PROJECT-BASED LEARNING IMPLEMENTATION IN SCIENCE CLASS

Challenges for Indonesian Educational System

PjBL

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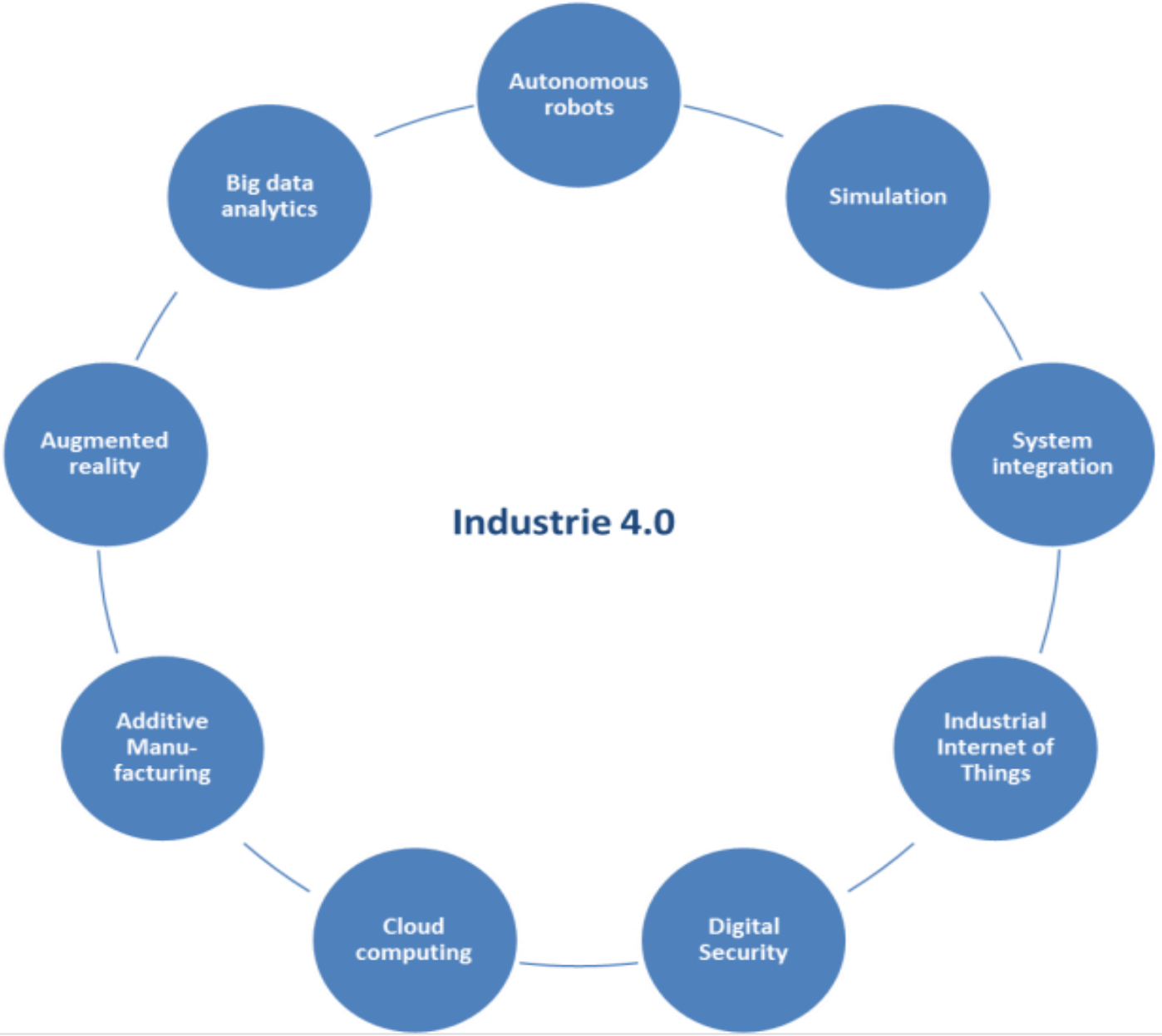
EDUCATION

