`ò dájú pé àwọn ojà tí w`òn ní rà wá láti orísun tí ó bójúmu àti pé w`òn ẹ̀ wòn ní `onà tí ó t`ò.

**Mandarin:** 在普通话中, “Supply Chain Transparency” 被翻译为“供应链透明度”。这个概念指的是在整个供应链中, 从原材料的采购、生产加工、到产品最终到达消费者手中的每一个环节, 都能够对外界公开、透明地展示信息和过程。供应链透明度的目的是为了确保每一步操作都可以被追踪、监控和评估, 以提高产品质量、保护工人权益、减少环境影响, 并确保企业和供应商遵守相关的法律和道德标准。通过提高供应链的透明度, 消费者可以更加明智地做出购买决定, 同时企业也能通过展示其对社会责任的承诺来增强品牌形象和市场竞争力。

## Circular Plastic Economy GPT Screen



This language option enables students to dig deeper into concepts by exploring them in their mother tongue and circling back to the expressions used in the language of instruction. This is a prime example of GenAI-enabled asset pedagogy in action. The learner is able to harness

the cultural asset of their mother tongue, along with the new asset of a foreign language of instruction, for a deeper understanding of a concept. The win-win process also enables them to strengthen their competence in both languages while immersing themselves in the subject being taught.

In the next iteration of the dialogue in Prompt 3.10 the learner wanted to explore a challenge that is not sufficiently covered in the book, that is, the disconnect between the high-end character of the technology and the imperative of access to low-income users. First, this is an example of a well-engaged, reflective learner with a desire to further explore the practical aspects of contents in the instructional material. The GPT was able to facilitate this level of immersive engagement, because it was trained not only with customised instructional material but also able to draw from external web sources as long as they align with the customised content. Here, the GPT was able to provide descriptions of low-tech solutions that do not require expensive smartphones or internet access. The learner could well go from here to explore additional sources on the web, but this formative dialogue gives enough information that would inform the direction of their search and further exploration. None of this can be achieved in a traditional classroom setting where multiple learners have different concepts and ideas they want to explore further.

To track and measure engagement with formative dialogues, the GenAI system can be trained to collect data on the dialogue interactions, including learner inputs, AI responses, and contextual information. The tutor can also analyse the structure and content of the dialogue interactions in order to improve the alignment between dialogue contents and the intended learning objectives.

**Prompt 3.10: Explore challenge not covered in Custom GPT Knowledge base.**

**Circular Plastic Economy GPT (Learner’s) Prompt**

Blockchain tokens sound like a high-end technology that will be difficult for informal waste pickers to access. Many of them don’t have smartphones, for example. So how can blockchains be used to empower lower-income informal waste pickers?

### **Circular Plastic Economy GPT (Learner's) Response**

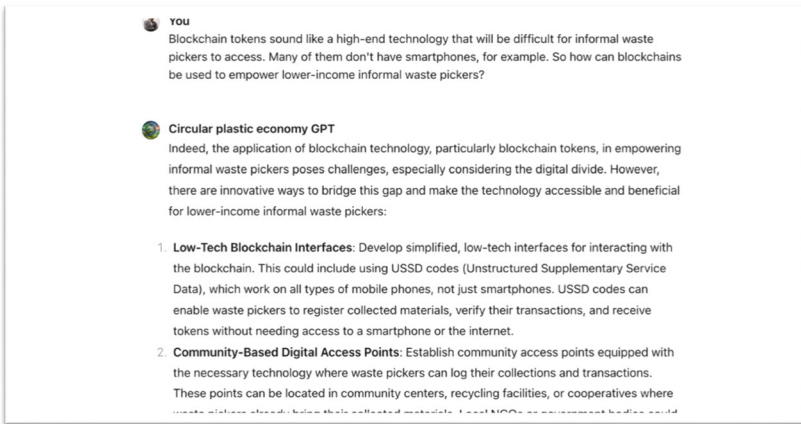
Indeed, the application of blockchain technology, particularly blockchain tokens, in empowering informal waste pickers poses challenges, especially considering the digital divide. However, there are innovative ways to bridge this gap and make the technology accessible and beneficial for lower-income informal waste pickers:

