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Considerations for School-Level STEM Implementation

Pioneering STEM Education in Africa Summit

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Opening statement:

'Effective, meaningful and successful STEM education should be synergistic for learners at the classroom level.'

Overview

- Considerations: Philosophical Level
  - Epistemic Nature and Roles.
- Considerations: Practical Level
  - Challenges & Contexts

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Philosophical Considerations

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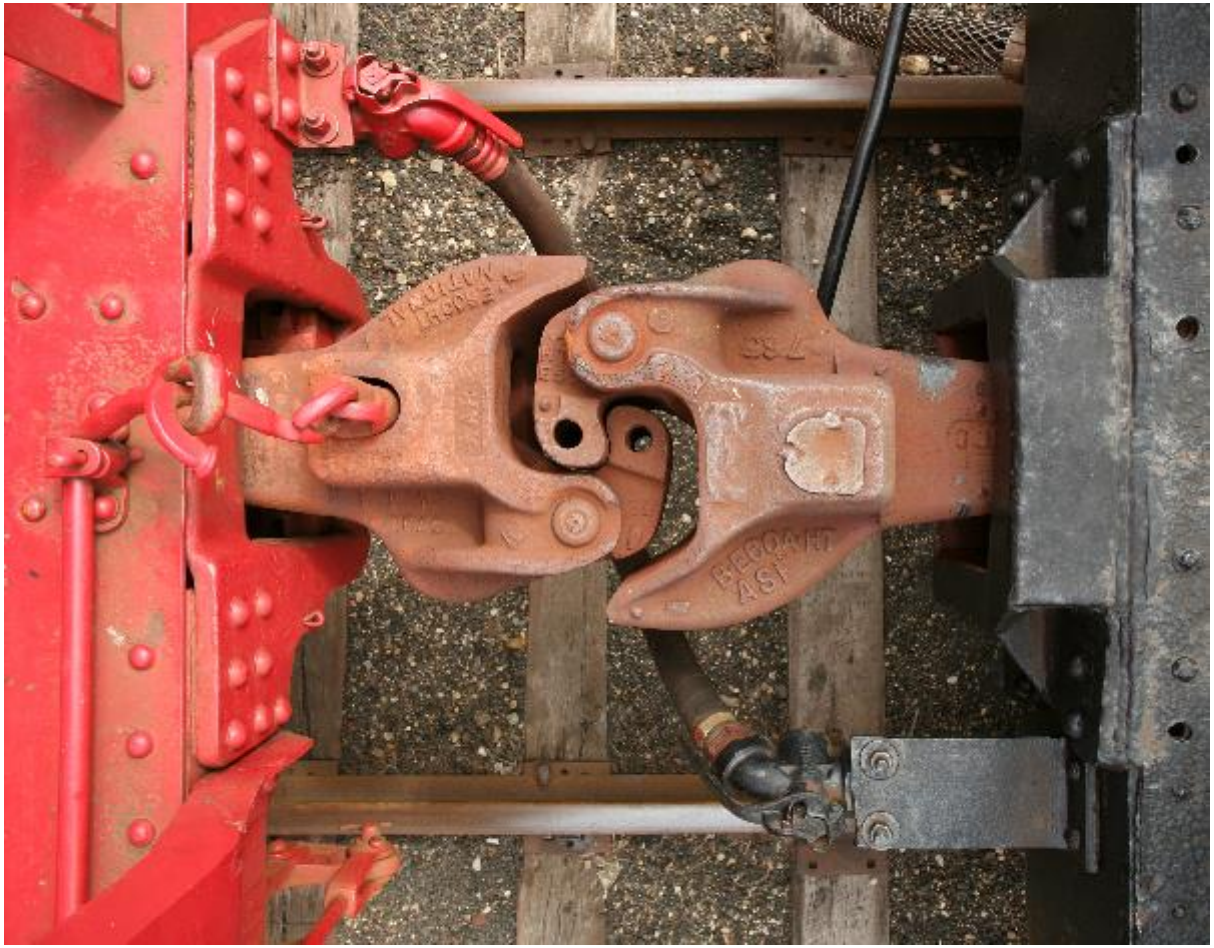

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Philosophical Considerations

Philosophical Considerations

Science

- Description & explanation of natural world
- High degree of objectivity
- High degree of epistemic consistency
- Established systems for validating scientific knowledge

Philosophical Considerations

Mathematics

- Demonstration of proof.
- Abstract and symbolic world.
- High degree of objectivity
- High degree of epistemic consistency
- Established systems for validating scientific knowledge

Philosophical Considerations

<u>Engineering & Technology?</u>

- Both relate to man-made world.
- Engineering – closer ties to Maths & Science (analysis/application)
- Technology:
  - Subjective and objective.
  - Epistemically inconsistent: Transformation.
  - Difficult to validate technological knowledge.