TRANSFORm

TO DATE THROUGH INNOVATION

Nine technologies that are transforming industrial production



Some examples of technological transformation

Sumber: liputan6.com 2020 Merdeka.com

Robots and learning machine will be replaced teacher/lecturer

Sumber: liputan6.com 2020 Merdeka.com

e-money and Robot will be replaced bank teller

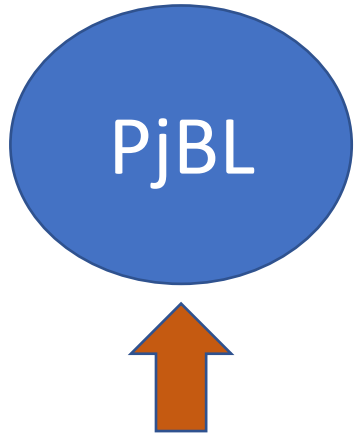
5. Pustakawan

Sumber: liputan6.com 2020 Merdeka.com

e-book from smartphone

What is innovation?

- Latin verb “innovare”, which means to renew. In practice, innovation means to improve or to replace something, for example, a process, a product, or a service.
- In the context of education, innovation can be innovation in education (including educational, scientific and technological, infrastructural, economic, social, administrative, and other innovation) and educational innovations. Innovation in education is a broader concept than educational innovations.
- Educational innovations are considered as a procedure or method of educational activity, include pedagogical innovation, scientific and methodological innovation, educational and technological innovation, that differs significantly from established practice in a competitive environment.



To meet the need of society in quality education (include for SDGs)

