Arizona State University

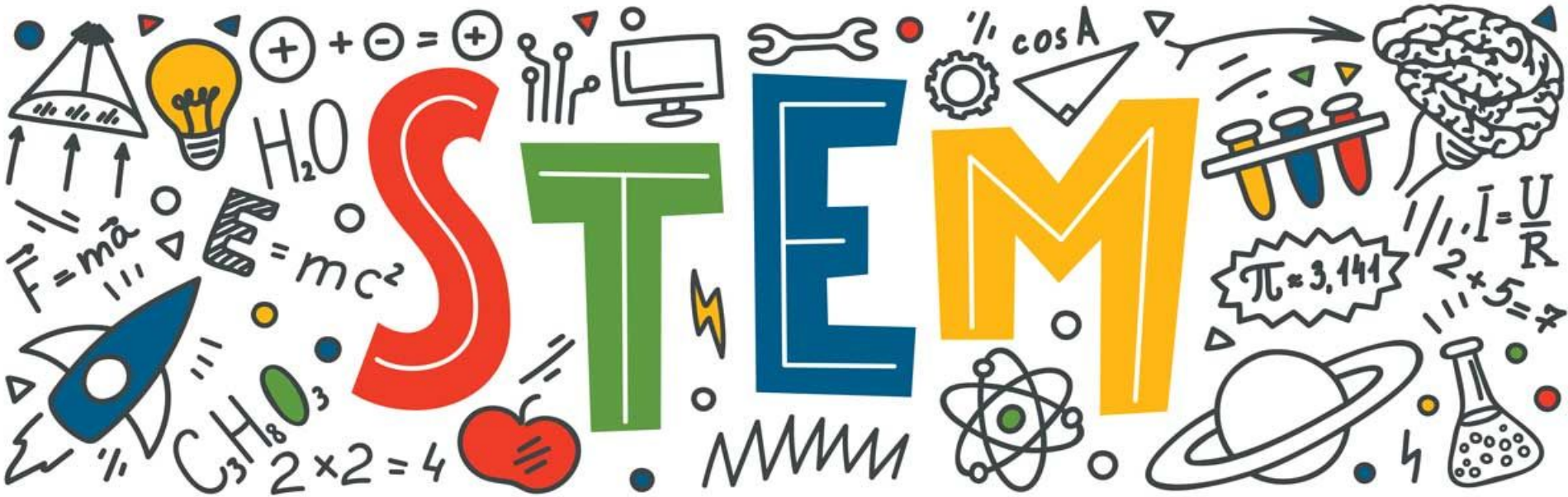
Designing the future of undergraduate STEM education: An inter-institutional, interdisciplinary approach

