

USING GENERATIVE ARTIFICIAL INTELLIGENCE TO DESIGN A COLLEGE ENVIRONMENTAL SCIENCE COURSE

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ABSTRACT

It has only been one year since an easy-to-use, widely available generative artificial intelligence (GenAI) service has been available. Open AI Chat Generative Pre-trained Transformer (ChatGPT) is a large language model (LLM)-based chatbot that was launched in late November 2022. ChatGPT uses natural language processing to create human-like conversational dialogue. The language model can respond to questions and compose various written content, including articles, social media posts, essays, code, and emails. This paper intends to use ChatGPT (and a similar GenAI service, Anthropic Claude for comparison) to design a college environmental science course using a foundational backward design model (Wiggins & McTighe, 2005). Backward design typically includes three major steps, Results (learning outcomes), Evidence (assessment), and Experience (teaching methods, curriculum). The goal of this paper is to determine how effective GenAI could be at designing a course. The steps that were taken include using GenAI to create a concept outline from the course title; then using the outline to create active, conceptual learning outcomes (LOs); and then creating authentic assessments with analytical rubrics. All of this information would be entered into a GenAI platform to create a course schedule, slide outlines, and syllabus.

Keywords: Generative Artificial Intelligence (GenAI), Course Design, Andragogy, Learning Outcomes, Authentic Assessment

INTRODUCTION

As of the writing on this manuscript, it has only been one year since generative artificial intelligence (GenAI) has been offered in a user-friendly mainstream mode through OpenAI ChatGPT (Al-Shawwa, et al., 2023; Hill et al., 2023). ChatGPT is a language model developed by OpenAI based on the GPT-3.5 architecture (Wade et al., 2022). The acronym stands for "Generative Pre-trained Transformer," and it is part of the GPT series, known for its ability to understand and generate human-like text. Here are some key aspects of ChatGPT and what it can do:

- **Natural Language Understanding:** ChatGPT is proficient in understanding and generating human-like text in natural language. It can comprehend and respond to a wide range of queries and prompts.
- **Conversational AI:** One of its primary applications is in conversational AI. Users can engage in open-ended conversations, asking questions, and seeking information.
- **Task Execution:** ChatGPT can perform various tasks based on the input provided. This includes answering questions, writing creative content, and offering explanations to support human information processing (Atkinson & Shiffrin, 1971).
- **Text Completion:** It is skilled at completing text prompts, making it useful for a variety of creative writing tasks, content generation, and programming assistance.
- **Language Translation:** ChatGPT can be used for basic language translation by providing text in one language and receiving a generated translation.
- **Educational Support:** ChatGPT can provide explanations, answer factual questions, and help users understand various concepts across a wide range of topics (Hadi, et al., 2023; Bates, et al., 2020; Enkelejda, et al., 2023).

Keep in mind that ChatGPT is a tool designed to assist and generate human-like text, but it's not infallible, and its responses should be critically evaluated. OpenAI continues to refine and improve its models, and future versions may address some of the current limitations.

In this paper, I will use the OpenAI ChatGPT free version (GPT) to design an Environmental Science course that I have taught previously. The following steps are a derivative of the three-step backward design (Results/LOs; Evidence/Assessment and Experience/Teaching Methods) that were taken to create a meaningful learning experience efficiently:

1. Course Title to Topic Outline
2. Outline to Learning Outcomes (LO)
 - a. Note: Concepts are foundational elements in the process of learning, and they play a crucial role in shaping LOs. Once conceptual frameworks are created for a course, the instructor will most likely create sub-LOs for each concept and/or day/week.
 - b. In an educational context, a concept refers to an abstract idea that represents a category of objects, events, or experiences. Concepts are fundamental to the process of learning and are used to organize, understand, and categorize information. They serve as mental constructs that help individuals make sense of the world and provide a framework for acquiring and processing new knowledge.
3. LOs to Authentic Assessment, Measurement and Evaluation (AME)
 - a. Authentic assessment is an approach to measuring and evaluating knowledge, skills, and abilities that closely mirrors real-world applications. The goal is to assess a student's ability to apply what they have learned in a context that is relevant to their professional life.
4. AME to Analytical Rubrics
 - a. Analytical rubrics are assessment tools that break down a task's measurement into specific performance criteria. They provide a detailed and systematic way to assess skills.

AND/OR Assessment to Multiple Choice (MC) Test with Item Analysis

5. Steps 1-4 used to Schedule (integrating active teaching methods)
 - a. Active teaching methods can include several approaches such as Inquiry-based, Collaborative, Competency, Project-based, or Experiential (Gao & Hargis, 2010; Minnes, 2017; Iwamoto, et al., 2016). In addition, we can consider sequencing (inductive/deductive), pacing, and interleaving (Rodriguez & Koubek, 2019). Common examples of active learning strategies include One Minute Paper, Think-Pair-Share, Muddiest Point, Concept Maps, Storyboarding, and Role Play (Angelo & Cross, 1993; Davis, 1993).
6. Steps 1-4 to create Slide Outlines
7. Steps 1-6 to create a Course Syllabus

To initiate course design using GenAI, in its simplest form, we can start by inputting the course title. In my case, the title is Environment Connections: Water, Waste, and Wellness. **The first step** is to create a Topic Outline from the Course Title. To accomplish this, I created the following prompt:

- "Create an outline of major topics for the college course Titled Environment Connections: Water (chemistry and treatment), Waste (water and solid), and Wellness (connect water and waste to nutrition)."

GPT Response (OpenAI, 2023):

- I. Introduction to Environmental Connections: Water, Waste, and Wellness
 - A. Definition of Interconnectedness
 - B. Importance of Understanding Chemistry and Treatment of Water
 - C. Role of Waste Management in Water and Solid Waste
 - D. Linking Water, Waste, and Wellness through Nutrition
- II. Chemistry and Treatment of Water
 - A. Chemical Composition of Water
 - B. Water Quality Parameters
 - C. Sources of Water Pollution
 - D. Water Treatment Processes
 - E. Case Studies on Successful Water Treatment Initiatives
- III. Waste Management: Water and Solid Waste
 - A. Liquid Waste Management: Wastewater Treatment

- a. Overview of Wastewater
 - b. Treatment Technologies
 - c. Reuse and Recycling of Treated Water
 - B. Solid Waste Management
 - a. Types of Solid Waste
 - b. Landfills and Recycling
 - c. Hazardous Waste Handling
- IV. Interconnection of Water and Wellness through Nutrition
 - A. Importance of Clean Water for Nutrition
 - B. Waterborne Diseases and Nutrition Impact
 - C. Nutrient Content in Water Sources
 - D. Integrating Water Quality into Dietary Guidelines
 - E. Public Health Initiatives Addressing Water-Related Nutrition Issues
- V. Connecting Waste Management to Wellness
 - A. Impact of Poor Waste Management on Water Quality
 - B. Solid Waste and Public Health
 - C. Food Waste and Nutrition
 - D. Circular Economy and Sustainable Nutrition
 - E. Wellness Programs Integrating Waste Reduction Practices
- VI. Advanced Topics in Water Chemistry
 - A. Emerging Contaminants in Water
 - B. Advanced Water Treatment Technologies
 - C. Sustainable Chemistry in Water Treatment
 - D. Implications of Climate Change on Water Chemistry
- VII. Technological Solutions for Waste Management
 - A. Innovations in Liquid Waste Treatment
 - B. Smart Technologies for Solid Waste Monitoring
 - C. Waste-to-Energy Technologies
 - D. Robotics and Automation in Waste Management
- VIII. Environmental Wellness and Lifestyle Choices
 - A. Sustainable Living Practices
 - B. Impact of Consumer Choices on Water and Waste
 - C. Eco-friendly Nutrition: Farm-to-Table Concepts
 - D. Integrating Environmental Responsibility into Wellness Routines
- IX. Case Studies and Practical Applications
 - A. Real-world Examples of Successful Water Treatment Projects
 - B. Waste Management Programs in Different Communities
 - C. Wellness Initiatives Addressing Water and Waste Connections
 - D. Student Projects Integrating Chemistry, Waste Management, and Wellness
- X. Future Directions and Challenges
 - A. Emerging Trends in Water Chemistry
 - B. Challenges in Sustainable Waste Management
 - C. Nutrition, Water, and Waste in the Face of Climate Change
 - D. The Role of Education in Shaping Future Environmental Stewardship

[note: as a quality control comparison, I entered the same prompt into OpenAI ChatGPT and Anthropic Claude GenAI.]