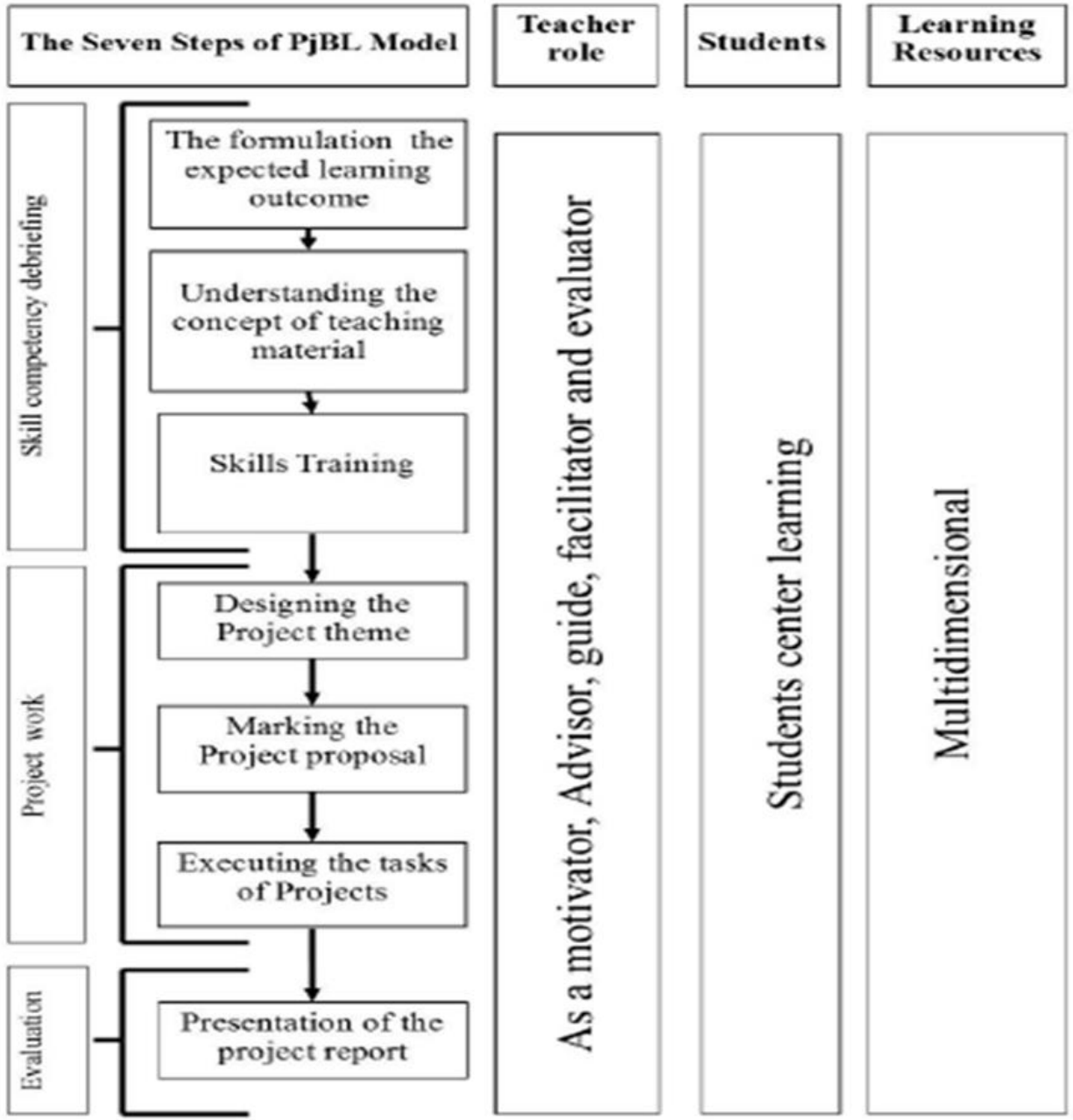
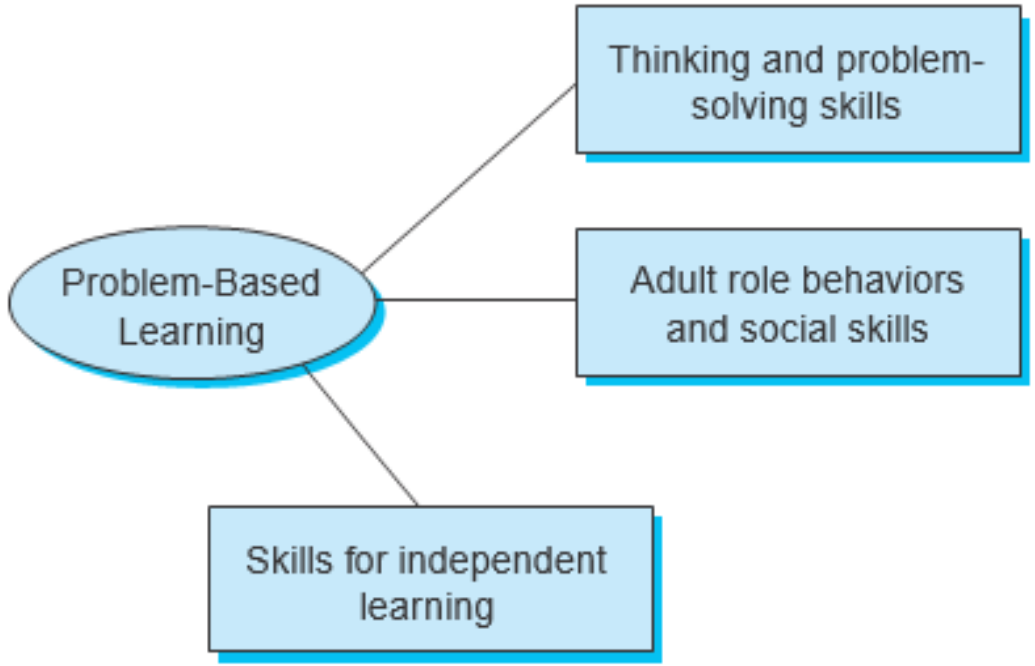


Fig.1. The Seven Steps of PjBl model



Why should PBL/PjBL?