April 1, 2021

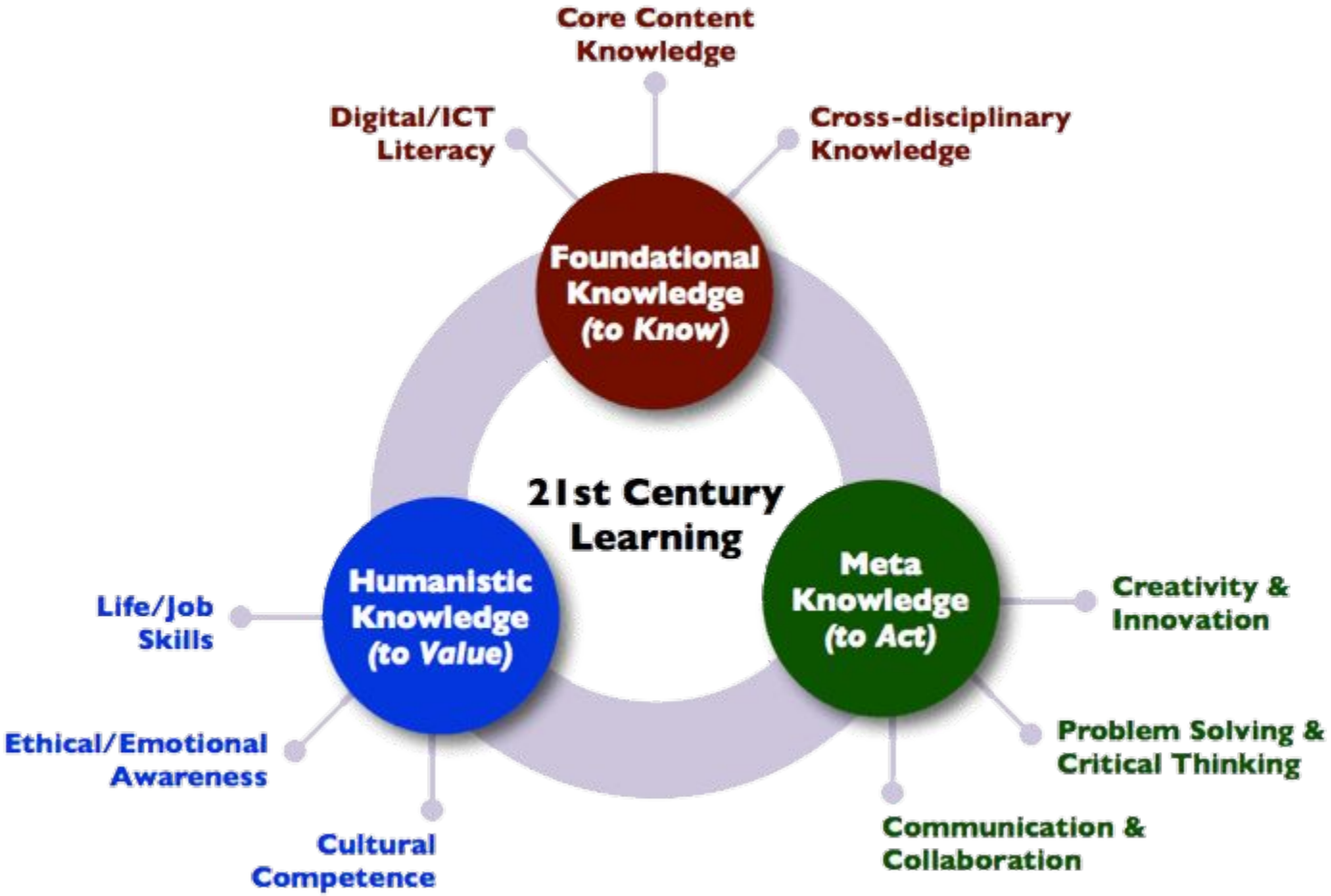
SITE Conference
Agenda

5 mins	**11:15 a.m. (ET)** *Welcome* | *Introductions* | *Workshop Background*
5 mins	**11:20 a.m** Workshop overview - including SERC site and products
5 mins	**11:25 a.m.** Workshop outcomes and permanent website | Next steps
5 mins	**11:30am** Discussion / Q&A

Living in the Anthropocene



WHAT we need to know, HOW we know it, and WHY is that important?



I think the humanities always have to take science, our great knowledge that we get from science, into account, but then try to answer the human questions and try to make sense out of our lives
— Rebecca Goldstein