Philosophical Considerations

- How are constituent subjects defined and understood within policy and by teachers?
- How is consistency in this understanding achieved?
- How can this effectively shape instructional & pedagogical design?
- How might this shape what STEM learning looks like within classrooms?

Philosophical Considerations

ITEEA Definitions Example

Science: Study of natural world.

Technology: Modifying natural world to meet the needs and wants of society.

Engineering: Applying maths and science to create technology.

Mathematics: System of Numbers, patterns, relationships that tie S, T and E together.

Philosophical Considerations

ITEEA Definitions Example

Integrative STEM:

Purposely integrates S, T, E & M through inquiry-based methods to resolve problems and address human needs.

Challenges & Contexts

- STEM: Form of interdisciplinary learning.
- Nature of learning is shaped by structure and context of the wider system and learning environment.

- Must consider things from the perspective of the learner also.
- No consensus of understanding STEM-IDL.

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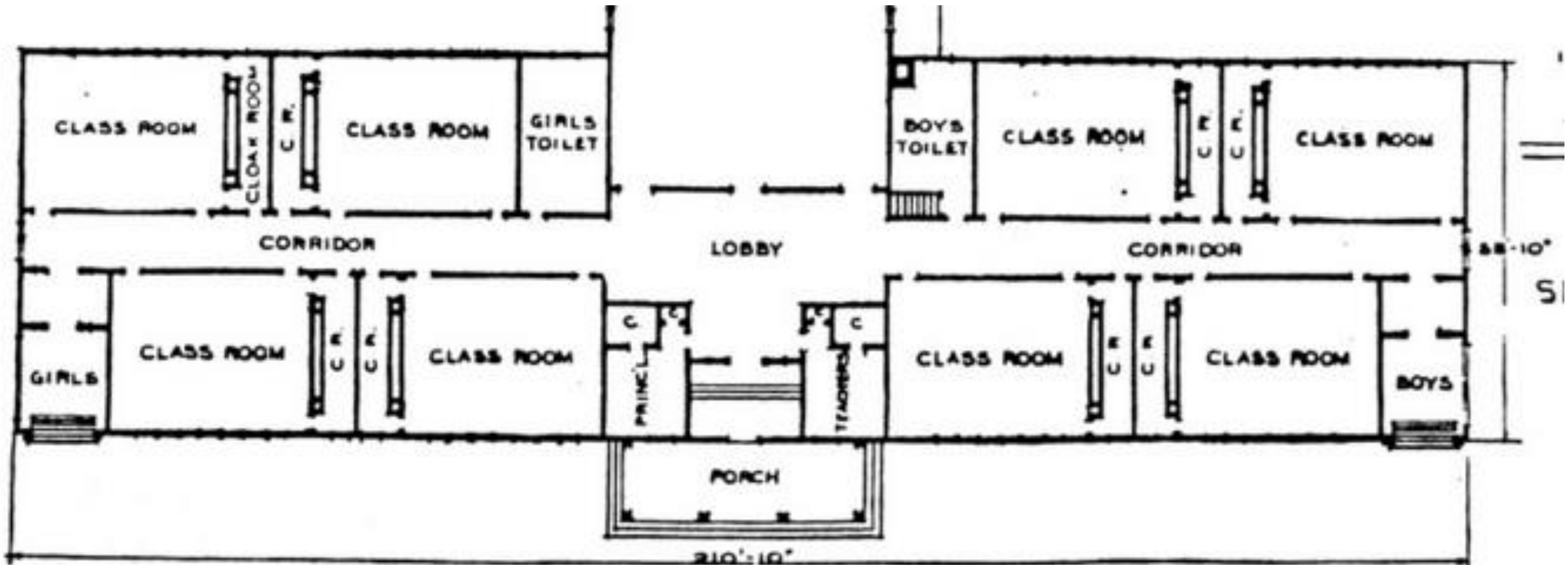
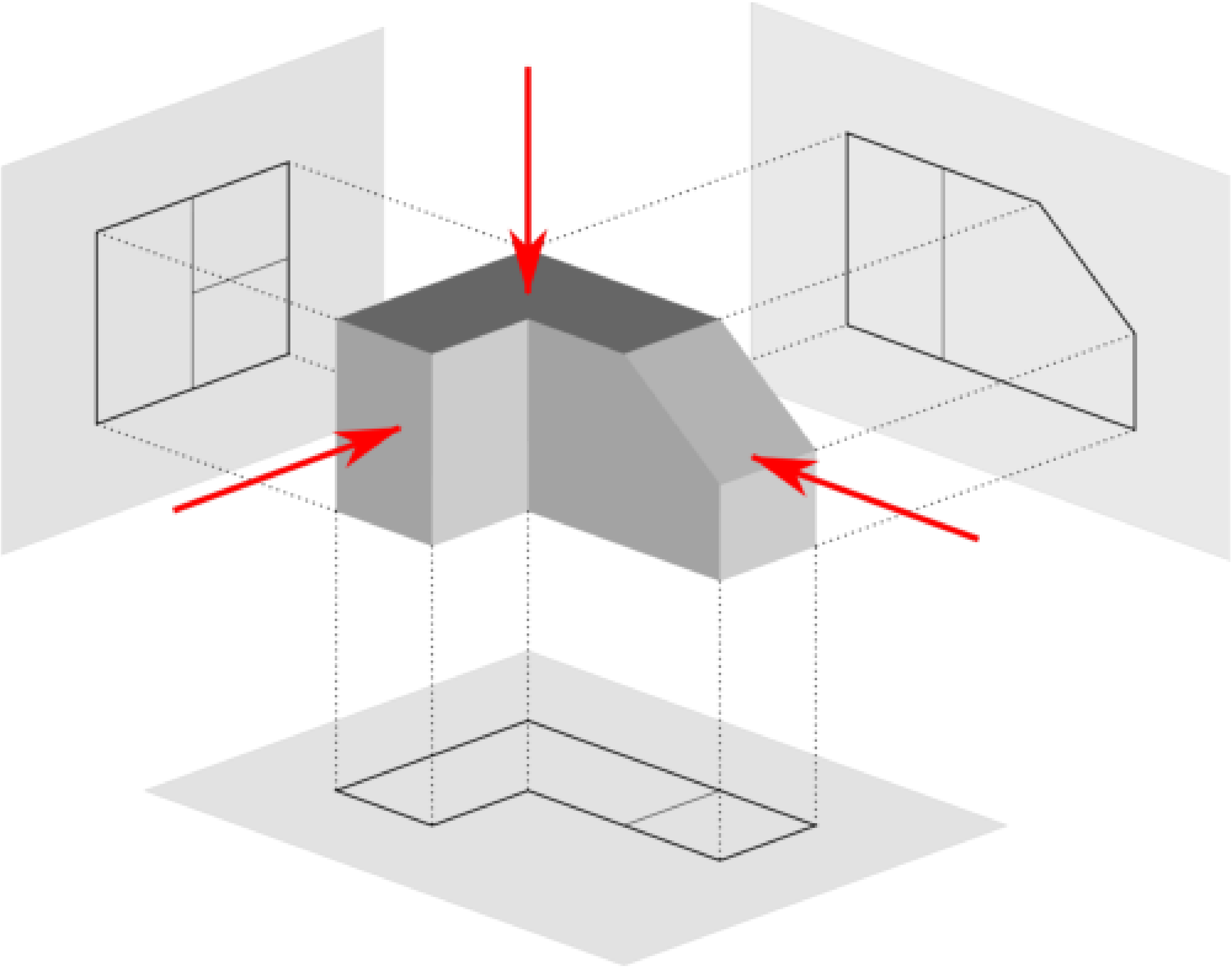
Challenges & Contexts