- Career aspiration (connecting to STEM career choice)
- Scientific literacy (Bybee, 1997)
- Preparing to live for 21th century
- High order thinking skills (Bloom taxonomy)
- Self-efficacy, attitude, and value

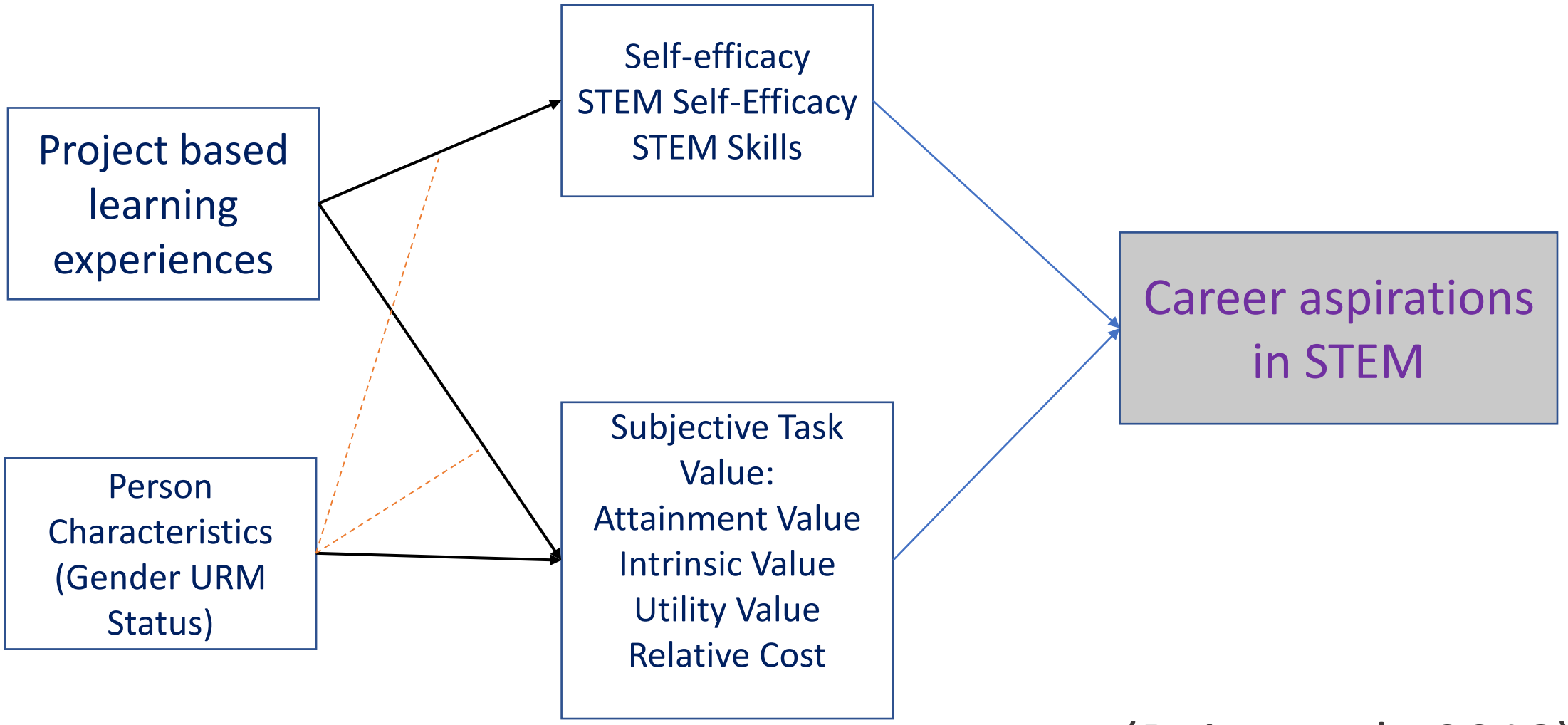
PjBL connecting to STEM career choice

STEM education is an interdisciplinary approach to learning where rigorous academic concepts are coupled with real world lessons as students apply science, technology, engineering, and mathematics in contexts that make connections between school, community, work, and the global enterprise enabling the development of STEM literacy and with it the ability to compete in the new economy. (Southwest Regional STEM Network 2009, p. 3)