Future Substance of STEM Education

Leadership Team

Ariel Anbar
Arizona State University

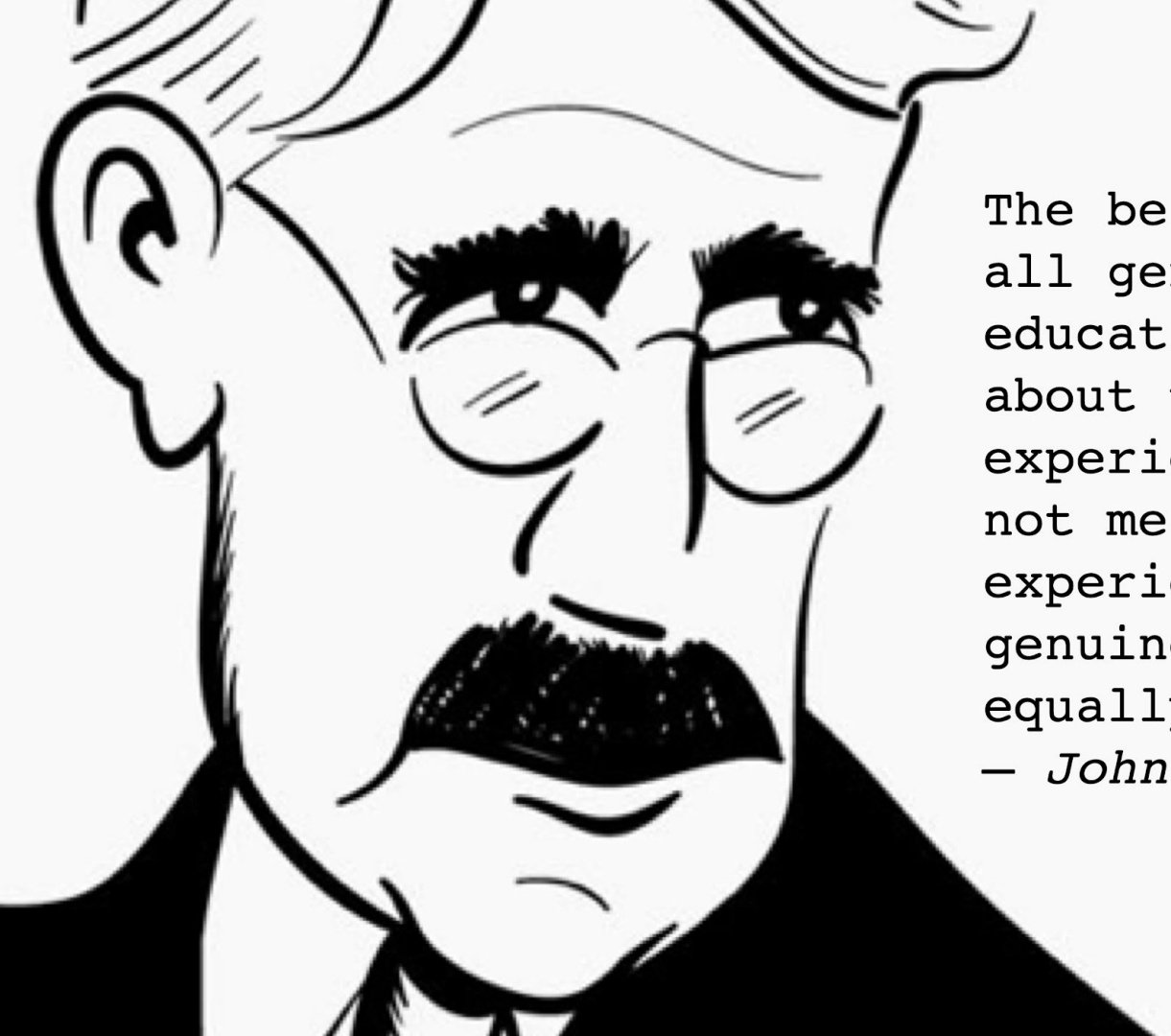
Punya Mishra
Arizona State University

Trina Davis
Texas A&M University

Cathy Manduca
Carleton College

Stephanie Pfirman
Arizona State University

Larry Ragan
Webinar moderator



The belief that all genuine education comes about through experience does not mean that all experiences are genuinely or equally educative
— *John Dewey*

The Future Substance of STEM Education

STEM-Futures.org

Webinars

Humanistic
9/15

Meta
9/17

Foundational
9/23

Design sessions
10/5 - 10/9

Day 0 (Prep)
9/24

Optional prep
9/28

Optional prep
9/29

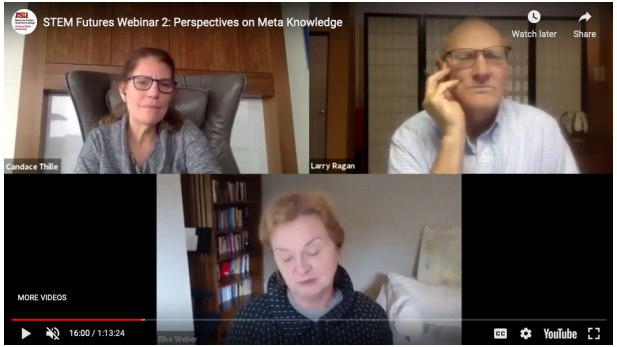
Day 1	Day 2	Day 3	Day 4	Day 5
Values / Anchor statement Final artifact (draft #1)	Assessments / Learning Outcomes Feedback round-robin (#1)	Catalog Description Final artifact (draft #2	Holistic Alignment & Implementation Feedback round-robin (#2)	Preparing for Wrap up & presentation Presentations & Next steps

Final Products
10/25

Perspectives on Humanistic Knowledge

Katina Michael, Professor at Arizona State University and Founding Editor-in-Chief of IEEE Transactions on Technology and Society; **Richard Pitt**, Associate Professor of Sociology at the University of California San Diego

Humanistic Knowledge includes attributes that provide a learner with a vision and narrative of the self within social contexts, scaling from local to global.