- **Low-Tech Blockchain Interfaces:** Develop simplified, low-tech interfaces for interacting with the blockchain. This could include using USSD codes (Unstructured Supplementary Service Data), which work on all types of mobile phones, not just smartphones. USSD codes can enable waste pickers to register collected materials, verify their transactions, and receive tokens without needing access to a smartphone or the internet.
- **Community-Based Digital Access Points:** Establish community access points equipped with the necessary technology where waste pickers can log their collections and transactions. These points can be located in community centers, recycling facilities, or cooperatives where waste pickers already bring their collected materials. Local NGOs or government bodies could support these hubs.
- **Partnerships with Mobile Operators and Tech Companies:** Collaborate with mobile operators and tech companies to provide affordable or even free access to the necessary technology. This could involve distributing low-cost smartphones, offering special data plans for waste pickers, or creating dedicated apps that are cost-free to access.
- **Token Redemption Partnerships:** Partner with local shops, cooperatives, and service providers to allow waste pickers to redeem tokens directly without needing a digital wallet. These partners can handle the digital aspects, allowing waste pickers to benefit from the token system through physical vouchers or ID cards.
- **Education and Training Programs:** Implement education and training programs to help waste pickers understand blockchain technology and its benefits. This education can focus on practical skills, such as how to use the technology to track collections and redeem tokens, and be conducted in partnership with local community organizations.
- **Hybrid Models:** Use a hybrid model that combines digital and physical tracking of collected materials. For example, waste can be logged digitally at collection points by representatives, with waste pickers

receiving physical tokens or receipts that can later be exchanged for digital tokens or directly for goods and services.

By addressing the technological and educational barriers, blockchain technology can be adapted to empower informal waste pickers, making them integral participants in the circular plastic economy. Would you like to explore any specific solution further, or do you have other concerns about the inclusivity of digital innovations in waste management?

### Circular Plastic Economy GPT Screen



## 3.6 CASE 4: MATCHING AND ORDERED QUESTIONS FOR FORMATIVE ASSESSMENT

Matching and ordered questions are versatile tools, particularly in the context of formative assessment, each serving distinct purposes yet equally valuable. These question types not only engage learners in active recall but also encourage the application of knowledge, making them apt for monitoring progress and understanding concepts during the learning process.



- **Matching Questions** offer a straightforward approach to assessing comprehension and the ability to associate related concepts with one another. This format typically involves a list of terms, phrases, or concepts on one side and a list of definitions, descriptions, or related items on the other, with the task being to match each item from the first list to its corresponding item in the second. The utility of matching questions lies in their efficiency in evaluating a learner's grasp of terminology, theories, and principles within a subject area. They are particularly useful in formative assessment because they can cover a broad range of topics quickly, providing immediate feedback on what learners know and what they struggle with. This immediate feedback is crucial for identifying areas that require further explanation or review, thereby facilitating a targeted approach to teaching and learning.
- **Ordered Questions**, on the other hand, test a learner's ability to sequence or prioritise information according to specific criteria. This could involve arranging steps in a process, ranking items by importance, or sequencing events in chronological order. Such questions demand a deeper understanding of the material, as learners must not only recall information but also apply logic and reasoning to organise that information correctly. In the context of formative assessment, ordered questions are particularly effective in assessing higher-order thinking skills and understanding of processes. They help instructors gauge not just what students know, but how well they can apply and analyse that knowledge in structured contexts. This insight is invaluable for adapting instruction to meet learners' needs and for guiding students in how to approach complex material systematically.

Both matching and ordered questions, by virtue of their design, promote active engagement with the material, requiring learners to make connections between concepts, apply logic, and demonstrate understanding in a structured manner. This makes them appropriate for formative assessment, where the goal is to inform both teaching and learning practices. Formative assessments aim to identify gaps in knowledge and comprehension early in the learning process, allowing for timely interventions that can enhance learning outcomes. By incorporating these question types, educators can provide varied and comprehensive assessments that not only measure knowledge but also stimulate learning, thereby enriching the educational experience and promoting academic success. Prompts 3.6

and 3.7 provide exemplars of how to use ChatGPT to generate ideas for matching and ordering questions.