FLOOR PLAN
SCHOOL

Challenges & Contexts

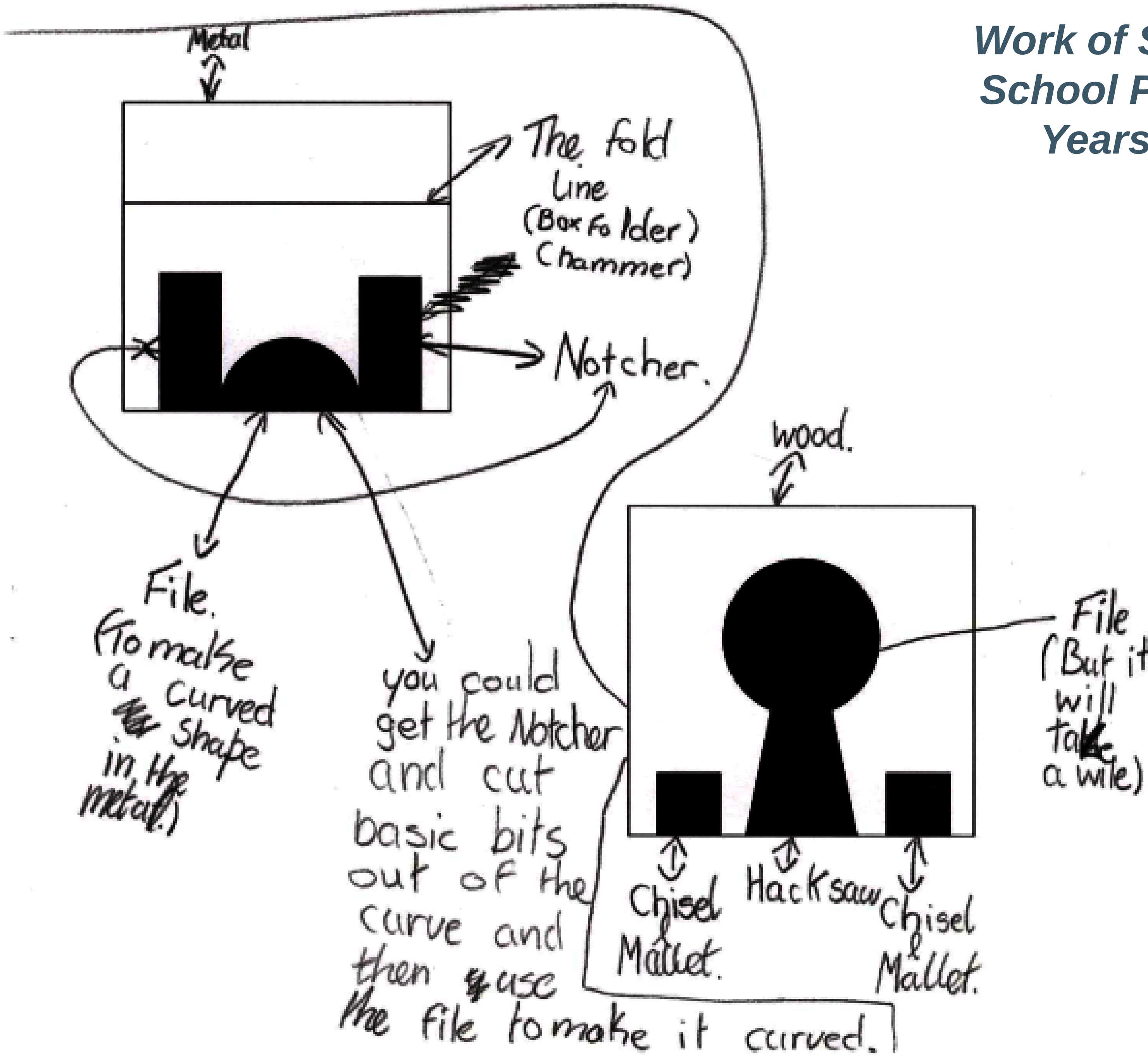
- Compartmentalised learning.
- Context masking.



Challenges & Contexts

- Compartmentalised learning.
- Context masking.
- Difficult to make links.

Work of Scottish School Pupil: 12 Years of Age.



Challenges & Contexts

- Compartmentalised learning.
- Context masking.
- Difficult to make links.
- Teacher assumed ‘transfer’.
- IDL: Knowledge vs process.
- Mastery > a ‘way of thinking’.