Perspectives on Meta Knowledge

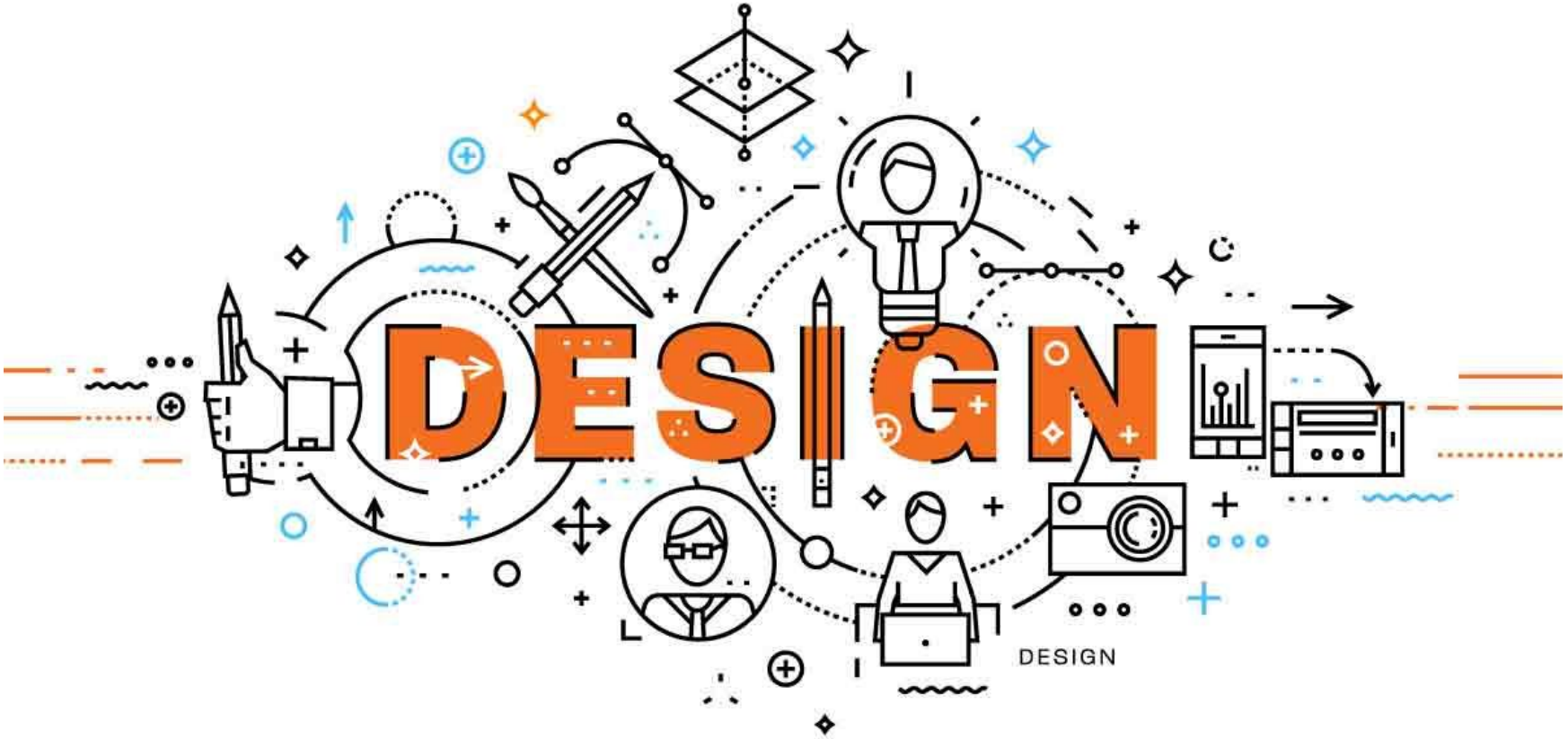
Candace Thille, Director of Learning Science and Engineering at Amazon; **Elke Weber**, Professor and Director of the Behavioral Science for Policy Lab at Princeton University

Meta Knowledge includes the skills, mindsets, and attitudes that address the process of working with core STEM knowledge, turning knowledge into action.

Perspectives on Foundational Knowledge

Thomas Zurbuchen, Associate Administrator for the Science Mission Directorate at NASA; **Susan Singer**, Vice President for Academic Affairs, Provost, and Professor at Rollins College

Foundational Knowledge is the core knowledge that is essential for learners to obtain as part of STEM programs.