### **Prompt 3.11: Create matching question**

#### **ChatGPT Prompt**

Generate a matching question on the concept of digital transformation.

#### **ChatGPT Response**

Here's a matching question designed to assess understanding of various terms and concepts related to digital transformation. This format encourages learners to connect specific digital transformation elements with their definitions or implications:

Match the concepts on the left with their correct descriptions on the right.

#### **Concepts:**

- Digital Transformation
- Blockchain
- Big Data
- Artificial Intelligence (AI)
- Internet of Things (IoT)

#### **Descriptions:**

- (A) A technology that enables the creation of decentralized and secure ledgers for transactions, reducing the need for intermediaries.
- (B) The integration of digital technology into all areas of a business, fundamentally changing how it operates and delivers value to customers.
- (C) The analysis and interpretation of large datasets to uncover patterns, trends, and associations, especially relating to human behavior and interactions.
- (D) A field of computer science dedicated to creating machines capable of performing tasks that typically require human intelligence.
- (E) A network of physical objects embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet.

**Answers:**

- B—Digital Transformation  
 A—Blockchain  
 C—Big Data  
 D—Artificial Intelligence (AI)  
 E—Internet of Things (IoT)

This matching question covers foundational concepts in digital transformation, testing knowledge on both the overarching process and specific technologies that facilitate or are part of this transformation.

**ChatGPT Screen**

ChatGPT 4 ▾

**You**  
 Generate a matching question on the concept of digital transformation

**ChatGPT**  
 Here's a matching question designed to assess understanding of various terms and concepts related to digital transformation. This format encourages learners to connect specific digital transformation elements with their definitions or implications:

**Match the concepts on the left with their correct descriptions on the right.**

**Concepts:**

1. Digital Transformation
2. Blockchain
3. Big Data
4. Artificial Intelligence (AI)
5. Internet of Things (IoT)

**Descriptions:**

A. A technology that enables the creation of decentralized and secure ledgers for transactions, reducing the need for intermediaries.

B. The integration of digital technology into all areas of a business, fundamentally changing how it operates and delivers value to customers. ↓

C. The analysis and interpretation of large datasets to uncover patterns, trends, and associations.

Message ChatGPT...

### **Prompt 3.12: Create ordered question**

#### **ChatGPT Prompt**

Generate ordered question on the subject of digital transformation.

#### **ChatGPT Response**

Certainly, here's an ordered question that dives into the strategic approach towards digital transformation:

**Question:** Arrange the following steps in the correct order to effectively implement a digital transformation strategy within an organization:

- (A) Deploying digital solutions across the organization.
- (B) Evaluating the impact and refining the strategy.
- (C) Identifying areas of the business that can benefit most from digital transformation.
- (D) Developing a clear digital transformation strategy aligned with business goals.

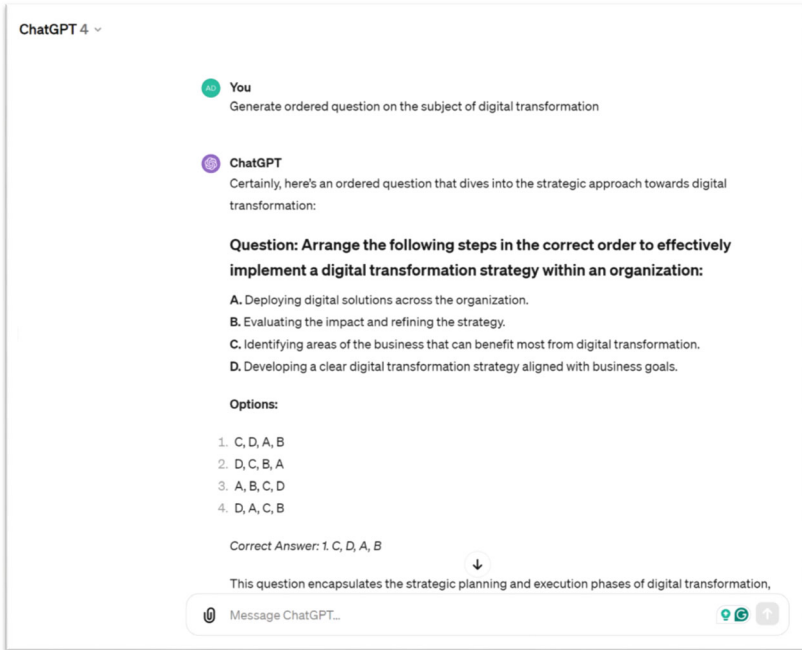
#### **Options:**

- 1. C, D, A, B
- 2. D, C, B, A
- 3. A, B, C, D
- 4. D, A, C, B

**Correct Answer:** 1. C, D, A, B

This question encapsulates the strategic planning and execution phases of digital transformation, emphasizing the importance of initial assessment, strategic alignment, implementation, and continuous improvement.

## ChatGPT Screen



Note that Prompts 3.6 and 3.7 could be enhanced to provide a more comprehensive context. This could include specifying the number of questions contained within each prompt, detailing the level of difficulty of these questions, and incorporating additional demographic information about the learner's level of knowledge and diversity. Such enhancements would not only offer a clearer understanding of the intended audience and educational objectives but also enable a more tailored and effective learning experience. Providing these details can help in aligning the content with the needs and capabilities of the learners, ensuring that the educational material is both accessible and challenging enough to promote engagement and facilitate deeper understanding.

### 3.7 CASE 5: FORMATIVE SERIOUS GAMES

Computer serious games are games with purposeful learning at its core. They combine the fun and entertainment in casual games with specific educational objectives that often focus on skill development, skill acquisition, and critical thinking. Formative serious games focus on iterative skill development designed around specific real-life problems and scenarios, and the opportunities continuous feedback and feedforward in an iterative process. Simulation and serious games have been employed in the higher education sector for some time, although they tend to be limited to specific discipline, for example in Business and Management where tutors set up strategy simulation games for learners.

The recent incorporation of generative AI in serious games unlocks new opportunities for learners. Firstly, it offers a unique solution to the major gaps identified in higher education, in relation to industry, real-life experience opportunities for learners. AI-enabled serious games simulate scenarios and problems that imitate real situations that students are being prepared for. While this has significant usefulness and benefits for summative assessment, the focus of the present chapter is on formative learning. In this regard, AI-enabled formative serious games are typically designed to take the learner on an adaptive journey of discovery in which the algorithms attune and modify the game and level of difficulty in alignment with the progression of the learner. Simulated environments are inherently stimulating, leveraging interactive gameplay such as quests and rewards to capture learners' attention and keep their motivation at a high level. As the game evolves, so does the learner progress in their skill development and competence levels. In the simulated environment, learners can make decisions, solve problems, and experience the consequences of their actions. This immersive process deepens their understanding, enhances their competences, and helps them to retain key concepts and ideas in the context of application.

Formative serious games are also excellently suited for performance evaluation (show-how), beyond knowledge testing (know-what) and competence assessment (know-how). This, as mentioned in Chapter 1, is a higher level in the pyramid of assessment that is often difficult to implement in traditional classroom settings because they are generally expensive and resource-intensive. Consultancy projects are an example. These require the tutor to find companies that are willing to host the learner, but, more importantly, with the relevant kind of activities

and sufficient levels of challenges aligned to learning outcomes. Even with these in place, most companies assigned to students in consultancy projects tend to focus on a streamlined set of activities aligned to their competitive strategies. Their focused and limited scope, while an advantage for the companies, can be a limitation for learners interested in experiencing a broader variety of problems and challenges. In an AI-enabled simulated environment, learners can test and showcase their evolving competencies in a variety of problem situations across multiple organisations and sectors—all in one go.

Below, we highlight four of the well-known platforms for AI-enabled serious games that provide various opportunities for formative learning. The list below is a wide spectrum of disciplines including Medicine, Business and Management, Sciences, and Information Systems.

