Improving Instruction, Assessment, and Policies for Secondary English Learners Across the Content Areas • September 2024

Design Principles for Educative Curriculum Materials and Professional Learning in Mathematics: Lessons from an Iterative Development Project

CSEL CENTER FOR THE SUCCESS of ENGLISH LEARNERS

National Research & Development Center to Improve EDUCATION FOR SECONDARY ENGLISH LEARNERS
WestEd

IES Institute of Education Sciences

Reimagining and Amplifying Mathematics Participation, Understanding, and Practices (RAMPUP)

Design Principles for….

1. Ambitious Mathematics Learning for Multilingual Learners (with pedagogical experience)
2. Educative Teacher Materials (Initially)
3. Teacher Use
4. Educative Teacher Materials and Professional Learning (Revised)

Orientation of Curriculum

Delivery Mechanism

- Formal definitions are introduced at the beginning of the lesson.
- Procedures are modeled and given at the beginning of the lesson.
- Problems are bounded and perhaps admit multiple known approaches.
- Problems are sequenced to increase fluency through repetitive application.

Thinking Tool

- Terminology that is developed is grounded in student experiences.
- Procedures emerge from clarification after initial ambiguity.
- Approaches to problems are ambiguous and surface connections.
- Problems add to understanding of a central theme, concept, or context.

(Choppin et al., 2022)

Barriers to Quality Learning of Mathematics for Multilingual Learners

- Access to challenging mathematics coursework is limited.
- Mathematics courses and curricula are organized sequentially.
- Learning is viewed as “mastery” of pre-ordained procedures.
- “Academic language” is viewed as prerequisite.
- Curriculum materials view English Learners through deficit lenses, monolithically.

(de Araujo & Smith, 2022)

Designing Powerful Learning Experiences for Multilingual Learners

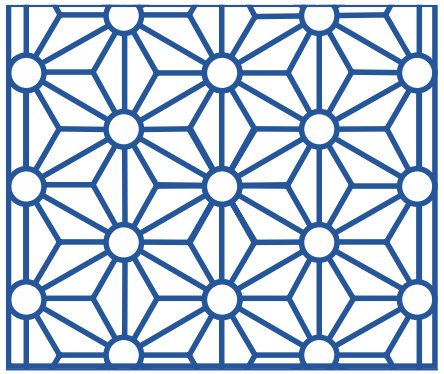
- Center lessons on concepts to drive lesson activities.
- Foster quality peer interactions to co-construct understanding.
- Offer language support that enables students to develop understanding and engage in disciplinary practices.

(Chu & Hamburger, 2022; Walqui & Bunch, 2019)

Ambitious Mathematics Learning for Multilingual Learners

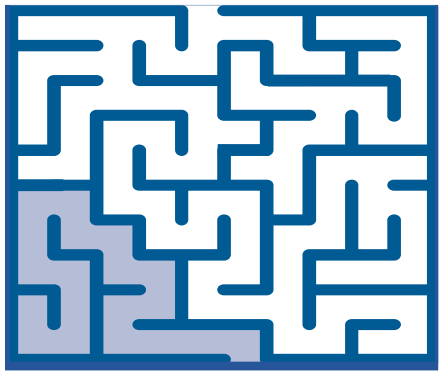
Dimension	Characteristics
Conceptual Focus	• Enticing problems that generate important mathematics • Opportunities to make deep connections • Opportunities to engage in mathematical practices
Participation by Design	• Sustained talk with peers • Reciprocal interactions • Growth in participation over time
Purposeful Language Focus	• From dialogic to more monologic • From more peer to more authoritative • From everyday to more technical

RAMPUP Module Themes and Questions



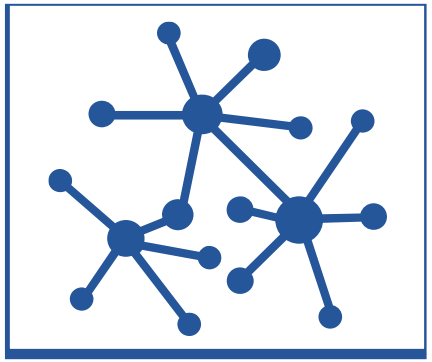
Patterns of Growth & Change

How can I find and extend patterns?



Equivalence & Transformation

When are two things the same?



Networks & Surfaces

How are social networks connected?

Initial Educative Design Principles

Our initial design principles were (adapted from Davis et al., 2017):

- Teachers will adapt, so give them clear ***choices***.
- Teachers need clear ***vision*** of quality work (samples) and quality implementation (videos).
- Teachers need deep and generative understanding of the powerful and relevant ***ideas and their interconnections***, so provide them multiple forms of developing that understanding.
- Teachers will need different levels of support to enact necessary shifts, so materials need to clearly ***signal and justify*** departures from current practice.
- Teachers need explicit information about particular ***genres*** (e.g., mathematical proof).

(Chu & Hamburger, 2022)

RAMPUP Development at a Glance

Year	Classes	Teachers	Students
2022	1	1	10
2023	3	5	30
2024	18	14	240
Total	22	17	280

When Principles Meet Practice

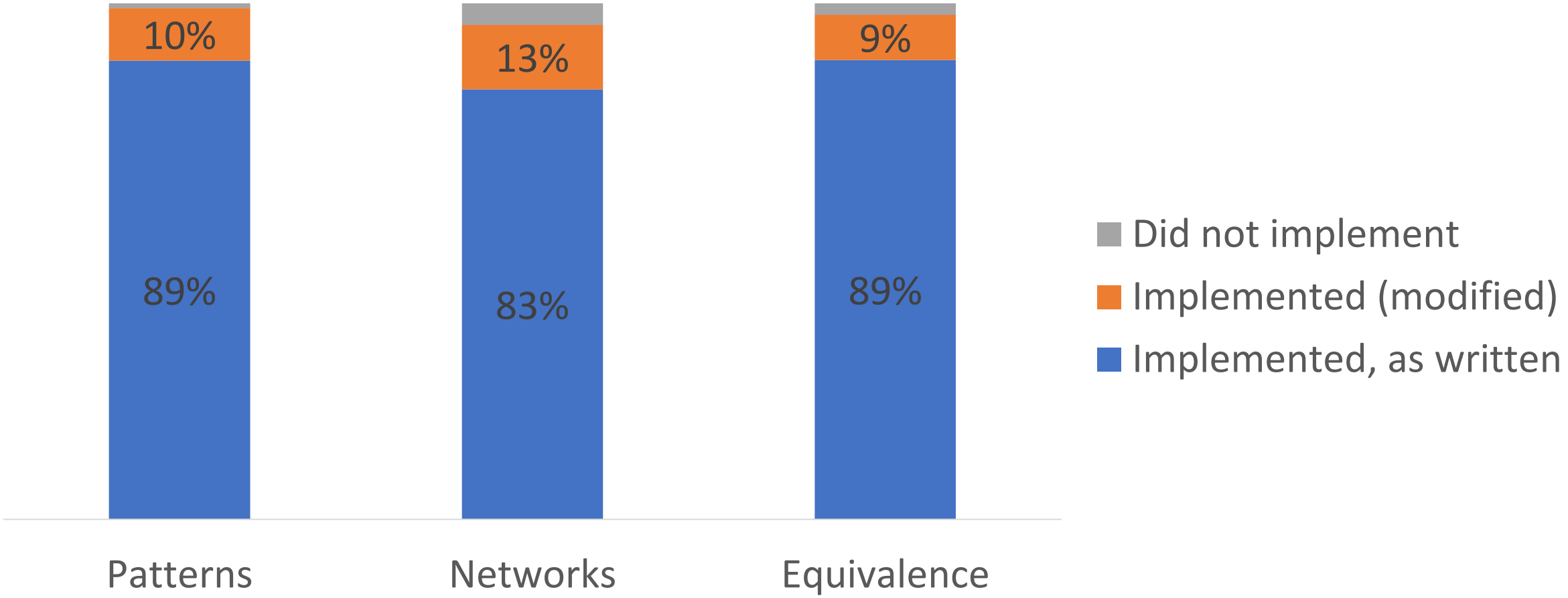
- Usability Survey
- Feasibility Survey
- Implementation logs
- Classroom observations

What Do Teachers Think Would Enhance Usability & Feasibility?

Teachers thought the following would improve materials:

- Answer key
- Student work samples
- Intro and “outro” for each activity
- Clearer alignment with state standards
- Required training activities

To What Extent do Teachers Implement Activities?



What did Teachers Report Modifying?

- Additional videos from YouTube and other popular sources
- Physical experiences (manipulatives, stairs)
- Shift from small-group discussion to whole-class presentations or discussion
- Editing and feedback on writing activities
- Skipping writing extension activities

To What Extent did Observations Match Logs?

Classes observed

- 12 – Complete sessions observed in summer 2024.
- 8 – Perfect matches between logs and observations.
- 4 – Sessions with mismatches ranging from 33%-75%
  All differences were between “as written” and “modified”

Total activities observed

- 68 – Complete activities observed in above classes.
- 57 – Perfect matches between logs and observations.

What Else Did We Observe?

- Proceduralizing
- Note-giving
- Inconsistent connections between tasks
- Lack of modeling steps and structures within activities

Revised Design Principles for Educative Materials and Professional Learning

- Let teachers do, before you show.
- Show, don't tell!
- Offer choices with clear rationales.
- Tell with generality.
- Have teachers explore key genres.

Selected References

Choppin, J., Roth-McDuffie, A., Drake, C., & Davis, J. (2020). The role of instructional materials in the relationship between the official and the enacted curriculum. *Mathematical Thinking and Learning, 24*(2), 123–148. doi: 10.1080/10986065.2020.1855376

Chu, H., DePiper, J. N., & Hamburger, L. (2023). Varying the intensity of scaffolding for English Learners. *Mathematics Teacher: Learning and Teaching PreK-12, 116*(12), 906-911. doi: 10.5951/MTLT.2022.0231

Chu, H., & Lopez, G. V. (2024). All sorts of quality interactions with English Learners. *Mathematics Teacher: Learning and Teaching PreK-12, 117*(4), 285-292. doi: 10.5951/MTLT.2023.0108

Chu, H., & Hamburger, L. (2022). Educative curriculum materials for English Learners: Varying the intensity of scaffolding. In L. de Oliveira & R. Westerlund (Eds.). *Scaffolding for Multilingual Learners in elementary and secondary schools* (pp. 181-196). Routledge.

De Araujo, Z., & Smith, E. (2022). Examining English Learners' learning needs through the lens of algebra curriculum materials. *Educational Studies in Mathematics*. https://doi.org/10.1007/s10649-021-10081-w

Hamburger, L., & Chu, H. (2019). Making slope a less slippery concept for English Learners: Redesigning mathematics instruction with rich interactions. In A. Walqui & G. Bunch (Eds.) *Amplifying the curriculum: Designing quality learning opportunities for English Learners* (pp. 115-137). Teachers College Press.

Disclaimer

The research reported here was supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R305C200008 to WestEd. The opinions expressed are those of the authors and do not represent views of the Institute or the U.S. Department of Education.

Thank You!

For more information, please contact:

Haiwen Chu

Haiwen.Chu@wested.org

Visit our website at
www.elrdcenter.wested.org