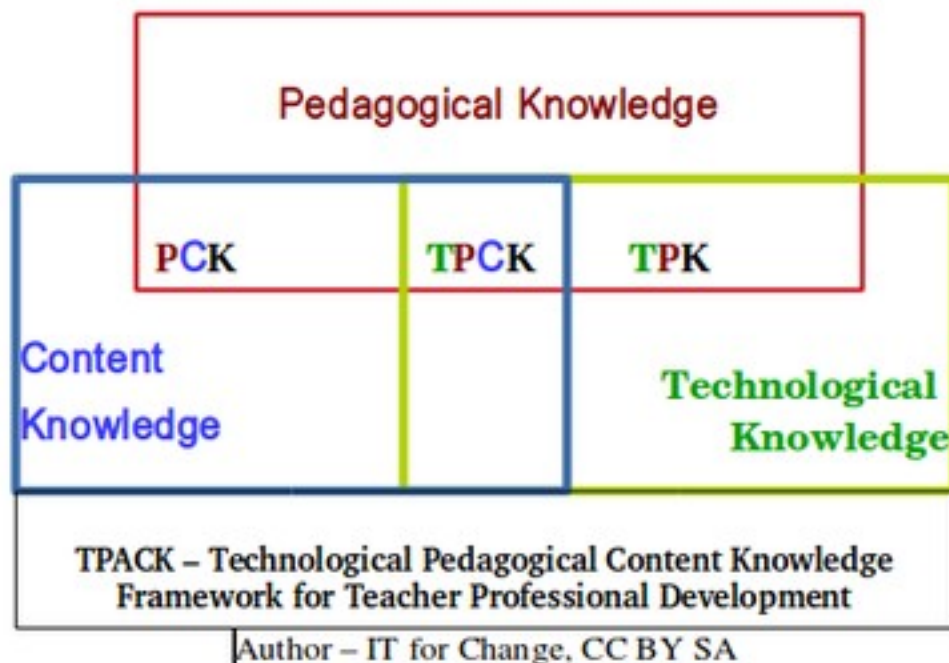


# Share your reflections in the forum

## Technological Pedagogical Content Knowledge

Technological Pedagogical Content Knowledge, (TPCK), is a framework that explores how content knowledge and pedagogical knowledge can interact with technological knowledge of the teacher and how this interaction can improve teacher practice as well as impact educational outcomes.



A key starting point for a teacher in the teaching-learning process is a curriculum analysis to determine methods of transacting. Apart from the objectives of that lesson, this includes - what do I need to teach, (what do I need to know to teach this), how do I teach it and how do I know what learning happened<sup>1</sup>. Identifying the resources needed as well as accessing and creating the resources follows this analysis. The availability of digital technologies (hereafter technologies / technology) has added another dimension to how the teachers' content knowledge and pedagogical knowledge interact with each other in influencing her practice.

One of the biggest affordances of technology is in the design, development and accessing of a variety of resources; and the effectiveness of a teachers' practice lies in how well she is able to map the resources and design the pedagogies for her learning context. Such an evaluation also includes evaluating the resource in terms of its

<sup>1</sup> Aims, curriculum, pedagogy and assessment are the four components of the [Tyler curriculum model](#)

suitability to the concepts to be covered, the areas of learning reinforced, learning extensions that are possible, suitability to a given classroom context (age appropriateness, content level) and developing appropriate pedagogies integrating the resources. This process requires the teacher to be familiar with technology besides being well versed in content and pedagogy.

This approach has been theorized as the [Technological Pedagogical Content Knowledge](#) approach to teacher professional development. A teacher can no longer ignore the technology aspect in her practice. To demonstrate how this plays out in a **mathematics teaching-learning context**, we examine in this note, three use cases of technology integration in mathematics. We take here an example of a topic in Geometry that is being explored with a different set of activities. At the end of each of these use cases, we will examine the lesson in terms of the learning objectives, the role technology played in the lessons and the kind of teacher preparation involved.

The TPCK framework can also be used to evaluate the use of digital technologies in teaching. Technological knowledge should help in furthering the pedagogical knowledge and content knowledge of the teacher, for it to enhance teaching practice and educational outcomes. If the use of technology does not impact content or pedagogy, then its use must be interrogated. The integration of digital technologies may not always be useful in teaching and this framework helps us decide if such integration would be meaningful and beneficial.

Technological knowledge for the teacher can help in furthering her own content knowledge – through accessing and creating resources to represent content in multiple ways – and pedagogical knowledge – through providing newer and diverse methods of teaching, learning and assessment. On the other hand, a robust content and pedagogical knowledge of the teacher will help her in identifying meaningful digital tools and integrating them in her practice in more enriching ways.