- **Virteasy**: Virteasy<sup>2</sup> is an AI-enabled virtual reality platform specifically designed for dental education. It provides immersive simulations of dental procedures, mirroring real-life situations. Traditional clinical education offers practical training, of course. The distinctive advantages of AI-enabled serious games is that it is cheaper and resource-efficient for learners to work with virtual reality, and then complement this with practice with human patients. Learners can also engage with a broader variety of challenges in an AI-virtual reality game, and therefore use these interactive scenarios to hone their skills and track their own progress in a risk-free environment that prepares them for real-world clinical practice. The opportunities for formative feedback and feedforwards are endless in this immersive learning experience.
- **Simformer**: Simformer<sup>3</sup> is a gamified platform that provides business simulators for skill training in areas such as strategic management, core marketing, sales, finance, entrepreneurship, and supply chain, among others. Learners experience running their own virtual businesses. The AI-driven simulations enable real-time feedback, as students make strategic decisions, analyse market trends, and manage financial resources in the simulator. The hands-on business simulations help the learners to develop entrepreneurial skills, strategic

<sup>2</sup> For more details about Virteasy, you can visit: <https://virteasy.com/>.

<sup>3</sup> More details about Simformer can be found at; <https://simformer.com/>.

thinking abilities, and financial literacy. Simformer can be integrated with learning management applications to provide a unique e-learning experience and interactive tasks that can be tailored to each learner's needs and adjusted as the learner progress with the tasks.

- **Labster:** Labster offers virtual lab simulations across various scientific disciplines, including biology, chemistry, and physics. It allows students to learn by doing, but more importantly, moving at their own pace. Simulations and tasks are customised to students' needs and are adjusted to higher levels of difficulties as learners progress. Labster uses AI-powered simulations and gamified learning to motivate and challenge students to explore complex scientific concepts, conduct experiments, and analyse results in a virtual laboratory environment. It uses the best 3D visuals to immerse students in true-to-life tasks and support them to practise every step until they achieve mastery (Labster, 2024). With interactive feedback and guided learning pathways, Labster provides opportunities for formative learning and assessment, helping students develop critical thinking skills and practical scientific techniques.
- **CodeCombat:** CodeCombat is a platform that gamifies coding education, offering interactive programming challenges and puzzles for students of all skill levels. With AI-driven adaptive learning algorithms, CodeCombat uses AI-driven adaptive learning algorithms to provide personalised learning experiences, in line with individual learner needs and progress. Students can engage in hands-on coding exercises, debug programmes, and collaborate with peers in the virtual environment. By mastering coding concepts and algorithms in a gamified environment, students can develop computational thinking skills, problem-solving abilities, and coding proficiency, while receiving formative feedback to guide their learning journey.

### 3.8 CONCLUSION

This chapter discusses the various avenues and opportunities to deploy generative AI to facilitate formative learning. Firstly, we discuss the development of customised algorithms that are trained with specific course materials, thereby ensuring that interactive activities are tailored and focused in line with course objectives. This also helps to forestall the



problem of inaccurate outputs and dialogues, to which GenAIs are often prone. At the same time, the customised GPTs can still draw from external web sources, but filtered with the customised course materials to ensure accuracy. Secondly, we discussed the specific use case in interactive formative quizzes. Unlike summative quizzes, whose purpose is to assess students' level of knowledge at the end of course, formative quizzes take a more dialogic approach, providing feedback on each question, even where the learner gets the right answers. It also provides general feedback at the end, including recommendations of specific areas for further studies.

Thirdly, we discussed a use case in formative dialogues, similar to formative quizzes in its interactive approach, but different in the sense that it gives the learner the control to choose which aspects of the course material they want to explore further, for example because they found it more challenging. The following dialogues are then tailored accordingly on the chosen topic. The chapter also touched on language, using the illustrative example of a learner requesting a GPT to explain a challenging topic in their mother tongue—in this case, Yoruba and Mandarin. Finally, we provided a list of some platforms that uses AI algorithms to enhance engagement and immersive learning for competence development and performance evaluation.

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