Claude Response (Anthropic Claude, 2023):

- I. Water Chemistry and Treatment
 - A. Water contamination
 - 1. Biological, chemical, physical
 - 2. Point source vs nonpoint source
 - B. Water treatment
 - 1. Filtration, disinfection, softening
 - 2. Wastewater treatment steps
 - C. Water quality testing and policy
 - 1. Drinking water standards and testing
 - 2. Regulatory bodies and policy
- II. Waste - Water and Solid

- A. Wastewater
 - 1. Sewage composition and impacts
 - 2. Emerging contaminants (pharmaceuticals, microplastics etc.)
- B. Solid waste - non-hazardous
 - 1. Municipal solid waste (plastics, paper, organics)
 - 2. Life cycle, recycling, composting
- C. Hazardous waste
 - 1. Industrial waste (chemicals, nuclear etc.)
 - 2. Treatment, storage, and disposal
- III. Wellness - Connections to Water, Waste, and Nutrition
 - A. Food safety
 - 1. Agricultural water use and contamination
 - 2. Effects of soil contamination
 - B. Diet and health
 - 1. Bioaccumulation up the food chain
 - 2. Heavy metals, microplastics, and emerging concerns
 - C. Food waste
 - 1. Upstream and downstream impacts
 - 2. Prevention, recovery, recycling
 - D. Sustainability
 - 1. Local food production, urban gardening
 - 2. Reducing waste in the food system
 - E. Policy and reform
 - 1. Subsidies, incentives, guidelines
 - 2. Public awareness and pressure

For the Second Step, I connected the Topic Outline to Course Learning Outcomes (LOs). To accomplish this, I entered the prompt:

- “Create six learning outcomes (LOs) with the course outline topics using the SMART model: Specific, concise, well-defined statements of what students will be able to know, do, or value; Measurable, how students attend to clear, previously developed attributes of quality. Start with a Bloom’s Taxonomy action verb that can be directly observed; Attainable, students have sufficient prerequisite knowledge and skills (pre-assessment); Relevant skills or knowledge described are appropriate and meaningful; and is there Time for students to demonstrate the skill: By the end of our course, students will be able to:”

GPT Response:

By the end of the course, students will be able to

1. analyze the chemical composition of water using appropriate testing methods, ensuring an accurate assessment of water quality (SMART Criteria: Specific - Analysis of chemical composition, Measurable - through testing methods, Attainable - assuming a basic understanding of chemistry, Relevant - to water quality assessment, Time - by the end of the course).
2. design a comprehensive waste management plan incorporating both liquid (wastewater) and solid waste, demonstrating an understanding of sustainable waste practices (SMART Criteria: Specific - Designing a waste management plan, Measurable - comprehensive approach, Attainable - with prerequisite knowledge of waste types, Relevant - to sustainable practices, Time - by the end of the course).
3. correlate the impact of water quality on public health, linking specific waterborne diseases to their nutritional implications (SMART Criteria: Specific - Correlating water quality and health, Measurable - through disease-nutrition linkages, Attainable - with basic knowledge of waterborne diseases, Relevant - to public health, Time - by the end of the course).
4. assess the environmental impact of different waste management strategies, evaluating their effectiveness in reducing pollution and promoting community wellness (SMART Criteria: Specific - Assessing environmental impact, Measurable - through effectiveness evaluation, Attainable - with knowledge of environmental impact factors, Relevant - to community wellness, Time - by the end of the course).
5. integrate principles of sustainable living into personal wellness routines, emphasizing the connection between nutrition, lifestyle choices, and environmental responsibility (SMART Criteria: Specific - Integrating sustainable principles, Measurable - through personal wellness

routines, Attainable - with an understanding of sustainable practices, Relevant - to personal and environmental well-being, Time - by the end of the course).

6. propose innovative solutions to emerging challenges in water chemistry and waste management, applying knowledge of advanced technologies and considering future environmental trends (SMART Criteria: Specific - Proposing innovative solutions, Measurable - through application of advanced technologies, Attainable - with a solid understanding of course content, Relevant - to future challenges, Time - by the end of the course).

Claude Response:

By the end of this course, students will be able to:

1. Evaluate the impacts of water pollution by accurately assessing three ways contaminated water can lead to adverse human and environmental health outcomes. (Evaluating environmental impacts; Bloom's: Evaluating)
2. Recommend appropriate water treatment methods by selecting two of the most effective technologies after analyzing a water contamination scenario. (Applying understanding of water treatment; Bloom's: Evaluating)
3. Compile an action plan for reducing food waste that includes economic incentives, municipal programs, and public awareness campaigns by researching evidence-based waste minimization strategies. (Creating a waste reduction plan; Bloom's: Creating)
4. Test for the presence of emerging contaminants in water samples by properly preparing reagents and accurately operating analytical test equipment after reading protocols. (Demonstrating technical lab skills; Bloom's: Applying)
5. Develop an outline of key topics to include in a 5-minute presentation advocating for clean water access in disadvantaged communities using learned concepts of environmental justice. (Applying advocacy concepts; Bloom's: Creating)
6. Explain the potential transfer of three specified toxins from soil to crops for human consumption using the concepts of bioaccumulation and biomagnification across trophic levels. (Understanding toxin movement in food chains; Bloom's: Understanding)

For the third step, creating LOs to Authentic Assessments from the LOs, I submitted the following prompt to GPT.

- "From the learning outcomes (LOs), create five authentic assessments with point values that align with the importance of each topic resulting in 1000 total points for the course assessments."

GPT Response:

In an environmental science course, evaluating authentic assessments involves assessing students' ability to apply scientific concepts to real-world environmental issues. These assessments may include projects analyzing local ecosystems, simulations of environmental policy-making, and fieldwork investigating ecological phenomena, ensuring students develop practical skills and a deeper understanding of the complexities of environmental challenges. By engaging with authentic assessments, students not only demonstrate their comprehension but also cultivate critical thinking and problem-solving skills vital for addressing environmental issues.

Water Quality Analysis Report (250 points)

- Task: Students will conduct a comprehensive analysis of the chemical composition of a local water source using appropriate testing methods. They will compile their findings into a detailed report, highlighting key parameters and their implications on water quality. The report should demonstrate a deep application of water chemistry.

Point Breakdown:

- Accuracy of Analysis: 100 points
- Clarity and Organization of the Report: 75 points
- Integration of Key Concepts: 50 points
- Presentation and Formatting: 25 points

Waste Management Plan Presentation (200 points)

- Task: In teams, students will design a waste management plan that addresses both liquid (wastewater) and solid waste. Each team will present their plan to the class, emphasizing the sustainability of their approach and its potential impact on community wellness.

Point Breakdown:

- Overall Sustainability and Effectiveness: 100 points
- Clarity of Presentation: 50 points
- Integration of Course Concepts: 30 points
- Responses to Questions and Feedback: 20 points

Waterborne Diseases and Nutrition Analysis (150 points)

- Task: Students will research and present a case study on a waterborne disease, analyzing its nutritional implications on affected populations. The presentation should demonstrate a clear understanding of the connection between water quality, disease, and nutrition.

Point Breakdown:

- Disease Overview and Impact: 70 points
- Nutritional Analysis: 50 points
- Clarity of Presentation: 20 points
- Responses to Questions: 10 points

Environmental Impact Assessment (250 points)

- Task: Students will assess the environmental impact of a selected waste management strategy, considering its effectiveness in reducing pollution and promoting community wellness. They will present their findings in a detailed report, including recommendations for improvement.

Point Breakdown:

- Thoroughness of Assessment: 120 points
- Identification of Positive and Negative Impacts: 80 points
- Clarity and Structure of the Report: 30 points
- Feasibility of Recommendations: 20 points

Personal Wellness and Sustainability Plan (150 points)

- Task: Each student will develop a personal wellness plan that integrates principles of sustainable living, emphasizing the connection between nutrition, lifestyle choices, and environmental responsibility. The plan should be presented in a creative and reflective format.

Point Breakdown:

- Integration of Sustainable Practices: 70 points
- Clarity and Creativity of Presentation: 40 points
- Alignment with Course Concepts: 30 points
- Reflection on Personal Impact: 10 points

These assessments collectively align with the learning outcomes, providing a comprehensive evaluation of students' application of the course material.

Claude Response:

1. Water Contamination Impact Assessment (Evaluating environmental impacts, LO1) - 200 points. Students will analyze an environmental disaster case study and write a detailed explanatory report assessing causes, contamination pathways, adverse effects, and prevention recommendations.
2. Water Treatment Plan Project (Applying water treatment, LO2) 150 points. Students will develop a proposal for improving water treatment methods for a developing community based on a contaminated water profile.
3. Food Waste Action Plan (Creating waste reduction plan, LO3) - 250 points. Students will research evidence-based practices and create a formal action plan for reducing food waste with economic, policy, and technology strategies accounted for at societal and individual levels.
4. Emerging Contaminants Lab Testing Practicum (Demonstrating lab skills, LO4) - 150 points. Students will run lab analyzes testing for the presence of emerging water contaminants using

proper scientific protocols, lab techniques, and equipment operation while accurately reporting quantitative results.

5. Environmental Justice Advocacy Presentation (Applying advocacy concepts, LO5) - 100 points. Students will prepare and give a 5-minute multimedia presentation for a public forum making the case for increased clean water access in marginalized communities using researched evidence and scientific data.
6. Toxins in the Food Chain Video (Applying bioaccumulation, LO6) - 150 points. Students will produce a 3-5 minute video explaining the process of bioaccumulation and biomagnification of toxins from soil to crops for human consumption with visual aids.

For Step #4, creating Analytical Rubrics to measure each Assessment, I provided the following prompt:

- “For each of the five assessments, create an analytical rubric detailing clear expectations for work quality and number of points with a focus on Bloom's application, analysis and synthesis levels.”

GPT Response:

1. Water Quality Analysis Report (250 points) Analytical Rubric:

Criteria	Excellent (90-100)	Good (80-89)	Satisfactory (70-79)	Needs Improvement (Below 70)
Accuracy of Analysis	Comprehensive identification of key chemical components and their implications on water quality.	Adequate identification of key chemical components with some insightful analysis.	Identification of key components with limited analysis or minor inaccuracies.	Limited identification of key components with significant inaccuracies.
Clarity and Organization of Report	Well-organized report with clear sections, headings, and a logical flow.	Organized report with clear sections, but may lack a seamless flow.	Adequate organization with some confusion in structure.	Poor organization, hindering the understanding of content.
Integration of Key Concepts	Thorough integration of water chemistry concepts, demonstrating a deep understanding.	Good integration of key concepts with minor gaps in understanding.	Basic integration of concepts with notable gaps in understanding.	Limited integration of course concepts.
Presentation and Formatting	Professional presentation with proper formatting, citations, and visual aids.	Clear presentation with minor formatting issues.	Adequate presentation with noticeable formatting issues.	Poor presentation and formatting detracting from content.

2. Waste Management Plan Presentation (200 points) Analytical Rubric:

Criteria	Excellent (90-100)	Good (80-89)	Satisfactory (70-79)	Needs Improvement (Below 70)
Overall Sustainability and Effectiveness	Comprehensive, innovative plan with clear sustainability goals and effective	Good sustainability and effectiveness, with some innovative elements and effective waste	Adequate sustainability and effectiveness, with notable room for improvement.	Limited sustainability and effectiveness, requiring

	waste reduction strategies.	reduction strategies.		significant improvement.
Clarity of Presentation	Clear, engaging presentation with effective communication of ideas.	Adequate clarity with some minor communication challenges.	Presentation is somewhat confusing, hindering understanding.	Presentation is unclear, making it difficult to comprehend.
Integration of Course Concepts	Thorough integration of course concepts, demonstrating a deep understanding.	Good integration of key concepts with minor gaps in understanding.	Basic integration of concepts with notable gaps in understanding.	Limited integration of course concepts.
Responses to Questions and Feedback	Thoughtful responses, demonstrating a deep understanding of the subject matter.	Good responses with some insightful elements.	Adequate responses, but with room for improvement.	Limited or inappropriate responses to questions and feedback.

3. Waterborne Diseases and Nutrition Analysis (150 points) Analytical Rubric:

Criteria	Excellent (90-100)	Good (80-89)	Satisfactory (70-79)	Needs Improvement (Below 70)
Disease Overview and Impact	Comprehensive analysis of waterborne disease, emphasizing nutritional implications with deep insights.	Good analysis of disease with some insightful elements regarding nutritional implications.	Adequate analysis of disease with notable gaps in nutritional implications.	Limited analysis of disease with significant gaps in nutritional implications.
Nutritional Analysis	Thorough examination of the nutritional impact of the waterborne disease on affected populations.	Adequate examination of nutritional impact with some gaps in understanding.	Basic examination of nutritional impact with notable gaps in understanding.	Limited examination of nutritional impact with significant gaps in understanding.
Clarity of Presentation	Clear, engaging presentation with effective communication of ideas.	Adequate clarity with some minor communication challenges.	Presentation is somewhat confusing, hindering understanding.	Presentation is unclear, making it difficult to comprehend.
Responses to Questions	Thoughtful responses, demonstrating a deep understanding of the subject matter.	Good responses with some insightful elements.	Adequate responses, but with room for improvement.	Limited or inappropriate responses to questions.

4. Environmental Impact Assessment (250 points) Analytical Rubric:

Criteria	Excellent (90-100)	Good (80-89)	Satisfactory (70-79)	Needs Improvement (Below 70)
Thoroughness of Assessment	Comprehensive evaluation of the environmental impact, considering both positive and negative aspects.	Good evaluation with some thorough elements, addressing both positive and negative impacts.	Adequate evaluation with notable gaps in addressing both positive and negative impacts.	Limited evaluation with significant gaps in addressing impacts.
Identification of Positive and Negative Impacts	Clear identification and analysis of positive and negative environmental impacts.	Adequate identification with some gaps in analysis or understanding.	Basic identification with notable gaps in analysis or understanding.	Limited identification and analysis of impacts.
Clarity and Structure of the Report	Well-organized report with clear sections, headings, and a logical flow.	Organized report with clear sections, but may lack a seamless flow.	Adequate organization with some confusion in structure.	Poor organization, hindering the understanding of content.
Feasibility of Recommendations	Feasible and well-supported recommendations for improving the environmental impact.	Recommendations are feasible but may lack comprehensive support.	Adequate recommendations, with notable room for improvement or feasibility concerns.	Limited or impractical recommendations.

5. Personal Wellness and Sustainability Plan (150 points) Analytical Rubric:

Criteria	Excellent (90-100)	Good (80-89)	Satisfactory (70-79)	Needs Improvement (Below 70)
Integration of Sustainable Practices	Comprehensive integration of sustainable practices into the personal wellness plan.	Good integration with some insightful elements of sustainable practices.	Adequate integration with notable room for improvement.	Limited integration of sustainable practices.
Clarity and Creativity of Presentation	Clear, engaging, and creative presentation demonstrating effective communication.	Adequate clarity with some creative elements, but may lack seamless communication.	Presentation is somewhat confusing, hindering understanding.	Presentation is unclear, making it difficult to comprehend.
Alignment with Course Concepts	Thorough alignment of the personal wellness plan with key course concepts.	Good alignment with some gaps or minor inconsistencies.	Adequate alignment with notable room for improvement.	Limited alignment with course concepts.
Reflection on Personal Impact	Thoughtful reflection on the personal impact of sustainable choices.	Good reflection with some insightful elements.	Adequate reflection with notable room for improvement.	Limited or inappropriate reflection on personal impact.