STEM education can be considered a single or multi-disciplinary field, and in the case of the latter, no clear consensus exists on the nature of the content and pedagogic interplay among the STEM fields (Holmlund, Lesseig, & Slavit, 2018)

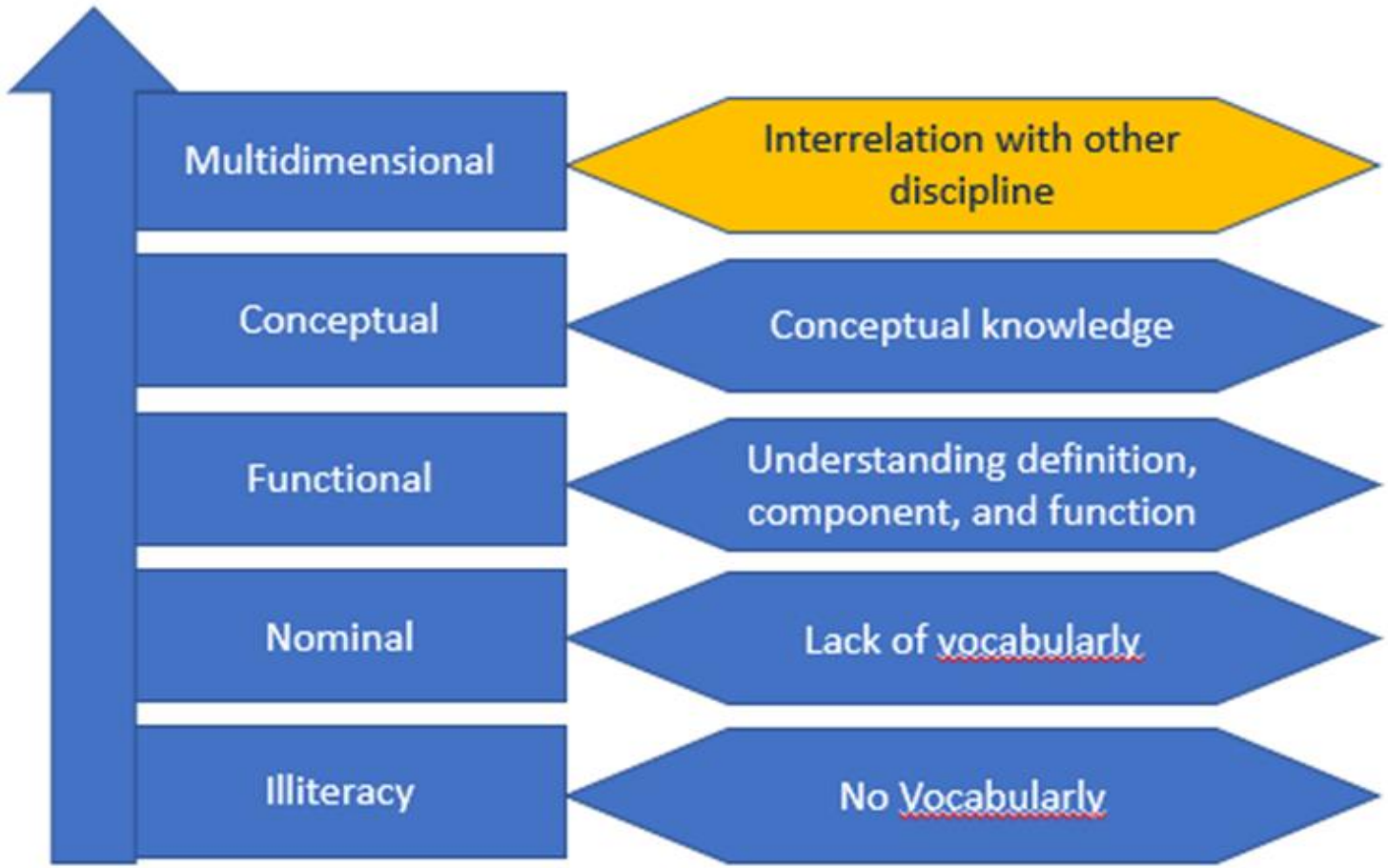
STEM education is an innovation with various instructional models and emphases that are shaping reform in many educational systems (Bybee 2013; National Academy of Engineering and National Research Council 2014; Wang et al. 2011).

