INNOVATIVE INSTRUCTIONAL DESIGN TO ADDRESS DIGITAL DIVIDE THROUGH FLIPPING MATHEMATIC CLASS ROOMS

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Abstract

Mathematics has been considered a foundational knowledge and skill-based discipline. The teaching of mathematics revolves around this concept, and learners find it difficult as most teachers fail to localise and connect to real life. Appreciating mathematics concepts and applications needs to focuson foundational and numeracy skills. Focusing on these would bring the complaint about the curriculum overload and time factors. Uncovering the syllabus is more important than covering the syllabus, such that mathematics teachers can adopt the inputs from instructional designs without diluting the achievement of learning outcomes. Innovating teaching methodologies are compelled by the recent experiences of the stakeholders. Since the mathematics concepts are the same, dealing according to the needs ofthe learners through innovative and interactive ways would be needed. The methodology of teaching mathematics can be strengthened and enhanced with the adequate use of technologytools, allowing teachers to adopt innovative designs. While innovating, the existing digital divide also needs to be considered instead of blind adaptation of technology tools. Flipping mathematics classrooms is possible through both offline and online tools. This paper tries to discuss the need and importance of innovation and provide a sample for flipping with some selected tools.*Keywords***:** Innovation, engagement, instructional design, flipped learning.

Introduction

The world witnessed a variety of divides in terms of those who have and have not. In every phase of development, this divide is imperative. Efforts were immense to address social, cultural, economic and even political divides. These kinds of divides affected education in all these times. When the shift happened methodologically and content-wise, these divides disrupted attaining the educational aims.

Digital divide is a reality even with the widespread of the internet and advanced technologies. Digital natives and digital migrants were the kinds of digital divide that were discussed a lot and accelerated efforts to bridge the gap. Digital migrants including the teachers equipped through various attempts to synchronise with the digital natives. When extensively depending on the internet and cyberspace, a new divide in terms of digital residents and digital visitors is brought into discussion.

Innovativeness in instructional design is anchored in the methodology of integrating varieties of resources or media in the teaching-learning as well as objective and informed assessment strategies focusing on the formation of learning.

Teachers usually focus on the teaching method which helps them cover the syllabus in the easiest ways. Curricular load is been discussed as an excuse for not trying thealternatives or revised methods of teaching. Without any attempts, teachers blindly either ignore or avoid certain best methodologies of teaching in Mathematics. Speer M. Natasha (2005) argues about the misfit between professed and attributed beliefs. This case could be easily in Mathematics teaching, especially using methodologies. Since the learners of the dayare digital natives or digital residents, teachers are compelled to embrace technology and bring varietyto teaching.

Various efforts are been made by mathematics teachers to integrate technology. The integration mostly becomes for the sake of using technology rather than a planned integration of technology with the method of teaching. The majority of them are sacrificing theirteaching styles and even their assessment. In this background, it would be better to discuss the innovativeness that should address the digital divide.

There are lots of concerns that at the teacher level, one may not be able to address, like access to digital gadgets, uninterrupted power supply, stable network bandwidth andeven support from the parents, who are supposed to be partners in their wards' learning. Agreeing on these, teachers would work on the areas where they can bring innovation, like designing teaching-learning experiences, formative assessment and support mechanisms.Instructional design ideas always support teachers who are interested in integrating technology into themathematics classroom. Various instructional design models give enough opportunities for the teachers to design the teaching and learning. Content competency and pedagogic competencies of the teachers are crucial in thinking of innovation. When the focusof teaching teaching-learning process is on content coverage rather the foundational knowledge, teachers fail in their design.

Instructional Design to Innovate

Teachers need to explore the various components of instructional design like analysing learner, content, context and tasks including the assessment. Their confidence inthe area can be falsified based on their experiences and cases. Deliberate attemptsto analyse the content by the teacher would set up the base for the instructional design. Nature and type of content flavoured with the experience of the teacher would help in designing smartoutcomes. Once the smart outcomes are designed with appropriate cognitive, affective or psychomotor processes, it will be easy to design the learning experiences.

While involved in the content analysis, teachers' conceptualisation of mathematics as a mere body of knowledge and skill may not be helpful. Going beyond the foundational knowledge and skill are indeed needed. Considering Greek mathematics as the fundamental and maximising the coverage may not be appropriate (Devlin, 2021). This would be why the student feels that mathematics is tough. Exploring the connection between localised knowledge and real life and simplifying the learner's language without deviating from mathematics syntax and semantics may help the teachers address this concern. Historical methods and allowing the learners to appreciate the history behind each mathematic also support in order to create interest among them. The content analysis process needs to be rigorous such that comprehensiveness in attaining mathematisationis made easy.

The content analysis helps anchor the design of specific learning outcomes and meaningful and constructive teaching-learning experiences. Teachers resort to activity-based approaches, and if the activities are pedagogically designed, the learners and teachers fail in the entire process; rather, simple activity completion would be done. While designing the learning experiences, the teachers' digital literacy and technological competencies correlated with the effectiveness of the instructional design that supports technology integration. Teachers may use the task analysis or even design a flowchart leading to an algorithm for teaching learning. In the decision-making, teachers may take up the technology tool analysis, exploring their pedagogic values appropriate for Mathematics. Finding room for applied reasoning, verification, higher-level analysis, and even observation of the mathematics concepts and processes generally missed in a regular classroom. Wrap and weaving of mathematics teaching-learning would be aligned to the mathematisation. How the learning experiences feel by the learners in the classroom would be a question to be raised by the teachers. Teachers need to move ahead with the content analysed to the analysis of tasks and contexts.

All these pre-phase activities are either neglected or avoided, claiming the years of experience of teaching with the same contents. Teachers feel that this could be revived in the light of technology integration. Selection and improvisation of the technology tools can be justified with a detailed analysis. Maximum time has been spent delivering the foundational knowledge and skills, and teachers may get exhausted in scaffolding the learners to the higher levels of learning. These complaints can be easily resolved when a teacher tries to innovate the teaching-learning.

There are various technology tools that each teacher may be aware of. They try some of the tools out of curiosity and mostly stop using them. The detailed analysis of the same tool's pros and consis not taken seriously. Researchers also try to bring simple to most advanced technology tools' application in mathematics teaching, but the case studies on the success or failure of the technology integration are seen as missing in most of the literature. It is a result of a misconception that any research should statistically signify positively.

The race is behind blended, m-learning, and flipped learning with technology integration. Various researchshows these strategies' effectiveness, but in actual practice, the effectiveness depends on how best the teacher designs the same. Technological and Pedagogical Content Knowledge (TPACK) helps to set up the sage for designing instruction in any of these strategies. The following section tries to explain some of the technology tools that could be used to flip the mathematics classroom, intending to innovate and address the digital divide.

Ideas to Flip the Mathematics Classroom

Learning is conceived generally as multi-dimensional, but teachers address the same as if it is uni-dimensional. The multi-dimensional learning modelallowed the teachers to plan the mathematics classrooms' flipping. Flipped Learning is seen as a teaching-learning strategy that can flip those learning tasks carried out in a regular classroom with those learning activities assigned to the learners as either extended orhomework. The flippedlearning strategy opens up the opportunities of flipping with the requirement of a flexible learning environment, intentional content, learning culture and professional educator, as the Flipped Learning Network (FLN) suggested.

The flexible learning environment need not be as a multi-purpose room as suggested; the learners should be able to explore their learning flexibly. Intentional content selected by the teacher, though students doubt sharing/ doubt corner post box with enriched content, can

take the learners to higher levels of learning. Learning culture would be challenging in our classroom as teachers and learners are habituated toteacher-led classrooms, where the teacher supports learning. Flipping the learning culture can include self-learning, peer learning, and group-based learning. Allowing the varieties of learner-centred activities and objective in diagnosing and remediating needsa professional outlook by the teacher.

Active and engaging learning experiences result in better learning. With this focus on mathematics as a subject of applied reasoning logical and critical thinking, flipping would be appropriate (Wilson, 2013; Cronhjort et al., 2018; Lo & Hew, 2021). Researchwas carried out on different dimensions of engagement, like behavioural, emotional, and cognitive engagement, which a flipped classroom can provide.

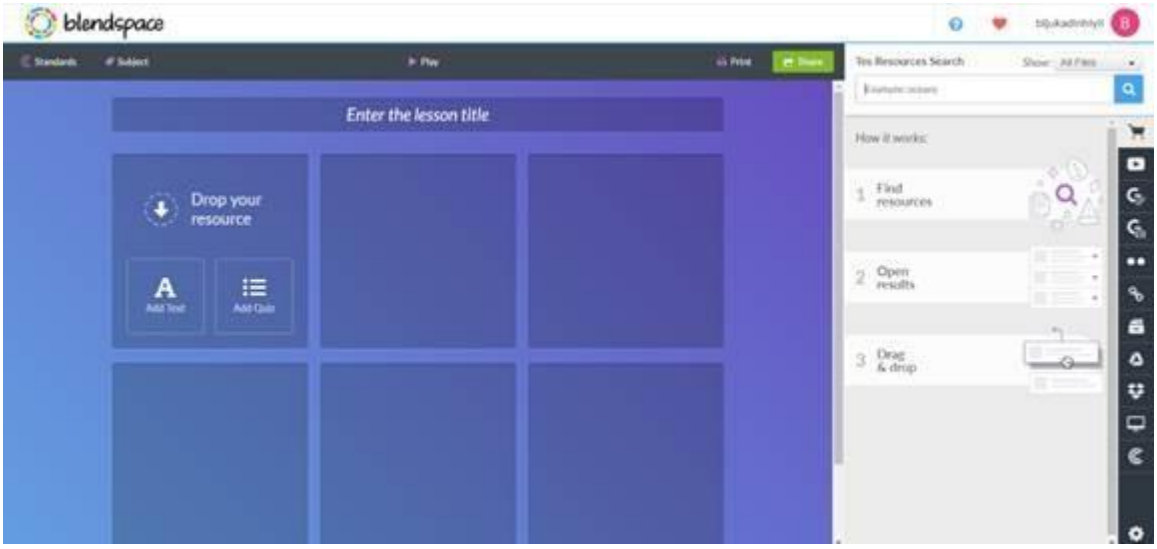
Flipping of Mathematics classrooms can be achieved in different ways. Literaturesuggests that teachers share pre-recorded videos with the learners based on the designed outcomes, allowing them to explore the content and supporthigher-level interactions in the classroom. The other way would be designing a course based on a learningmanagement system (LMS) or a content management system (CMS) and sharing the resources for self-exploration followed by problems/questions to solve. Higher dependency on technology tools may raise doubts among the teachers because they are experiencing the challenges of learners' active participation in the online mode. Dependency on technology tools need not be confined to web-based online resources; teachers can act as the course designers, which could be accessed even without the internet.