Claude Response:

Water Contamination Impact Assessment Rubric (200 points)

- Research & Data Application (60 points)
 - Uses relevant, accurate data to assess causes, pathways, impacts (30 points)
 - Identifies appropriate prevention recommendations supported by analysis (30 points)
- Analysis Depth (60 points)
 - Assesses short- and long-term human health impacts completely (30 points)
 - Fully analyzes environmental damage and ecosystem impacts (30 points)
- Report Quality (80 points)
 - Content and structure clearly address all required report elements (40 points)
 - Writing is logical, clear, grammatically correct with proper citations (40 points)

Water Treatment Plan Project Rubric (150 points)

- Situation Analysis (50 points)
 - Fully identifies context and issues needing intervention (25 points)
 - Accurately analyzes water chemistry data to derive treatment needs (25 points)
- Plan Justification (50 points)
 - Logically justifies technology choices citing evidence of effectiveness (25 points)
 - Convincingly explains benefits and feasibility of plan (25 points)
- Presentation Quality (50 points)
 - Content flows logically, meets length criteria, visually appealing (25 points)
 - Speaking is clear, practiced, open to audience questions (25 points)

Food Waste Action Plan Rubric (250 points)

- Strategy Research (100 points)
 - Plan incorporates 8+ carefully researched reduction strategies (50 points)
 - Demonstrates thorough analysis of economic and policy levers (50 points)
- Viability (100 points)
 - Convincingly models adoption feasibility and waste impacts if implemented (50 points)
 - Accounts well for needed incentives, participation issues, opposition (50 points)
- Presentation (50 points)
 - Content and visuals compellingly present research and plan (25 points)
 - Speaking and handling of feedback is professional (25 points)

Emerging Contaminants Lab Testing Rubric (150 points)

- Testing Preparation (50 points)
 - Correctly prepares reagents and contamination-free glassware (25 points)
 - Properly sets up and calibrates analytical equipment (25 points)
- Testing Procedure (50 points)
 - Precisely follows published protocols for sample incubation, testing, analysis (25 points)
 - Proficient technique operating microscopes, spectrophotometers, chromatography (25 points)
- Reporting (50 points)
 - Results presented clearly in required format with statistics, methodology noted (25 points)
 - Thoughtfully analyzes accuracy of results and experimental sources of error (25 points)

Environmental Justice Presentation Rubric (100 points)

- Content Quality (40 points)
 - Successfully uses scientific data and concepts to build persuasive argument (20 points)
 - Slides logically structured to support presentation goals (20 points)
- Presentation Delivery (30 points)
 - Speaks clearly and maintains audience engagement throughout (15 points)
 - Thoughtfully fields questions using evidence and data (15 points)
- Advocacy (30 points)
 - Convincingly presents ethical reasoning on justice issue (15 points)
 - Passionately argues duty for policy change or action (15 points)

An additional request was made for **step number four**, which was to ask GenAI to create a multiple-choice test as assessment which includes an Item Analysis (Discrimination Index, Difficulty Level). The prompt that was provided was:

- “Create five 30-item multiple choice exams with one correct answer and three distractors that evenly address each learning outcome, indicating the correct response for each item. Provide an item analysis including difficulty level and discrimination level and validity and reliability analysis.”

GPT Response:

Creating a full set of 30-item multiple-choice (MC) exams is beyond the scope of this platform. However, I can provide you with one sample multiple-choice question, and then you can create variations based on this template.

Sample MC Question: What is the primary role of the water cycle in ecosystems?

- A. Nutrient transport
- B. Energy production
- C. Waste decomposition
- D. Air purification

Correct Answer: A. Nutrient transport

Item Analysis:

- **Difficulty Level:** Moderate: The question requires an understanding of the primary role of the water cycle in ecosystems, which is moderate in complexity.
- **Discrimination Level:** Good. The item effectively differentiates between students who understand the concept of the water cycle's role in ecosystems and those who do not.

Validity and Reliability Analysis:

- **Content Validity:** The question aligns with the learning outcome related to the water cycle and its role in ecosystems.
- **Construct Validity:** The question measures the intended construct of understanding the role of the water cycle in ecosystems.
- **Reliability:** The question has good reliability, as it consistently measures the knowledge related to the specified learning outcome.

You can create similar questions for each LO, ensuring a balanced representation of the content and cognitive levels. To further enhance the validity and reliability of the exam, consider employing a variety of question formats and thoroughly reviewing and piloting the questions before the actual exam.

Claude Response:

Unfortunately, I do not have enough information to create full 30-item MC exams with item analyses for this course. To develop quality questions that align to LOs, I would need:

1. The specific LOs to link exam questions to;
2. The topics, concepts and level of difficulty covered in the weekly schedule;
3. Examples of proper question structure and terminology expected for this content area;
4. Details on the number of questions tied to each LO;
5. Guidance on proper creation of plausible distractors in line with best practice; and
6. Context on the student population and prerequisite skills needed to determine appropriate challenge level.

Additionally, conducting full item analyses, assessing validity and reliability, and assigning meaningful difficulty and discrimination scores requires:

- Administering full exam drafts to a suitable sample size of students;
- Collecting detailed psychometric data on student responses; and
- Having a sense of desired benchmarks in the content area.

Subsequently, I engaged in a dialogue with Claude providing the requested information and the following prompts:

- “Use the following learning outcomes to create five 30-item multiple choice exams with one correct answer and three distractors that evenly address each learning outcome, indicating the

correct response for each item: Evaluate the impacts of water pollution by accurately assessing three ways contaminated water can lead to adverse human and environmental health outcomes. Recommend appropriate water treatment methods by selecting two of the most effective technologies after analyzing a water contamination scenario. Compile an action plan for reducing food waste that includes economic incentives, municipal programs, and public awareness campaigns by researching evidence-based waste minimization strategies. Test for the presence of emerging contaminants in water samples by properly preparing reagents and accurately operating analytical test equipment after reading protocols. Develop an outline of key topics to include in a 5-minute presentation advocating for clean water access in disadvantaged communities using learned concepts of environmental justice. Explain the potential transfer of three specified toxins from soil to crops for human consumption using the concepts of bioaccumulation and biomagnification across trophic levels.”

Claude Response:

Unfortunately, even with the LOs provided, I do not have enough context about the course content, structure, topics, or student population to develop full and aligned MC exams. Key reasons include:

1. The LOs span a wide range of skills and content from water pollution to lab testing to developing outlines and presentations. To write balanced and connected exam questions, I would need an understanding of how these fit together into cohesive course units with aligned topics and concepts to test students on.
2. Writing quality questions requires an understanding of the level of challenge that is appropriate for the students based on prerequisites and program expectations. Without any sample questions or content, the questions I create could be much too difficult or basic.
3. To write plausible distractor options, I need foundational knowledge of the key terminology, scientific processes, and major debates related to these environmental topics that would reasonably confuse students if not fully learned.
4. Assessing impact of water pollution, testing for contaminants, and other LOs suggest specialized scientific knowledge. Realistically creating connected exams assessing this requires some grounding in the field.

What would be most helpful is if you could provide details on course topics, expected student background, key concepts taught, and what level of analysis you aim for exams to target. This would give a foundation for me to build quality, aligned test questions for your specific course.

After receiving this prompt, I replied with the following from my course:

- “Thank you for appreciating the complexity of creating meaningful exams. Please use the following information on details on course topics (I. Water Chemistry and Treatment A. Water contamination; 1. Biological, chemical, physical; 2. Point source vs nonpoint source; B. Water treatment; 1. Filtration, disinfection, softening; 2. Wastewater treatment steps; C. Water quality testing and policy; 1. Drinking water standards and testing; 2. Regulatory bodies and policy II. Waste - Water and Solid; A. Wastewater; 1. Sewage composition and impacts; 2. Emerging contaminants (pharmaceuticals, microplastics etc.) B. Solid waste - non-hazardous; 1. Municipal solid waste (plastics, paper, organics); 2. Life cycle, recycling, composting; C. Hazardous waste; 1. Industrial waste (chemicals, nuclear etc.); 2. Treatment, storage, and disposal; III. Wellness - Connections to Water, Waste, and Nutrition; A. Food safety; 1. Agricultural water use and contamination; 2. Effects of soil contamination; B. Diet and health; 1. Bioaccumulation up the food chain; 2. Heavy metals, microplastics, and emerging concerns; C. Food waste; 1. Upstream and downstream impacts; 2. Prevention, recovery, recycling), expected student background (have completed general chemistry course), key concepts taught (refer to topic/concepts outline), and what level of analysis you aim for exams to target (application, analysis, synthesis).”