## **Read, reflect and respond in the forum**

Read the scenarios discussed in the table given below, and discuss the following:

1. What are the learning objectives in each use case? Are they the same? Could they be different?
2. What are the different possibilities for student learning in each approach?
3. What are the challenges / limitations that you could face in each approach?
4. What is the nature of teacher preparation that is needed for each use case?

## Concept: Angles, types of angles and angles in a triangle

**Activity:** Building an angle, Measuring the angle, Building (cutting out) a given angle, Making complementary and supplementary angles, Verifying the angle sum property of a triangle through cutting the angles

| Use Case 1                                                                                                                                                                                                                                                                                                                                                                                                                            | Use Case 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Use Case 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The teacher introduces angles to the class through physical manipulative's like strings or sticks.</p> <p>Either before or after explaining the students are asked to “Build the angle”. Given angles are cut out after being measured through a protractor.</p> <p>After the angles are likewise introduced, students are asked to make a right angle with two complementary angles.</p> <p>A second concept is that of angle</p> | <p>Students are given an explanation of how an angle is formed. There is a video of a teacher which shows the explaining along with manipulative's the content of angles, types of angles and the angle sum property of a triangle. The video could also have some multi media representation (animations etc.) of the concept.</p> <p>There are two variations possible here – the manipulative's and the activity are shown in the video as an explanation and discussed. The activities are done by the students. Or the video is show and the students watch. The teacher can either play the video in full or stop, discuss,</p> | <p>The teacher introduces angles to the class through physical manipulative's like strings or sticks, asking them to “Build the angle”; either before or after the teacher has explained the idea of an angle. Angles are cut out after being measured through a protractor. - <b>This is home work or prior work.</b></p> <p>In class the students do both these activities of building an angle and measuring as well as marking out a given angle using an application called “Geogebra”. The teacher animates and shows different types of angles and how they can be combined to form complementary angles.</p> <p>With a given file, the students go through the logical proof of angle sum property of a file (the teacher can also guide the students to make this file). A teacher</p> |

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| sum property of a triangle. In a traditional verification, the students cut the corners of the triangle and put these on a straight line to “prove” $180^\circ$                                   | interpret and add hands on activities.<br><br>The teacher could also have recorded herself in the video.                                                                                                                                                            | can record her explanation of this using Geogebra and project                                                                                                                                                                                                                                                                                                                     |
| <b>Content</b>                                                                                                                                                                                    |                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                   |
| Angles<br>Types of angles<br>Angle sum property of triangle<br>Models depicting this content                                                                                                      | Angles<br>Types of angles<br>Angle sum property of triangle<br>Models depicting this content<br>Video – can be of different kinds – a lecture, a recreation of a black board explanation, or a teacher using materials or digital representations of content.       | Angles<br>Types of angles<br>Angle sum property of a triangle<br>Models depicting this content<br>Geogebra files<br>Video – can be of different kinds – a lecture, a recreation of a black board explanation, or a teacher using materials or digital representations of content.                                                                                                 |
| <b>Pedagogy</b>                                                                                                                                                                                   |                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                   |
| Typically, the teacher will ask students to make the angles,<br><br>The activity often has a single defined path and an end in mind.<br><br>Different activities are used to build understanding. | The pedagogy has been modified here to have a video of a lesson. The use of the video allows different ways of interacting in the classroom; can also allow for after-class learning.<br><br>Learning the use of multi media equipment is new here (including using | In addition to the approaches followed in the previous two cases, the following new pedagogies are possible:<br><br>1. The students can explore in a dynamic way how angles change (in a physical manipulative – often – there is one given angle; though it is possible to build sophisticated models also). Students can be challenged to construct a triangle where the sum of |

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|                                        | the computer, projector, copying files and other related skills)                           | <p>measures of angles <math>\neq 180</math>. They can confirm through their attempts that this sum is 180 and it can never be <math>\neq 180</math></p> <p>2. The concept of an angle as a clockwise or counter clockwise rotation is possible to build over and above the physical representation – this allows misconceptions to be clarified</p> <p>3. The classroom conversation direction changes.</p> <p>4. The use of technology also provides additional assessment pegs for the teacher. As students work with Geogebra and create their files, reviewing their work helps the teacher understand their level of conceptual understanding as well as misconceptions.</p> |
| <b>Technology</b>                      |                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Blackboard<br>Using physical materials | Blackboard<br>Using physical materials<br>Using a video and other ICT equipment to project | Blackboard<br>Using physical materials<br>Using Geogebra<br>Using a video and other ICT equipment to project                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

In addition, please also read the following articles:

1. A chapter on how to introduce learning with Geogebra to students, from a book on ICT integration, that has been developed by IT for Change - [Use of Geogebra in mathematics teaching-learning](#)
2. [https://en.wikipedia.org/wiki/Technological\\_pedagogical\\_content\\_knowledge](https://en.wikipedia.org/wiki/Technological_pedagogical_content_knowledge)