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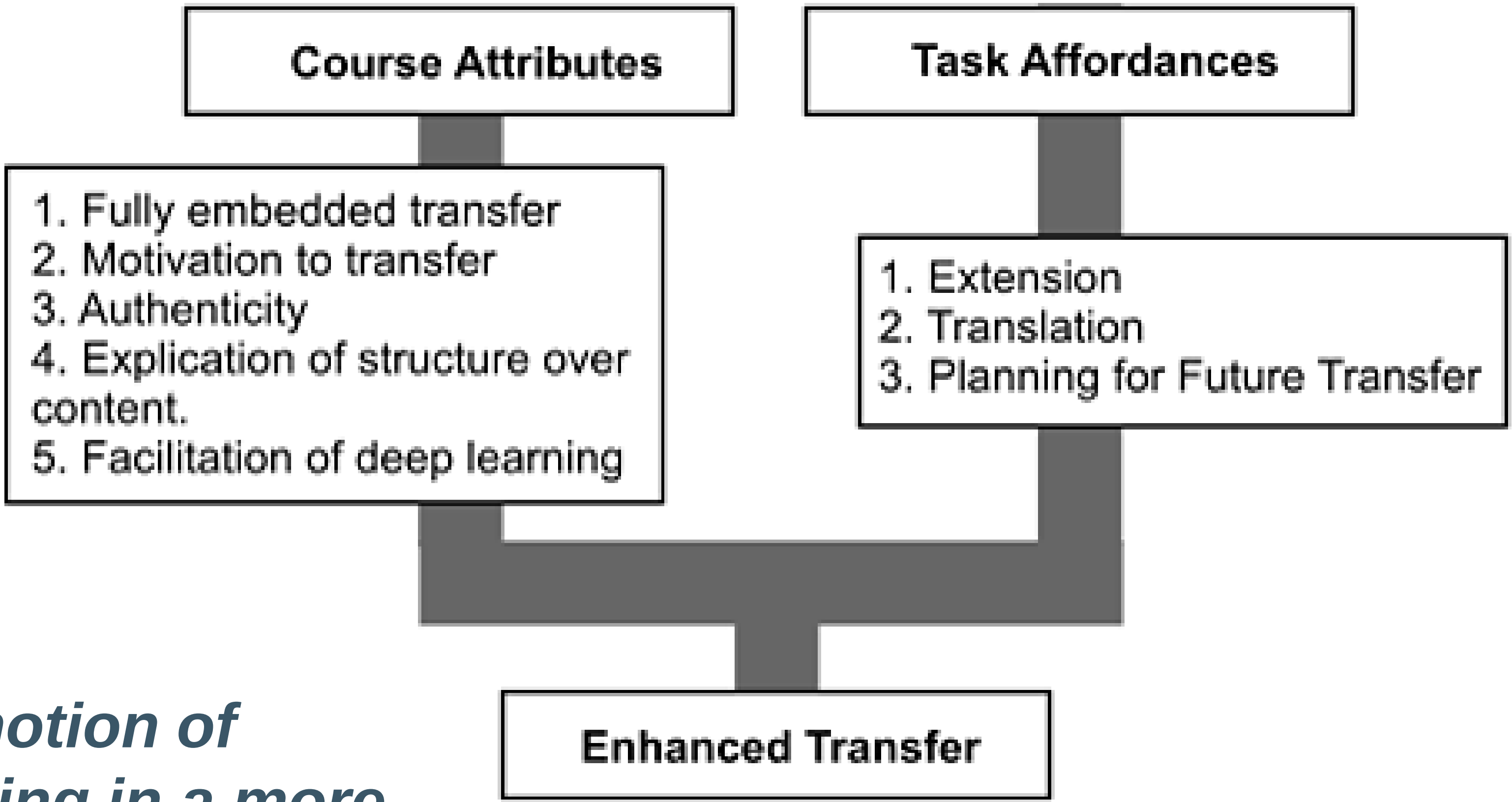
Challenges & Contexts



Promotion of thinking in a more integrated way.

Morrison-Love (2014)

Challenges & Contexts

- Fully integrated STEM departments
  - Maximal opportunity to shape success
- Long term cross-subject projects
  - Require **dependency** to avoid <u>split</u> subject learning.
- STEM Weeks
  - Often poor links back to subject learning, low educational return for investment of time.

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Challenges & Contexts

- How might school systems and the physical environment be structure to support STEM?
- In early stages, how might the teachers make links between areas?
- How can tasks be designed to move beyond links and maximise the possibility of autonomous ‘integration’ at a later stage?

Challenges & Contexts

- How can teachers ultimately cultivate a capacity for ‘interdisciplinary thinking’ in STEM?
- What are the implications for Initial Teacher Education.
- What findings from research and practise are relevant to shaping an effective approach to Teaching STEM?

Challenges & Contexts

'Effective, meaningful and successful STEM education should be synergistic for learners at the classroom level.'

Learning in STEM should ultimately be more than the sum of its parts.

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Related Sources

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About Dr David Morrison-Love

I was a practicing teacher of Technology Education for nine years before taking up the post of Lecturer in the School of Education at the University of Glasgow. My PhD explored dimensions of process and knowledge in pupils' technological problem solving. I am a member of the Curriculum, Assessment & Pedagogy Research & Teaching Group and my current research interests lie in Technology and STEM Education, learning contexts, problem solving and the role of physical objects and outcomes in pupils' learning.

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