Claude Response:

Thank you for providing more detailed information. With the outline of content areas, assumed chemistry prerequisite knowledge, and aim to target application and analysis cognitive levels, I can now create more aligned, appropriate questions. However, exam creation requires making assumptions about specifics not fully provided, like:

- Scope and sequencing of topics within water, waste, wellness units;
- Key concepts, processes, vocabulary covered in lectures; and

- Examples of issues and scenarios used to teach these concepts.

Additionally, writing 30 high-quality questions per exam solely on my own without context of actual instruction or materials would not effectively validate student learning. With those limitations acknowledged, here is a draft attempt at five questions per outlined content section, with answers indicated, tapping application and basic analysis skills:

I. Water Chemistry and Treatment

1. Which of these is an example of point source water pollution? A) Pesticide runoff from farms (Nonpoint) B) Leaking from underground gas tank (Point source)* C) Soil erosion after deforestation (Nonpoint)
2. What technology can filter cysts and pathogens in drinking water? A) Aeration (Incorrect) B) Flocculation (Incorrect) C) Ultrafiltration* (Correct) D) Fluoridation (Incorrect)

II. Waste - Water and Solid

1. What contributes heavily to sewage sludge residue? A) Microfibers from washing fleece (Incorrect) B) Leached synthetic fertilizers (Incorrect) C) Human waste and food scraps* (Correct)
2. How are most consumer electronics waste handled? A) Incineration releasing toxins (Incorrect) B) Repurposing rare earth metals (Incorrect) C) Stockpiling unused in landfills* (Correct)

III. Wellness - Connections to Water, Waste, and Nutrition

1. Which agriculture practice risks water contamination? A) Hydroponics reducing runoff B) Cover cropping to control erosion C) Overapplying chemical pesticides*
2. Persistent bioaccumulative toxins like PCBs and dioxins... A) Breakdown quickly by water treatment B) Magnify up the food chain over time* C) Filter out through wastewater processing

Next, I provided the following response:

“Great! You are correct on each account and how these are needed to create quality exams. I appreciate your efforts, please continue to try and create an exam with the additional information, Scope and sequencing of topics (use the outline for the topics), Key concepts, processes, vocabulary covered in lectures (use the outline and/or use information that you can access from the internet on other similar courses), Examples of issues and scenarios used to teach these concepts (use the following conceptual framework, Unifying Theme “Connecting” (Gerth, 2010) As China Goes, So Goes the World: How Chinese Consumers are Transforming Everything

- What is Environment (Thoreau, 1854) Walden
- Water (Science Articles)
- What is in our water?
- Where does clean water come from and unclean water go?
- Waste (Minter, 2013) Junkyard Planet: Travels in Billion-Dollar Trash Trade
 - Where does our garbage go?
- Wellness (Pollan, 2009) Food Rules: An Eater’s Manual
- Physical, Mental, Emotional, Social-Emotional, Financial, etc.)”

Claude Response:

Thank you for the additional resources and guidance on conceptual frameworks to utilize. With the suggested readings, outline, and connecting theme of "where does it come from/where does it go" - I have enough context to put together a more meaningful, aligned sample exam:

Environmental Connections Exam

I. Water Chemistry and Quality

1. Which of the following is typically filtered out during primary wastewater treatment? a) Pharmaceutical residues b) Fecal coliform bacteria* c) Microfiber plastics d) Fertilizer nutrients
2. What is the main source of arsenic that shows up in drinking water supplies? a) Industrial waste outflow pipes b) Natural deposits in aquifers* c) Runoff from golf courses d) Old water distribution pipes

3. Up to what percentage of a human body's weight comes from water? a) 30% b) 45% c) 60%* d) 75%

II. Waste Systems and Impacts

4. What country leads the world in imports of plastic waste from other nations?
a) India
b) Taiwan c) Malaysia d) China*
5. Which chemical compounds comprise the majority of e-waste exported overseas? a) Lead and lithium* b) Barium and boron c) Nickel and neon d) Mercury and manganese
6. Roughly what portion of household waste could be composted but ends up in landfills? a) 10% b) 25% c) 33%* d) 50%

III. Environment - Wellness Connections

7. Which food production method typically uses the LEAST amount of water? a) Beef farming b) Almond growing
c) Aquaponics* d) Hydroponic tomatoes
8. What is the term for toxin levels increasing up the food chain?
a) Biodegrading b) Biomagnifying* c) Bioextracting d) Biotransformation
9. About what portion of total U.S. energy consumption goes to food production and supply? a) 5% b) 10% c) 15%* d) 20%

I responded with the following:

- "Yes, these items are fine, can you continue and produce a total of 30 items?"

Claude response:

Here are more MC items, continuing to align with the water, waste, and wellness content areas. I'll break this down into separate entities, for example environment connections two final exams with a total 30 items. Please let me know if this format is helpful. For the item analysis, difficulty level, discrimination index, validity, and reliability analysis. I didn't provide this analysis due to a lack of student data. In order to conduct analysis accurately, it would require administering the full exam to an appropriate sample size of students and collecting detailed response statistics. Please let me know if providing theoretical analysis without real data would still be helpful or if you would like me to explain typical processes for conducting each type of analysis.

Environment Connections Final Exam

Water Chemistry and Treatment

10. What process removes ionic compounds like calcium and magnesium from hard water? a) Precipitation b) Reverse osmosis c) Softening* d) Sedimentation
11. Which water body in the U.S. is considered to have the largest "dead zone" from fertilizer runoff? a) Colorado River b) Mississippi River Delta* c) Great Lakes d) Chesapeake Bay
12. Why are chloride salts often added during the water treatment process? a) Remove pathogens b) Improve taste* c) Reduce corrosion d) Aid coagulation

Waste Systems and Management

13. What electronics manufacturing waste product is especially dangerous if improperly disposed of? a) Glass dust b) Circuit boards* c) Plastics d) Light bulbs
14. Roughly what portion of landfill waste is made up of organic/food waste?
a) 5% b) 15%* c) 25% d) 35%
15. Which method of waste disposal releases the most amount of greenhouse gasses? a) Recycling b) Composting c) Incineration* d) Landfilling

Environment – Wellness Connections

16. Which consumer choice best reduces water usage related to diet? a) Locally sourced vegetables b) Organic animal products c) Minimal packaging d) Purchasing beverages in bulk*
17. What food processing method tends to generate the most plastic waste per food mile? a) Drying b) Curing c) Freeze-drying d) Single-serve packaging*
18. About what portion of a developed nation's water usage goes towards irrigating crops? a) 10% b) 30%* c) 60% d) 80%

I responded with the following:

- “Yes, please provide theoretical analysis without real data and explain typical processes for conducting each type of analysis.”

Claude Response:

Here is an overview of typical processes for conducting item analysis, assessing difficulty level, discrimination index, validity, and reliability on multiple choice exams, along with theoretical applications:

Difficulty Level

- Measures proportion of students who correctly answered an item
- Lower difficulty = higher % students correct suggesting too easy
- Higher difficulty = lower % correct suggesting too challenging
- Aim for 60-80% difficulty for best differentiation

Theoretical Application:

- On this exam covering fundamentals, would expect difficulty in 60-80% ideal range
- Could sort questions after administration by % correct into difficulty level categories

Discrimination Index

- Indicates how well an item distinguishes between high and low performing students
- Calculated by subtracting % correct for lower 27% minus % for higher 27%
- Values above 0.4 considered very good discrimination

Theoretical Application:

- Would expect higher level application/analysis to better differentiate top and bottom
- Could analyze discrimination index of each question to determine quality

Validity

- Indicates alignment between test questions and LOs
- Content validity assessed by aligning items to LOs
- Criterion validity compares test performance to external indicators

Theoretical Application:

- Mapping exam items to the outcomes they assess would establish reasonable content validity given single exam creator limits

Reliability

- Measures internal consistency and reproducibility of testing instrument
- Analyze Cronbach’s alpha - over 0.7 considered reliable
- Test-retest correlations also provide reliability estimate

Theoretical Application:

- With no opportunity for test-retest or inter-rater scoring, reliability is a limitation
- Internal consistency could theoretically be assessed via Cronbach’s alpha

In practice, analysis involves student sampling, statistical tests, and benchmarking.

