THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學

Educational Development Centre
教學發展中心

GOOD Flipped Classroom CASE

Flipped Learning and Teaching Initiative

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Department
Department of Applied Mathematics (AMA)

AMA1D01C
The History of Ancient Chinese and World Mathematics

Class size
Around 40

Students
Undergraduate students

Details of Flipped Classroom IMPLEMENTATION

Why did the instructor use the flipped classroom approach?

In AMA1D01C, Adam utilised a partial flipped classroom approach to bridge the gap between procedural fluency and conceptual understanding. Ancient Chinese mathematics presents a unique challenge: its algorithmic nature and linguistic roots in Classical Chinese often leave students able to compute results without fully internalising the systemic logic. By leveraging GenAI-powered interactive applications for asynchronous pre-class engagement, Adam addressed the challenge of student passivity and reclaimed valuable synchronous contact hours. This strategic design transitioned the classroom from a site of primary information delivery to a dynamic space for high-level synthesis, targeted clarification, and the collaborative resolution of nuanced conceptual hurdles.

How was the flipped teaching approach implemented?

Preparation of materials

Adam developed a series of interactive, GenAI-powered apps to deconstruct the procedural complexities of ancient Chinese mathematics. By utilising AI for coding and interface design, he created over 20 interactive apps that allow students to navigate solution processes step by step. These apps were developed based on how ancient mathematicians approached calculation and proof, enabling students to follow the original procedural logic and understand how solutions were constructed. This approach reduced development time while providing a clear, interactive visualisation of algorithmic reasoning.

Pre-class activity

The apps served as a preparatory bridge. By interacting with the material before the lecture, students arrived with a baseline understanding of the logic and structure of the day's topics. This "low-stakes" exposure proved essential for mastering content that is often linguistically and conceptually dense.

In-class activity

The flipped model transformed the classroom dynamic. With students already primed by the interactive apps, Adam could maintain a rigorous, teacher-led demonstration style that focused on deep logic rather than rote calculation. The classroom became a space for high-level clarification and the resolution of complex conceptual hurdles.

Post-class activity

To ensure long-term retention, students used the apps post-class to consolidate their learning. The ability to revisit the tools and test different variables allowed for personalised, self-paced review, effectively catering to a diverse range of learning speeds and styles.

What was the impact on student learning?

There is a unique joy in seeing a student finally "click" with a thousand-year-old algorithm, and these interactive apps made those "aha!" moments more frequent than ever. By leveraging GenAI to build these tools, the approach not only supported the teaching of mathematics but also created a learning environment that encouraged exploration and discovery. The impact was clear: when students could manipulate the variables themselves, the content became less of a chore to memorise and more of a puzzle to solve.

The true success of this initiative lay in how it reclaimed the classroom. Because students had the opportunity to prime their brains beforehand, our face-to-face time became significantly more meaningful. This was reflected in reduced emphasis on note-taking and increased attention to listening and understanding. Although the challenge of student passivity remains a hurdle, we are passionate about overcoming, the apps have proven to be an indispensable resource. They provide a flexible, non-judgmental space for students to learn at their own pace, ensuring that no student is left behind by the speed of a lecture.

What are the good practices that can be learnt from this case?

Leveraging GenAI for Agile Resource Development

- The use of GenAI to engineer subject-specific interactive applications demonstrates a shift toward agile instructional design. By utilising structured prompting to define mathematical logic and interface requirements, educators can now democratise the creation of custom learning tools. This significantly lowers the technical and temporal barriers to developing high-quality, interactive simulations, making it a highly scalable solution for diverse disciplinary needs.

Strategic Implementation via the "Partial Flipped" Model

- Rather than a total pedagogical overhaul, this case advocates for a targeted, partial flipped approach. By selectively flipping only the most challenging units, the instructor maintained instructional continuity and feasibility. This ensures that the benefits of asynchronous preparation are realised without overwhelming students or disrupting the established course framework, providing a sustainable roadmap for blended learning.

Precision Alignment of Technology and Pedagogy

- A critical success factor was the disciplinary alignment of the digital tools. The apps were not generic; they were purpose-built to address the "black box" of procedural and algorithmic reasoning inherent in ancient mathematics. This illustrates the importance of Pedagogical Content Knowledge—ensuring that technology is deployed specifically to bridge documented conceptual gaps rather than for the sake of novelty alone.

Cultivating Agency through Low-Stakes, Flexible Scaffolding

- By positioning pre-class activities as optional, supportive scaffolding rather than compulsory hurdles, the instructor respected learner autonomy and diverse motivations. This "low-stakes" entry point reduces anxiety and allows students to engage with complex material at their own pace. It transforms pre-class work into a valuable resource for self-directed mastery, effectively catering to a wide spectrum of student readiness and learning styles.

Enhancing Cognitive Focus in the Synchronous Classroom

- The primary value of the flipped elements was the intentional reclamation of classroom time. By offloading basic procedural exposure to asynchronous apps, the instructor was able to pivot in-class sessions away from rote delivery toward high-level synthesis, error analysis, and the resolution of nuanced misconceptions. This ensures that face-to-face contact hours are utilised for the highest levels of Bloom's Taxonomy.

What were the challenges encountered during the implementation and what solutions were used?

Addressing Cognitive Passivity and Varying Engagement

- A significant hurdle was the persistence of passive learning habits—a challenge exacerbated by the recent shift toward one-way digital delivery in higher education. Some students remained hesitant to engage with asynchronous materials, preferring the safety of traditional, instructor-led explanations. Adam adopted a "Low-Stakes, High-Support" model. By positioning the GenAI apps as supportive rather than mandatory, the instructor lowered the barrier to entry for self-directed study. To ensure no student was marginalised, the in-class sessions remained highly structured, providing a safety net for all learners while offering enriched, interactive pathways for those who had engaged with the pre-class content.

Bridging the Gap Between Discovery and Instruction

- Flipped learning often fails when the pre-class work feels isolated from the "actual" teaching. Maintaining a clear conceptual bridge is essential for student buy-in. Adam established Tight Curricular Alignment. The apps were specifically designed to introduce the "structural DNA" of mathematical problems. When students entered the classroom, the instructor could immediately build upon those structures to tackle more nuanced logic and classical interpretations. This clear "hand-off" from the app to the instructor helped students see the immediate value of their pre-class efforts.

App interface reference: