RAT

The RAT Technology Integration Model

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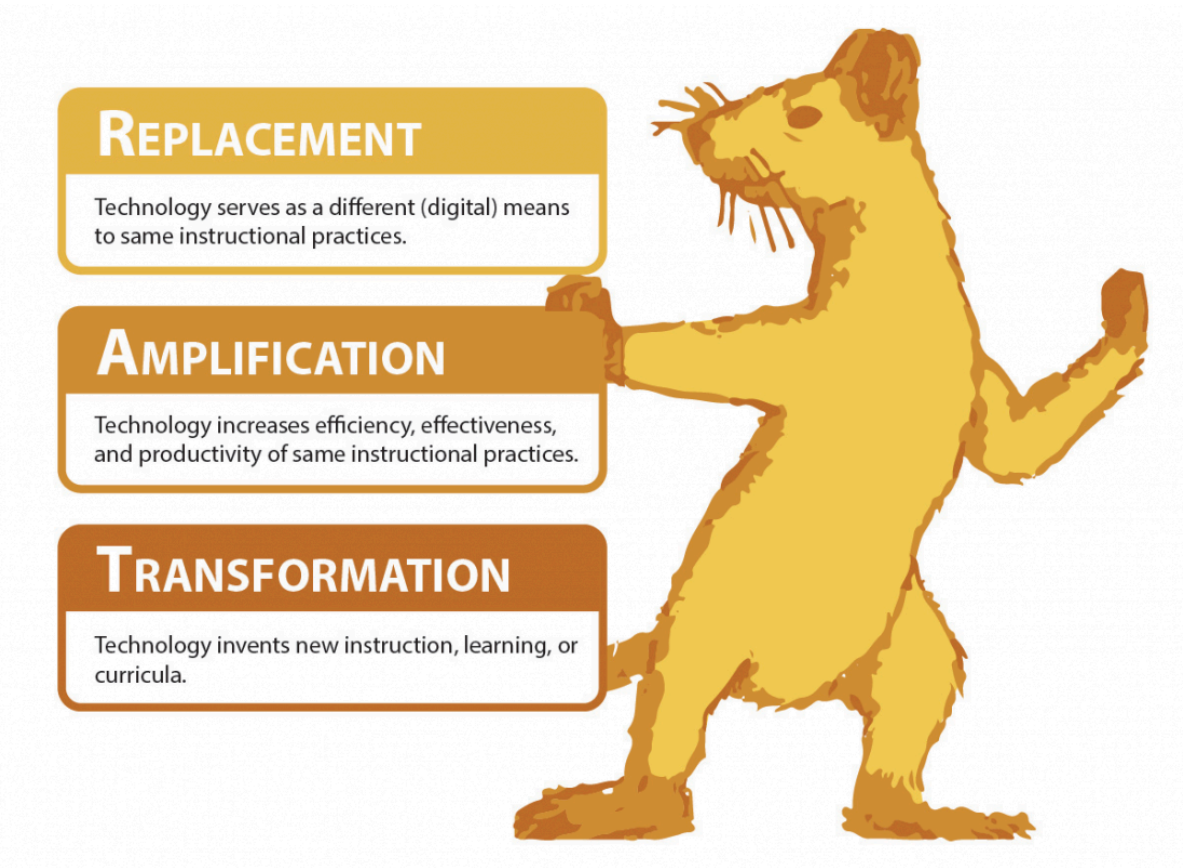
The Replacement, Amplification, Transformation (RAT) framework is a technology integration model and assessment tool that instructors can use to critically consider how their integration of technology in their classrooms serves their students and themselves. Originally developed by Dr. Joan Hughes in 1998, the RAT model aimed to study how teachers developed and integrated technology for teaching, learning, and curriculum development (Hughes, 2022). Hughes, Thomas, & Scharber (2006) further positioned the model as a framework for self-assessing technology integration "as a means to some pedagogical and curricular end." In her RAT Question Guide (2022), Hughes provides suggestions for extending this self-assessment to the school/district level. There are three primary purposes for technology integration outlined within the framework: to Replace existing, often non-digital, practices; to Amplify existing practices; and to Transform teaching, learning, and curricular goal development through digital practices.

The ways in which instructors use technology in the classroom impacts instructional methods, student learning, and/or the development of curricular goals via replacement, amplification, or transformation of existing lessons and activities (Hughes, et al., 2006). The Replacement, Amplification, Transformation (RAT) model (Hughes, 1998) identifies the primary purposes for technology integration. Figure 1 defines these technology-use purposes.

Figure 1

Artwork Depicting the RAT Framework

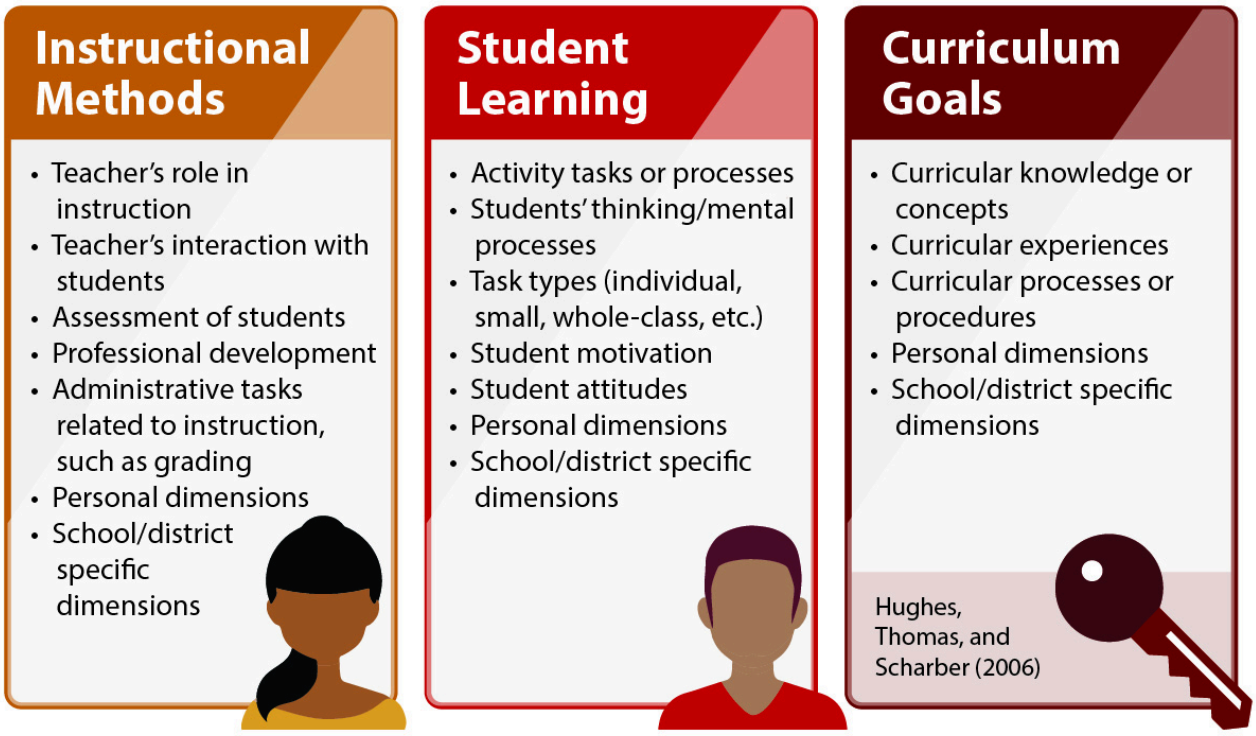


Based on CC BY artwork by Paleo-Beast-Emperor; Techedges.org by J. Hughes, 2022.
This rat-themed graphic defines the three classroom-based technology-use purposes: 1) replacement, when technology serves as a different (digital) means to same instructional practices; 2) amplification, when technology increases efficiency, effectiveness, and productivity of same instructional practices; and 3) transformation, when technology invents new instruction, learning, or curricula.

Originally developed as a research tool to study the "nature of technology-supported practices teachers developed and implemented in their teaching" (Hughes, 2022), the tool was later developed for use as an instructor self-assessment framework for critically determining how an instructor's use of technology best served themselves and their students "as a means to some pedagogical and curricular end" (Hughes, Thomas, & Scharber (2006). The RAT framework is organized around three themes and dimensions outlined in the RAT Question Guide (Hughes, 2022). In this guide, Hughes also proposes ways to consider these themes and dimensions at the school/district level. Themes include instructional methods, student learning, and curriculum goals (Hughes, et al., 2006). Each of the themes is further broken down into dimensions (see Figure 2).

Figure 2

Technology Use Impact Themes and Dimensions of the RAT Framework



Based on CC BY artwork by Dr. Michelle Read

See the RAT Question Guide, Table 1: Dimensions of Educational Themes for a screen-readable version of this information.

Table 1 and the following discussion focus on an example of a grammar lesson that might be taught in an elementary classroom by purpose. The more impact the technology use has on the three dimensions (instructional methods, student learning, and/or curriculum goal development), the more likely the use is transformative for that particular instructor and their learners.

Table 1

RAT Framework: Examples by Purpose

Original Activity: Students use highlighters in different colors to mark parts of speech on a worksheet printed from the teacher's computer files. Students might exchange papers for grading purposes.

Purpose	Examples
Replacement	This is replaced by having students use the built-in highlighter tool in Google Docs, Microsoft Word, or some other related app to identify different parts of speech (Hughes, et al., 2006).
Amplification	Allow students to use built-in tools in Google Docs to help define unknown words, or new vocabulary, and identify the parts of speech in use. Further, have them create their own sentences and use the tools to make sure they are writing complete sentences using all the desired parts of speech. Using commenting, or Track Changes (MS Word) or Suggestions (Google Docs), students can engage in peer review asynchronously or synchronously.
Transformative	After learning about the parts of speech, have students demonstrate their knowledge by creating a game in PowerPoint or a printable worksheet in Google Docs or some other game development tool. For example, they could create a sentence builder activity using images or a Jeopardy round, using PowerPoint templates. They must include an answer key. Students play each other's game and

Purpose	Examples
	evaluate the game for accuracy. Imagine how exciting this might be if they were exchanging their games with other students from other schools around the nation, or even the world.

Using the example from Table 1, as a replacement, technology moves the non-digital instructional methods, objectives, and ungraded or graded activities to an internet-based format. The use of a digital document as replacement for a printed document, which still asks students to highlight the parts of speech in different colors, does not change how the educator teaches, how/what the students learn, or the previously established curriculum goals.

As amplification, technology enhances or makes more efficient the instructional methods, the student learning processes, and/or the curriculum goals. For example, Hughes et al. (2006) describe a teacher who created tests, handouts, and other documents in a word processing application in the early days of technology use in the classroom as opposed to using handwritten or typewritten documents. This act served as amplification, according to the teacher's self-assessment, because it created an archive that she could later modify without having to recreate the whole document. In the early days of migration from workbooks and mimeo copies to digital files stored on computers, this would have been revolutionary. Although it did not enhance student learning or curriculum goals, this act significantly enhanced instructional preparation, making this use of technology an example of amplification.

In the Table 1 example of amplification, students are still identifying parts of speech, but they are using technology to help identify words that may not already be familiar with, such as vocabulary terms from new content being learned, and the tools allow the students to create their own sentences containing all the proper parts of speech. The technology use also changes curriculum goals by moving beyond parts of speech identification into application and evaluation of that knowledge and enhances the learning process for students by making the experience more student-centered and relevant. Moreover, the technology use amplifies the student learning process by expanding student interaction and knowledge exchange with each other within a space designed for back-and-forth dialogue around the application of learned skills. Finally, the use of commenting and editing tools in either synchronous or asynchronous modes allows for increased efficiency in peer review.

For transformative technology integration, the technology must significantly change any of the identified dimensions within the educator's instructional methods, the students' learning processes, and/or curriculum goals. In Table 1, an example of transformative technology included having students use technology to create a game and learn from each other or from students in other classrooms as they played and evaluated the accuracy of each others' creations. This changes all three themes of teaching and learning and various dimensions within those themes in the following ways:

- **Instructional methods:** Primarily, the instructor's method of assessing the students' knowledge has changed. Rather than a multiple choice test or grading highlighted parts of speech, the instructor is now assessing a product students have created to apply their knowledge of parts of speech.
- **Student learning:** The learning process for students has been transformed and made more rigorous. They have moved beyond identifying parts of speech and are now creating artifacts that rely on their knowledge for success. Students are more motivated, and their cognitive load is increased. If working with others, they are also increasing their collaboration skills.
- **Curriculum goals:** Creating a game or activity that relies on knowledge of the parts of speech requires students to use higher-level cognitive skills rather than simply being able to identify parts of speech. This means that students can identify the parts of speech, define their purpose, apply them appropriately, and evaluate their use and application by others.

The RAT framework was created to help educators to develop technology-integrated lessons and to assess the worthwhile use of the chosen technology (Hughes et al., 2006). Originally developed for K12 preservice and in-service teachers and later applied to K12 school administrators at a programmatic level, the RAT model has been implemented in higher education also. For example, Billingsley, Smith, Smith & Meritt (2019) used the RAT framework as a lens to conduct a systematic literature review of immersive virtual reality (VR) used in teacher preparation programs to help

address today's field placement limitations. Specifically, the authors looked at studies that explored the potential revolutionary use of immersive VR in teacher education as a training tool to learn about specific concepts, develop classroom and behavioral management skills, engage in role-playing scenarios or simulations, etc. They explained their rationale for using the RAT framework as follows:

> *By knowing the extent to which VR has been previously utilized, whether the technology replaced, enhanced, or transformed learning, teacher educators can decide whether these virtual experiences, indeed, broaden teacher candidates' learning experiences and justify the resource commitment (Billingsley et al., 2019).*

In another example, Dang, Smidt, Schumann, Funke, & Magassouba (2012) used the RAT framework as a lens to identify technology-use purposes related to the affordances found through a CMS/LMS system. While 9 professors and their courses were studied, this paper focused on one of the professors and his use of technology tools within the LMS for his online graduate-level education course. Overall, increased efficiency made using the LMS an amplification of typical physical classroom practices. When broken down by specific tools used within the LMS, some were identified as replacement, while others were marked as amplification.

- **Replacement:** The Survey tool used to gather student feedback about the course simply replaced a traditional printed survey.
- **Replacement:** The News and E-mail tools were also identified as replacement as they provided general feedback and course study guides and encouraged participation.
- **Amplification:** The Quizzes tool was used to create random selections of 30 questions from a 100-200 item question bank, which could be timed and retaken. Furthermore, students had access to their notes, which allowed for use of the quizzes for both assessment and as a guided learning tool.
- **Amplification:** The inclusion of 10-minute, instructor-made videos within the LMS that chunked the professor's typical classroom lectures into manageable segments for the students, which they could stop and review or rewatch later, was, as noted by the authors, "...the essence of amplification" (Dang et. al, 2012.)
- **Amplification:** the use of Dropbox and Gradebook tools made turning in assignments and grading more efficient.

While no transformative purposes were identified, the potential existed for the professor's use of several tools. The authors identified three tools used as having current amplification purposes with the potential for transformative use: (a) the professor's minimalist use of the Content tool that helped students in the flow of learning new material; (b) the structure, both small group and whole class, within the Discussion tool that helped to create "content-rich and student-driven discussions" (Dang, et. al, 2012); and (c) the purposefully-designed use of small-group chat.

Although transformative technology use often elevates the learning experiences of students and helps to engage higher-level cognitive thinking skills, the RAT framework does not suggest that all classroom technology use must be transformative, nor that it is a level of technological use to be achieved as part of a sequential technological improvement plan. In fact, there are times when instructors may purposefully decide not to make their lessons transformative due to time constraints, technology access barriers, or misalignment with school/district scope and sequence plans. Furthermore, transformative technology use as defined in the RAT model is subjective and, in the case of teacher self-assessment, a personally-determined attribute—meaning that what might be transformative use for one instructor, their students, and/or their curriculum goals may not be considered transformative for others. In RAT, transformative use of technology is not synonymous with the use of revolutionary technologies or the use of the latest technology tools and trends, unless it happens to support transformative teaching and learning and/or development and achievement of transformative curricular goals. Rather, technology integration should be a purposeful, planned event with the benefits and drawbacks of its use fully realized and understood.

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Watch on YouTube

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