For **step number five**, I used the Topics, Learning Outcomes, Assessments and Rubrics to create a course schedule using the following prompt:

- “Combine all prior data, Course Title, Topics, Learning Outcomes and Assessments to create a schedule table for a 15-week college course. Include in the table a column for Week number; Topic; Suggested Readings (from books and/or articles); Assignments/Assessment due dates and supplemental video resources for each week.”

GPT Response:

Week	Topic	Suggested Readings	Assignments Due Dates	Supplemental Video Resources
1	Introduction to Environmental Connections	- "Environmental Science" by G. Tyler Miller	- Introduce Course	N/A

2	Global Water Resources and Distribution	- "Water: The Epic Struggle for Wealth, Power, and Civilization" by Steven Solomon	- Water Quality Analysis Report Proposal	"Water: The Essence of Life" (National Geographic)
3	Water Cycle and Ecosystems	- "The Water Will Come" by Jeff Goodell	- Water Quality Analysis Report Proposal Due	"The Hidden Influence of Water" (TED-Ed)
4	Human Impact on Water Quality and Availability	- "Cadillac Desert" by Marc Reisner	- Readings Discussion	"Water Scarcity: A Global Issue" (World Economic Forum)
5	Sustainable Water Management Practices	- "Blue Mind" by Wallace J. Nichols	- Waste Management Plan Presentation Proposal	"Sustainable Water Management" (TEDx)
6	Types of Waste: Solid, Liquid, Hazardous	- "Cradle to Cradle" by William McDonough	- Waste Management Plan Presentation Proposal Due	"The Story of Stuff" (Annie Leonard)
7	Life Cycle Assessment of Products and Materials	- "The Upcycle" by William McDonough	- Readings Discussion	"Life Cycle Assessment: A Guide to Best Practices" (Sustainable Minds)
8	Landfills, Recycling, and Composting	- "Garbology" by Edward Humes	- Environmental Impact Assessment Proposal	"The Journey of a Plastic Bottle" (TED-Ed)
9	Pollution and its Consequences	- "Silent Spring" by Rachel Carson	- Environmental Impact Assessment Proposal Due	"Plastic Pollution: How Humans are Turning the World into Plastic" (World Economic Forum)
10	Environmental Health and Human Well-being	- "Our Stolen Future" by Theo Colborn	- Readings Discussion	"The Economics of Disease" (TED-Ed)
11	Impact of Water Quality on Public Health	- "Water: The Fate of Our Most Precious Resource" by Marq de Villiers	- Waterborne Diseases and Nutrition Analysis Proposal	"Water and Human Health" (World Health Organization)
12	Connection between Waste Management and Community Health	- "Governing the Commons" by Elinor Ostrom	- Waterborne Diseases and Nutrition Analysis Proposal Due	"Waste Management: A Sustainable Approach" (TEDx)
13	Policies and Regulations	- "The Sixth Extinction" by Elizabeth Kolbert	- Policy Analysis Presentation	"Environmental Laws and Policies" (TED-Ed)
14	Emerging Technologies and Innovations	- "The Uninhabitable Earth" by David Wallace-Wells	- Policy Analysis Presentation Due	"Innovations in Water Treatment" (National Geographic)

15	Community Engagement and Activism	- "Braiding Sweetgrass" by Robin Wall Kimmerer	- Final Reflection	"Community-Led Environmental Action" (TEDx)
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Note: The suggested readings are based on various topics covered during the weeks, and the supplemental video resources provide additional visual aids to enhance understanding. The assignments and assessments are designed to align with the learning outcomes specified earlier in the course outline.

Claude Response:

Week 1 Topic: Introduction to Environment Connections

Readings: Chapter 1 in Environment Connections textbook; EPA "Why the Environment Matters" article

Due: Pre-assessment quiz

Videos: Linking Environment and Health animated video

Week 2 Topic: Water Scarcity and Management

Readings: Textbook Ch. 3 Water Conservation; UN Water Scarcity fact sheet

Due: Current Event Analysis Water Conflict

Videos: Water Scarcity Causes and Solutions tutorial

Week 3 Topic: Water Chemistry and Pollution

Readings: Textbook Ch. 4 Water Quality; Article on Cuyahoga River Emergency

Due: Pollution Source Presentation

Videos: Cuyahoga River fire news clips

Week 4 Topic: Biological and Chemical Contamination

Readings: Textbook Ch. 5 Water Contamination; Article on Lead Poisoning Crisis

Due: Case Study Diagnostic Essay

Videos: The Lead-Laden Water Crisis documentary

Week 5 Topic: Physical and Disinfection Treatment

Readings: Textbook Ch. 8 Water Treatment Technologies; EPA Disinfection Rules

Due: Mini Lab Testing Water Quality

Videos: How Drinking Water is Treated animation

Week 6 Topic: Wastewater Systems and Treatment Stages

Readings: Textbook Ch. 10 Water Waste and Recycling; Article on Emerging Contaminants

Due: Reaction Paper to Readings

Videos: Where Does Your Sewage Go? | I Didn't Know That

Week 7 Topic: Nutrient Pollution and Stormwater Issues

Readings: Article on Nutrient Loading Impacts; Stormwater Runoff Regulations Fact Sheet

Due: Pollution Hypoxia Presentation

Videos: The Dead Zone: How Agricultural Fertilizer is Destroying Marine Ecosystems

Week 8 Topic: Solid Waste and Landfill Impacts

Readings: Textbook Ch. 12 Managing Solid Waste; Article on Landfill Crisis

Due: Municipal Budget Lobby Letter

Videos: The Landfill Crisis Explained

Week 9 Topic: The Plastics Problem

Readings: Article on Health Impacts of Plastic; UN Report on Single-Use Plastics

Due: Plastics Lifecycle and Policy Evaluation Essay

Videos: Plastic Pollution Threatens Marine Life | A Whale's Tale | Real Wild

Week 10 Topic: Food Waste Upstream and Downstream Ripple Effects

Readings: Textbook Ch. 15 Food Waste; Article on True Cost of Food Waste

Due: Food Waste Impact Infographic

Videos: How Our Food Waste Impacts People, Land and Water | Tracy Madlener | TEDxFremont

Week 11 Topic: Health Implications from Contamination
Readings: Textbook section on Bioaccumulation; Article on Soil Contaminants
Due: Heavy Metals Transfer Lab Results
Videos: The Soil Contamination Crisis Explained

Week 12 Topic: Inequities and Justice Issues
Readings: Article on Unequal Environmental Health Impacts; Clean Water Access Stats
Due: Debate on Water as a Human Right
Videos: Why Climate Change and Water Shortages Make Food Insecure Communities More Vulnerable

Week 13 Topic: Policy, Technology, and Sustainability Solutions
Readings: Textbook Ch. 20 Creating Sustainability; Article on Water Infrastructure Innovation
Due: Clean Water Innovation Policy Brief
Videos: Individual Actions that Benefit the Environment

Week 14 Topic: Environment Connections Wrap Up
Readings: Textbook Ch. 22 Your Role in Change; Article on Power of Lifestyle Choices
Due: Peer Feedback on Final Projects

Week 15 Due: Final Project Presentations on Water or Waste Campaign

For the sixth step, I asked GenAI to create Slide Outlines. There are dedicated GenAI services that will create actual Slide Decks (SlideAI.io, Tome, ChatBCG, Plus, Simplified.com). I offered the following prompt:

- “From the Topics and Learning Outcomes, create a slide outline for each of the 15 weeks.”

GPT Response:

I can provide a brief outline for each week, highlighting key topics and LOs. Please note that this outline is a condensed version.

Week 1: Introduction to Environmental Connections

- Slide 1: Course Title and Overview
- Slide 2: Importance of Water, Waste, and Wellness Interconnections
- Slide 3: Historical Context of Environmental Awareness
- Slide 4: LO 1: Analyze the Interconnectedness of Water, Waste, and Wellness

Week 2: Global Water Resources and Distribution

- Slide 1: Overview of Global Water Resources
- Slide 2: Water Cycle and Ecosystems
- Slide 3: Human Impact on Water Quality and Availability
- Slide 4: Learning Outcome 2: Understand Global Water Challenges

Week 3: Water Cycle and Ecosystems

- Slide 1: Recap of Global Water Resources
- Slide 2: Water Cycle Processes
- Slide 3: Ecosystems and Water Interactions
- Slide 4: Learning Outcome 3: Comprehend the Role of Water in Ecosystems

Week 4: Human Impact on Water Quality and Availability

- Slide 1: Sources of Water Pollution
- Slide 2: Case Studies on Human Impact
- Slide 3: Sustainable Water Management Practices
- Slide 4: Learning Outcome 4: Evaluate Human Impact on Water

Week 5: Sustainable Water Management Practices

- Slide 1: Defining Sustainable Water Management
- Slide 2: Technologies for Water Treatment
- Slide 3: Case Studies on Successful Water Management
- Slide 4: Learning Outcome 5: Propose Sustainable Water Solutions

Week 6: Types of Waste: Solid, Liquid, Hazardous

- Slide 1: Introduction to Different Waste Types
- Slide 2: Solid Waste Management
- Slide 3: Liquid (Wastewater) Waste Management
- Slide 4: Learning Outcome 6: Differentiate Types of Waste

Week 7: Life Cycle Assessment of Products and Materials

- Slide 1: Understanding Life Cycle Assessment
- Slide 2: Role of Life Cycle Assessment in Sustainability
- Slide 3: Case Studies on Life Cycle Assessment
- Slide 4: Learning Outcome 7: Apply Life Cycle Assessment Principles

Week 8: Landfills, Recycling, and Composting

- Slide 1: Overview of Solid Waste Management
- Slide 2: Landfills and their Environmental Impact
- Slide 3: Recycling and Composting Strategies
- Slide 4: Learning Outcome 8: Analyze Waste Management Strategies

Week 9: Pollution and its Consequences

- Slide 1: Types and Sources of Pollution
- Slide 2: Consequences of Pollution
- Slide 3: Environmental and Health Implications
- Slide 4: Learning Outcome 9: Understand Pollution Consequences

Week 10: Environmental Health and Human Well-being

- Slide 1: Defining Environmental Health
- Slide 2: Connection Between Environment and Human Health
- Slide 3: Public Health Implications
- Slide 4: Learning Outcome 10: Explore the Link Between Environment and Health

The structure of the remaining weeks would follow a similar pattern.

Claude Response:

To create meaningful slide outline for each week of the 15-week course, I would need:

1. The list of weekly topics and concepts covered each week
2. The key LOs tied to each week, segmenting the overall LOs over the span of 15 weeks
3. Ideal slide count or key points to cover for each week
4. Specific content or visuals that should be included (data charts, diagrams, maps, etc.)
5. Guidance on the purpose and audience for the slide decks

With clarification on a few additional details, I'd be happy to put together draft slide outlines.

I also used [SlidesGPT](#) to create a slide deck, using the prompt, "Create a slide deck on environmental science which includes hydrogeology." The result can be viewed [here](#).

For the final **step number six**, creating a Syllabus, I provided the following prompt:

- "With all of the information provided for this course, create a course syllabus including Course Title, Instructor name and title, Instructor office address, Instructor office telephone, Instructor office hours, Instructor email address, Name and contact information for Grader, TA, etc., Course Information, Course Term – fall, winter, spring; Course Credits, Course Description, Course Overview, class meeting days and times, Course Learning Outcomes, Learning Materials (including textbooks), Grades (Assessment), Course Policies, Class Attendance and Participation, Late Assignments, Rewrite Policy, Group Work Policy, Instructional Technology (Email/Texting, Mobile Devices), Professionalism Policy, Academic Honesty/Plagiarism, Disability."

GPT Response:

Course Title: Environment Connections: Water, Waste, and Wellness

Instructor:

- Name: [Instructor's Full Name]
- Title: Professor of Environmental Science
- Office Address: [Office Address]
- Office Telephone: [Office Telephone Number]
- Office Hours: [Office Hours]
- Email Address: [Instructor's Email Address]

Grader/Teaching Assistant (TA):

- Name: [Grader/TA's Full Name]; Contact Information: [Grader/TA's Email Address]

Course Information:

- Course Term: [e.g., Spring 2024]
- Course Credits: [Number of Credits]

Course Description: This course explores the intricate connections between water, waste, and wellness within the broader context of environmental science. Topics include the chemistry and treatment of water, waste management strategies, and the impact of these factors on human well-being. Students will engage in interdisciplinary learning, emphasizing the integration of environmental principles into personal and community wellness.

Course Overview: This 15-week course comprises lectures, discussions, case studies, and practical applications. Students will delve into the complexities of water systems, waste management, and their direct links to individual and community wellness.

Class Meeting Days and Times:

- Days: [Mondays and Wednesdays]
- Time: [10:00 – 11:30 AM]

Course Learning Outcomes: By the end of this course, students will be able to:

- Analyze the chemical composition of water and assess its quality.
- Design comprehensive waste management plans incorporating liquid and solid waste strategies.
- Correlate the impact of water quality on public health, specifically in terms of nutrition.
- Assess the environmental impact of different waste management strategies.
- Integrate principles of sustainable living into personal wellness routines.

Learning Materials:

Textbooks:

- "Environmental Science" by G. Tyler Miller
- "Water: The Epic Struggle for Wealth, Power, and Civilization" by Steven Solomon

Grades (Assessment, Measurement and Evaluation):

- Water Quality Analysis Report: 250 points
- Waste Management Plan Presentation: 200 points
- Waterborne Diseases and Nutrition Analysis: 150 points
- Environmental Impact Assessment: 250 points
- Personal Wellness and Sustainability Plan: 150 points
- Final Reflection: 200 points

Course Policies:

- **Class Attendance and Participation:** Regular attendance is expected. Active participation in class discussions is crucial.
- **Late Assignments:** Late assignments will be penalized unless an extension is requested in advance.
- **Rewrite Policy:** Assignments may not be rewritten unless otherwise specified.
- **Group Work Policy:** Group projects will be assigned, promoting collaboration and diverse perspectives.
- **Instructional Technology:** Use of email for communication; texting and mobile devices only during breaks.
- **Professionalism Policy:** Professional behavior and respect for diverse opinions are expected.
- **Academic Honesty/Plagiarism:** Follow the university's code of conduct regarding academic honesty and plagiarism.
- **Disability:** Students with disabilities should contact the instructor to discuss necessary accommodations.

Claude Response:

Environmental Connections: Water, Waste, and Wellness Course Syllabus

Instructor: Professor Name

Office: Hamilton Hall Rm 212

Phone: 123-555-1234

Office Hours: M/W/F 9-11am

Email: vyv.zzz@fakecollege.edu

Grader: Teaching Assistant (TA)

E-mail: j.smith@fakecollege.edu

Grading Calls: By Appointment

Course Information
Term: Spring 2024
Credits: 4 Units
Times/Days: Tues & Thurs 10am-12pm

Description: Interdisciplinary environmental science course exploring connections between water systems, waste streams, nutrition, environmental policy, and community health outcomes. Applied focus on analyzing challenges and proposing solutions.

Learning Outcomes.

By the end of the course, students should be able to:

1. Evaluate water contamination challenges and solutions
2. Analyze and recommend appropriate waste reduction programs & policies
3. Connect environmental issues to community health factors
4. Apply systems thinking lens across water, waste and wellness topics
5. Craft convincing sustainability solutions for real-world issues

Textbooks: Environment Connections (Pearson 2022). Supplementary Readings.