Participants' mission for the week:

Develop an innovative STEM program or certificate that integrates foundational, meta, and humanistic knowledge.

Participants had the five days of the workshop to do this – plus two weeks to polish, perfect, and publish.

Participants' Output: Product Components

Product Component 1

A set of learning outcomes / objectives for the program.

Product Component 2

A description of how the outcomes will be assessed at the program level.

Product Component 3

A short program description— perhaps something suitable for the catalog.

Product Component 4

An artifact that demonstrates the character of the program.

Product Component 5

Description of how foundational, meta and humanistic knowledge will be represented.

Product Component 6

Implementation strategies and recommendations.

Workshop Process & Flow: Daily Activities

11:15am ET | 8:15 am PT
(1 hour, 45 minutes)

Team Working Session #3

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Guidance for Team Working Session #5

Product Component 3: A short program description

- On Monday you started on this description in your Final Product page. Write or edit / revise (as needed) the 3-4 sentence summary of your program.
- This should be meaningful even without the surrounding PCs.
- You could touch on who the program is for and any key distinguishing features.This needs to be concise and compelling enough to motivate people to read further.

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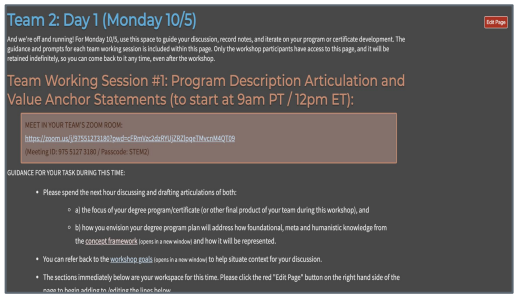
Please depart to your workspace

We will visit your workspaces to check-in; if you need immediate support, we can help you now.



Live chat support

If you have questions at any point, you can reach out for help by clicking the blue chat icon in the lower right corner of the workspace.

Workshop leaders will also be around to support you.

Day 1 Closing Session

Thank you so much for a great day! We are excited for the work you all have started, and we see lots of energy, creativity, and really thoughtful integration of the foundational, meta, and humanistic knowledge domains into your thinking.

- **Please complete the daily evaluation survey:** https://serc.carleton.edu/dev/stemfutures/monday_roadcheck.html

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Content Analysis

We began by extracting the **Goals** and **Learning Outcomes** from all 25 projects

Two Coders:

Projects 1-10 IRR = .95

Projects 11-25 IRR = .90

Next, we used an exploratory one word analysis for both exact matches and stemmed words [Using NVivo]

The top 100 list was used to triangulate the data and emerging themes from the original coding

Final layer of Analysis

Text search queries were completed on key words to glean utilization within the text

