How Colleges are Adopting Artificial Intelligence (AI) & Machine Learning (ML) in STEM Classrooms Today

Marie Tupaj, Ph.D., Peter Shea, M.A., Middlesex Community College
IEEE Boston Technology Conference and Exposition
April 12, 2024
The Application of AI Technologies in STEM Education (2011 to 2021)

Xu, et al. J STEM Ed 9, 59 (2022)

DeepTutor
Stemify
MathGPTPro, Azure
## Ways Colleges Engage with AI

<table>
<thead>
<tr>
<th></th>
<th>Students</th>
<th>Professors</th>
<th>Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Students</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tutoring</td>
<td></td>
<td>Grading Efficiency</td>
<td>Personalize Learning Experience (Virtual Tours)</td>
</tr>
<tr>
<td>Review of the assignment to increase class participation</td>
<td></td>
<td>Supplements Lessons Plans and Aids in Course Design</td>
<td>Identify Plagiarism/Fraud</td>
</tr>
<tr>
<td>Understanding if the point is getting across when writing</td>
<td></td>
<td>Accelerates Exam Prep (Problem Sets, Assessments)</td>
<td>Enhance Student Experience</td>
</tr>
<tr>
<td>Summarizing Text</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removes Tedious Activities</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Examples of AI Capabilities for Learning STEM Concepts

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Concept</th>
<th>Concept</th>
<th>Tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comp. Sci</td>
<td>Code Snippets</td>
<td>Manual Creation</td>
<td>GitHub Copilot</td>
</tr>
<tr>
<td>Tech Writing</td>
<td>Manual Creation</td>
<td>Data Analysis &amp; Simulation</td>
<td>ChatGPT</td>
</tr>
<tr>
<td>Engineering</td>
<td>Data Analysis &amp; Simulation</td>
<td>Newtonian Force Problems/Dynamics</td>
<td>MATLAB, COMSOL</td>
</tr>
<tr>
<td>Life Science</td>
<td>Cell &amp; Molec. Bio (morphology, pathology, protein recognition/sequencing), Material Properties</td>
<td>Program - Functions</td>
<td>ProtGPT2, ProGen</td>
</tr>
</tbody>
</table>

Program - Functions

```
<?php

function my_login_notification( $user_login, $user ) {
    $admin_email = get_option( 'admin_email' );
    $subject = 'User Login Notification';
    $message = 'A user has logged in: ' . $user_login;
    wp_mail( $admin_email, $subject, $message );
 }

add_action( 'wp_login', 'my_login_notification', 10, 2 );
```
Identifying Best Practices in Education Continues

<table>
<thead>
<tr>
<th>Concern</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plagiarism in essays/work</td>
<td>65%</td>
</tr>
<tr>
<td>Reduced human interaction in learning</td>
<td>62%</td>
</tr>
<tr>
<td>Data privacy and security</td>
<td>42%</td>
</tr>
<tr>
<td>Job displacement for teachers</td>
<td>30%</td>
</tr>
<tr>
<td>Unequal access to AI-powered resources</td>
<td>30%</td>
</tr>
<tr>
<td>Automation of manual tasks</td>
<td>23%</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>1%</td>
</tr>
<tr>
<td>N/A: No concerns in particular</td>
<td>4%</td>
</tr>
<tr>
<td>Not sure</td>
<td>1%</td>
</tr>
</tbody>
</table>

Source: Forbes Advisor
Ways AI and ML Evolves on Campus and Influences the Student Experience

Understanding Best Practices & Training Faculty and Staff Across Campus

Address Security Protections for
- Interpreting Recruitment Data on Admissions, Retention
- Addressing Financial Aid Questions
- Supporting Career Opportunities

Design of Future Platforms for Teaching STEM education

The Adoption of Learning & Empowerment Through Agency & Understanding via Experimentation
We’ve been working on ways to streamline this process. **MCC has a tool now** that will automatically generate entire modules of content.
Constructing Interactive Content

It's 7 am and you have just gotten up. Your first thought is to rehydrate. Choose between a glass of tap water, bottled water, or untreated water.
Constructing Interactive Content

Your island is considering a major investment in solar energy. This could reduce your carbon emissions but may divert resources from other priorities. How will you proceed?

I’d like to build solar panels all over the island!

Submit

The eventual goal is to have interactive games that can communicate with the LLM and dynamically generate feedback.
Thinking About Affordances

Constructing Interactive Content

AI can generate Retrieval practice tools which, using space practice, help stimulate, retrieve and preserve knowledge for future use.
Questions?
Extra: Places Policies Regarding the Use of AI Writing Tools Are Made

- **Public, 4-year or above**:
  - Institutional level: 28%
  - Department level: 7%
  - Course level: 19%
  - No policies are being made at my institution: 21%
  - Don't know: 25%

- **Public, 2-year**:
  - Institutional level: 19%
  - Department level: 14%
  - Course level: 16%
  - No policies are being made at my institution: 26%
  - Don't know: 26%

- **Private not-for-profit, 4-year or above**:
  - Institutional level: 26%
  - Department level: 11%
  - Course level: 32%
  - No policies are being made at my institution: 17%
  - Don't know: 14%

*Source: Fall 2023 Faculty Pulse Survey, Tyton Partners analysis*