Grading (see schedule for due dates)

- Assignments: 30%
- Lab Work: 20%
- Final Project: 25%
- Weekly Milestones: 25%

Course Policies

- Attendance is required at all class sessions
- Late work accepted within 48 hours for 75% credit
- Group work must adhere to posted collaboration policy
- Mobile devices must remain off during class sessions
- Academic honesty violations result in failing grade

Disability Accommodations. Accommodations can be arranged given sufficient notice.

DISCUSSION

In summary, I explored the relatively new integration of GenAI in the process of backward designing a college-level environmental science course (Lockard & Hargis, 2017). The application of GenAI in higher educational curriculum development represents a novel approach that holds promise for enhancing instructional design and fostering student engagement. The results highlight the potential of GenAI in streamlining the backward design process. By leveraging the language generation capabilities, educators can efficiently create detailed learning outcomes, assessments, and instructional materials. This not only expedites the design phase but also ensures that the course content aligns with desired LOs.

Teacher expertise remains paramount in effective integration of GenAI into effective teaching and learning. GenAI is not a replacement for educators but rather a tool to enhance their work. Educators bring critical thinking, context, and experience to the table, enabling them to evaluate and supplement AI-generated content effectively. They play a crucial role in contextualizing GenAI outputs within the curriculum, adapting them to meet educational standards, and addressing the diverse needs of students. The use of GenAI-generated content can have implications for student learning and development. While it may offer personalized learning experiences, there are concerns about its impact on critical thinking and problem-solving skills (Choi, et al., 2023). Over reliance on AI-generated materials could potentially stifle students' ability to think critically, analyze information, and develop independent problem-solving skills. Furthermore, there's a risk of a disconnect with real-world experiences in environmental science. Students may rely solely on AI-generated simulations or data, missing out on hands-on experiences and fieldwork crucial for understanding environmental phenomena in context. Additionally, anxieties surrounding the use of AI in education may arise, with students questioning the reliability or fairness of AI-generated content.

Ethical considerations loom large in the use of AI in education. Issues such as student privacy and ownership of learning data require careful attention. The collection and analysis of student data by AI systems raise concerns about data security, consent, and potential misuse. Moreover, the evolving role of educators in the age of GenAI raises questions about professional autonomy, responsibility, and the equitable distribution of resources and opportunities. There's also a risk of exacerbating educational inequalities if access to GenAI tools and resources is not equitable. Socioeconomic factors, technological infrastructure, and institutional support can influence access to AI-driven educational innovations, widening existing disparities in educational outcomes. GenAI can personalize learning for students with different backgrounds by adapting content delivery and pacing to individual needs (Gupta, et al., 2023). Simulations can enhance student engagement and understanding of complex environmental issues by providing interactive and immersive learning experiences. Furthermore, GenAI can create opportunities for self-paced learning or adaptive learning environments, catering to diverse student needs and preferences.

Further research is needed to evaluate the effectiveness of GenAI in environmental science education and identify areas for improvement. Comparative studies examining the learning outcomes of students exposed to AI-generated content versus traditional instructional methods can provide valuable insights. Additionally, exploring potential applications of GenAI in other scientific disciplines or educational contexts can expand its utility and impact. Optimizing human-AI collaboration for effective course design is another promising avenue for future research. Investigating best practices for integrating GenAI tools into instructional practices, designing AI-enhanced learning experiences, and fostering meaningful interactions between educators and AI systems can enhance the efficacy and sustainability of AI-driven education initiatives.

Since GenAI is still very new, little research has been published on using GenAI with backward design to create and organize curriculum. One of the goals of this research is to be an early adopter of this approach to support others who are interested in connecting the backward design model to updated educational technology. Therefore the hope is that through publication of this research other educators will have a chance to review the final product and subsequently comments and evaluate whether a similar approach could be used in their teaching.

LIMITATIONS AND CHALLENGES

Despite the promising outcomes, it is essential to acknowledge the limitations of GenAI. It may occasionally produce inaccuracies or lack the nuanced understanding required for certain complex environmental science concepts. Striking a balance between human expertise and AI-generated content remains a challenge that warrants further exploration. GenAI may not afford contextual information. Current models may not be aware of the latest developments, advancements, or changes in a particular field. They might not have access to real-time information or understand the current context of the subject matter. The following represents specific challenges for this project:

1. Potential Biases in GenAI Models

While GenAI models hold promise in revolutionizing environmental science education, they are not immune to biases inherent in their training data. Biases in training data can lead to inaccurate or misleading information, undermining the reliability of AI-generated content. For instance, if the training data predominantly represents certain geographic regions or ecosystems, the AI may produce biased outputs that overlook the diversity of environmental issues worldwide. Moreover, historical biases in data collection processes may perpetuate disparities in environmental representation, reinforcing existing inequalities. Specific examples of potential biases relevant to environmental science include:

- **Geographic Bias:** If the training data predominantly includes environmental data from certain regions, AI-generated content may overlook issues specific to other regions, leading to a skewed representation of global environmental challenges.
- **Species Bias:** Biases in species representation within training data could result in AI models prioritizing certain species over others, neglecting the conservation needs of underrepresented or lesser-known species.
- **Human Impact Bias:** If historical data primarily focuses on human impacts on the environment, AI-generated content may overlook the ecological dynamics and natural processes crucial for understanding environmental systems comprehensively.

2. The Role of the Educator

Human expertise remains indispensable in mitigating GenAI's limitations and biases. Educators play a pivotal role in curating and evaluating AI-generated content to ensure its accuracy and relevance in environmental science education. By leveraging their subject matter expertise, educators can critically assess AI-generated materials, identify inaccuracies or biases, and supplement them with additional context or corrective information. Moreover, educators need to adapt GenAI outputs to specific learning objectives and student needs. This entails contextualizing AI-generated content within the broader curriculum, tailoring it to address specific educational standards or learning outcomes, and integrating it seamlessly into instructional practices.

3. Solutions and Future Directions

Efforts are underway to enhance GenAI's capabilities in handling complex environmental concepts, incorporating real-time data, and adapting to diverse educational contexts. Ongoing research endeavors focus on refining AI algorithms, diversifying training data, and developing robust frameworks for human-AI collaboration in educational settings. Educators can benefit from specialized training programs aimed at equipping them with the necessary skills to effectively utilize and integrate GenAI tools into their teaching practices. These programs emphasize critical thinking, data literacy, and ethical considerations in AI-driven education, empowering educators to harness the full potential of GenAI while mitigating its limitations.

4. Specific Examples

Complex environmental science concepts such as ecosystem dynamics, climate change modeling, and biodiversity conservation pose challenges for GenAI due to their intricate nature and interdisciplinary scope. AI-generated content may oversimplify or misrepresent these concepts, hindering students' understanding of nuanced environmental phenomena. Furthermore, AI-generated materials may not align with regional educational standards or accreditation requirements, limiting their applicability in diverse educational contexts. For instance, AI-generated content may overlook specific topics mandated by regional curricula or fail to address culturally relevant environmental issues, impeding its effectiveness as an educational resource.

5. Connecting to the Broader Discussion

These limitations underscore the importance of critically evaluating the potential benefits of using GenAI in environmental science education. While GenAI holds promise in enriching learning experiences and democratizing access to environmental knowledge, its limitations and biases must be acknowledged and addressed to realize its full educational potential. By fostering collaboration between human educators and AI systems, we can leverage the strengths of both to enhance environmental science education and empower future generations to address pressing environmental challenges effectively. The models may have difficulty in grasping nuances. The platform may struggle to comprehend the cultural context, and pedagogical requirements of a particular course. Crafting a syllabus often involves considering the unique needs of the students, the learning environment, and the specific goals of the course. The AI may not be able to tailor to regional requirements. College syllabi often need to align with local educational standards, accreditation requirements, and institutional policies. AI may not be well-versed in these specific guidelines and may inadvertently produce content that does not meet these standards.

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