Content Analysis: Final Products Summary

88% of the projects **integrated all three forms of knowledge**

8% integrated two forms

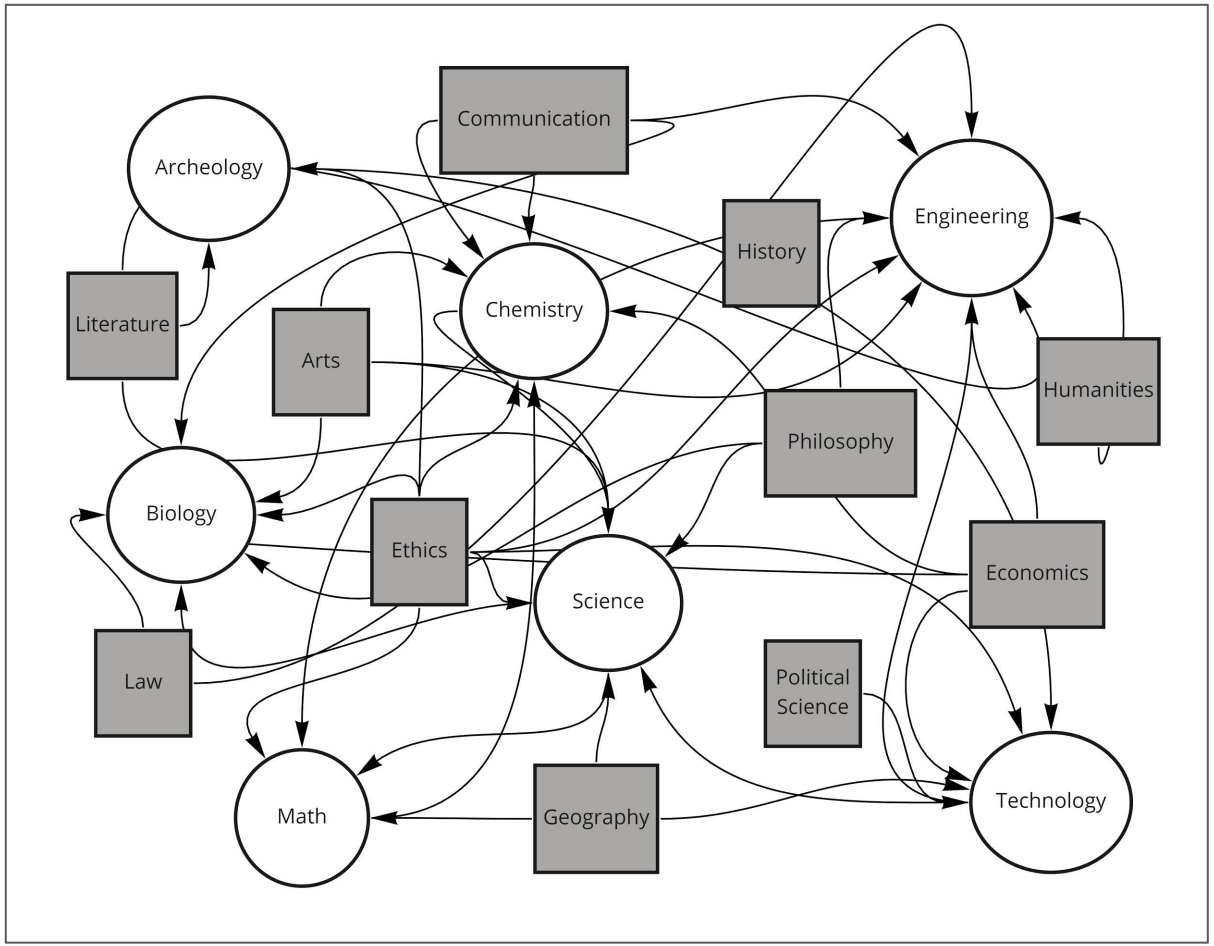
4% predominantly one category

Audiences included **STEM majors and non-majors**, first-year students, disciplinary majors in upper-level courses, college faculty, **preservice teachers**, student leaders, and **college STEM-bound** high school students.

6 degree programs,
9 certificate programs,
7 efforts for courses, course components/curricular alignments, and
3 training and **PD** programs

Theme: Integrating various disciplines with STEM

[Foundational]