Offline access to the content, designed in a detailed course structure, would be a solace for learners from remote areas who are divided digitally in terms of access. Content authoring tools like exe from exelearning.net can help teachers easily design enriched content in international standards like IMS and SCORM. The course or content designed in exe based on the selected learning outcomes can be easily embedded into any HTML-based pages, which can benefit the teachers.

As in the classroom, there is heterogeneity; web services like https://www.blendspace.com/ or https://nearpod.com/ or https://info.flipgrid.com/ or https://spiral.ac/help the teacher to arrange verities of resources, either teacher-made or browsed contents such as address varied needs. Readymade applets like Geogebra applets help the learners explore mathematical concepts at home, prepare sketches, and explore verification and higher-level analysis. Learning Management Systems like

https://new.edmodo.com/ or https://canvas.instructure.comhelpwith similar functionality but allowharnessing for other dimensions of learning management, including assessment.

Blendspace



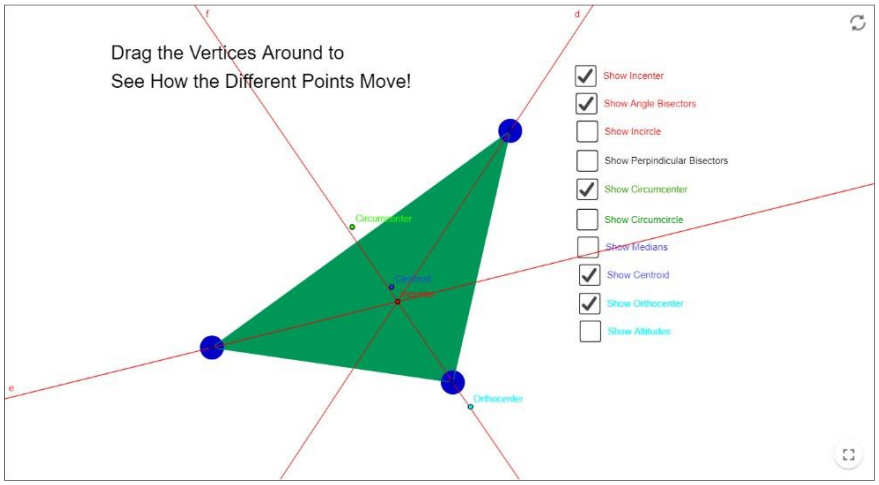
Blendspace allows one to create an account and then one can create a lesson. In order to design the lesson, one will have the different tiles where different resources can be placed from various platforms. Thus, a mathematics teacher can create lesson tiles in the blendspaceand share to the learners with the link. Learners at home can explore the resources and prepare the foundational knowledge. In the class,the teacher can take the doubt clarifications and further discussion or demonstrations and take the learners to higher levels of learning. Inside the classroom, the teacher can design various activities like puzzles, infographics or mind maps in order to confirm the higher-level learning mapping to the designed outcomes.

GeoGebra

Geogebra, free and open-source software, can be installed on the learners' gadgets. Mathematics teachers can create basic sketches of triangles and share them with the learners. By exploring the predesigned Geogebra sketch, learners will be able to clarify the basic concepts associated with triangles. Inside the classroom, the teacher will be able to demonstrate the following sketch: the incentre, ortho centre, centroid and circumcentre in a single sketch. Since Geogebra is an interactive app, the learners will be able to observe the behaviour of the different centres and infer the following:

1. Which are the centres always lie inside the triangle?
2. The position of different centres according to the type of triangles.
3. The condition where all the centres join in a single point.
4. Euler's line and theorem.

In a traditional class room, all the above inferences used to state to the students whereas by flipping the mathematics class room a teacher is able to take the learners to higher levels of analysis, verification and conclusion.



(Source: https://www.geogebra.org/m/BfVXWKGh)

Conclusion

Technology tools need to be selected based on pedagogic values that provides to the mathematics teaching rather according to the availability and accessibility. Instructionaldesign must be the heart of innovation, which can be assured using appropriate and comprehensive technology tools. This paper attempted to provide some insights intointegrating technology tools in teaching mathematics, which can be realigned with innovative methodologies.

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