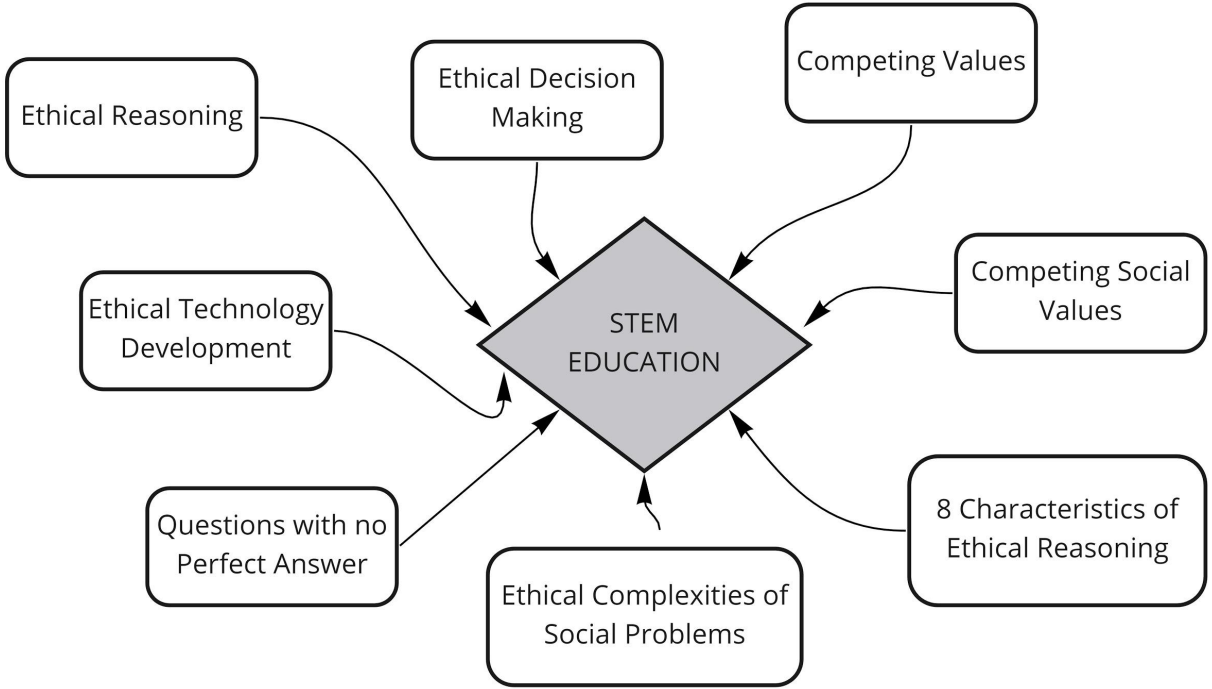


STEM Examples
biology, chemistry, geology, engineering, and health sciences, and interdisciplinary STEM foci

Non-STEM Examples
arts, history, humanities, philosophy, economics, law, political science, and geography

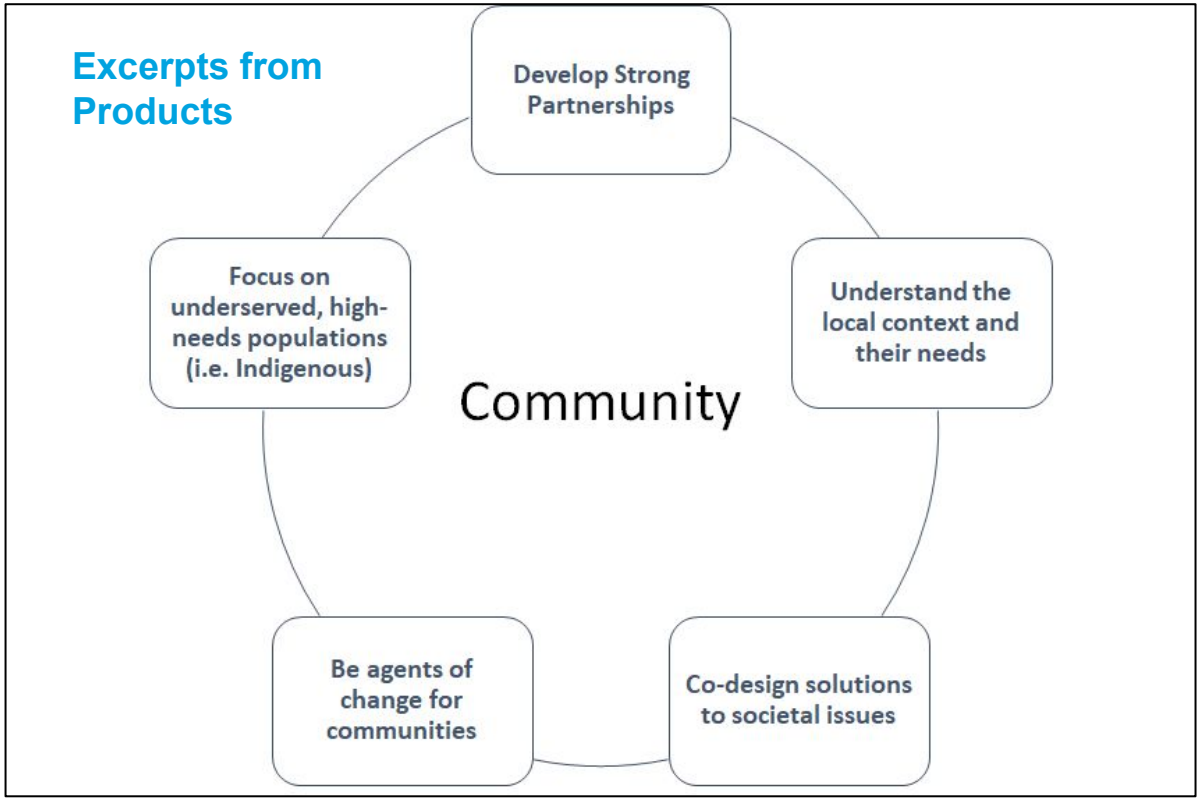
Theme: Ethics integration into the learning [Humanistic Foci]

Excerpts from Products



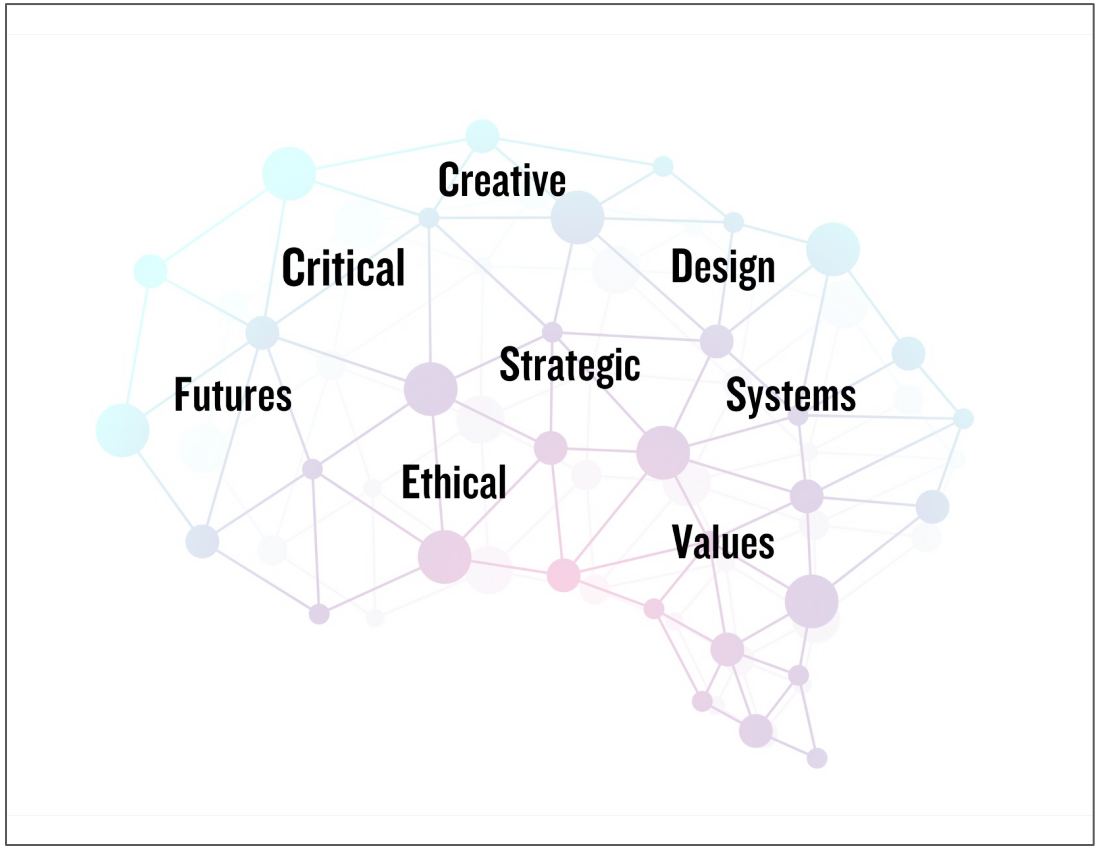
The critical need for target **learners to understand the importance of ethical concerns**, and to be fully aware of the complexities of societal problems they are being trained to address - were well-documented.

Theme: Creating design-based learning experiences to solve problems in community, society, world [Meta and Humanistic]



Community was a salient focus, emphasizing situating STEM as being an integral part of society, especially within local communities.

Theme: Intentionally including additional types of thinking [Meta and Foundational Foci]



Excerpts from Products
Use design thinking to innovate and iterate toward solutions within these complex systems

Futures thinking to envision desirable and possible outcomes

Use systems thinking and STEM tools to model complex systems

Theme: Valuing and addressing DEI issues in STEM

[Humanistic Foci]

Excerpts from Products
Issues of diversity and inclusion in healthcare and STEM fields

Implement practices that support inclusivity and diversity

Diversity of stakeholders are valued

Thank you!

Math . . . music .. . starry nights . . . These are ways of achieving transcendence, of feeling lifted into a grand perspective. It's a sense of being awed by existence that almost obliterates the self… It is an essential human experience — Rebecca Goldstein