A Model of Career Interest Incorporating Elements of Expectancy Value Theory (Eccles & Wigfield, 2005) and Social Cognitive Career Theory (Lent et al., 1994)



(Beier et al., 2018)

Scientific Literacy Level Need for STEM



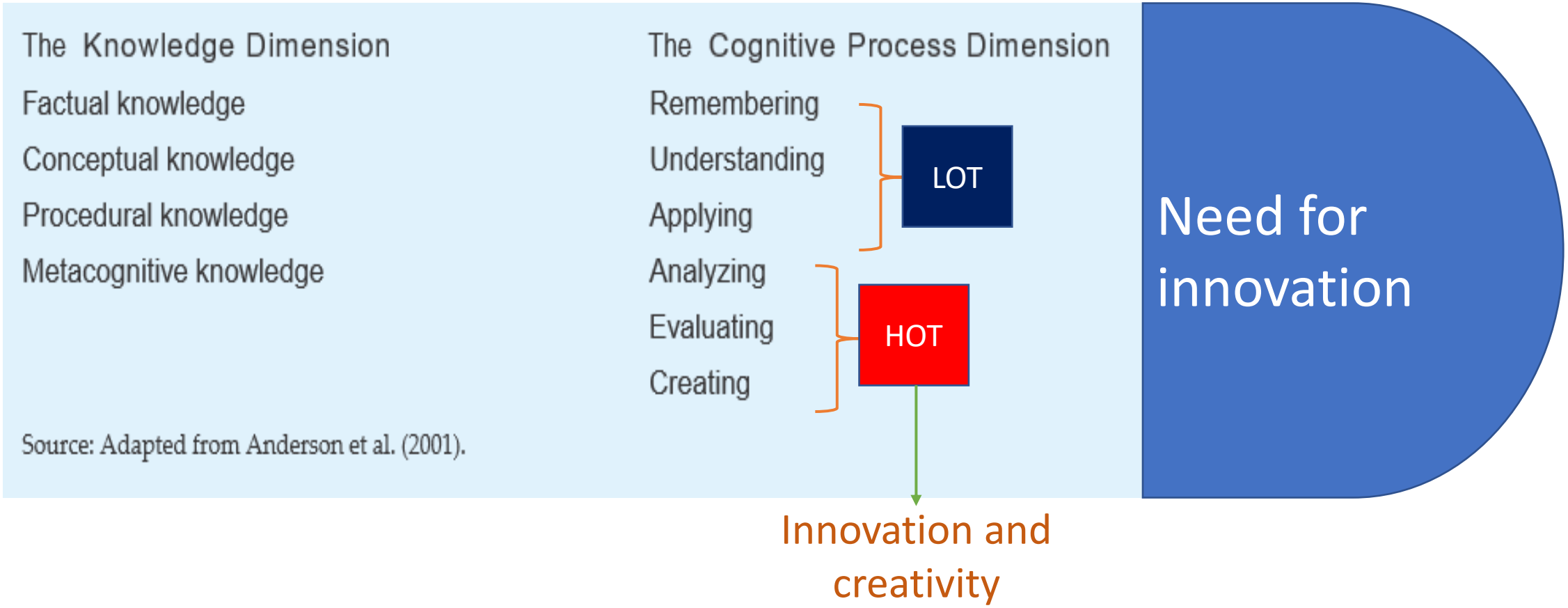
PjBL

PjBL promotes student's innovation for SDGs

The 21st Century of Citizenship

- Problem solving and critical thinking skills
- Cooperation and collaboration
- Tolerance
- Participation
- Science literacy

Bloom taxonomy and type of knowledge for educational Innovations



Source: Adapted from Anderson et al. (2001).

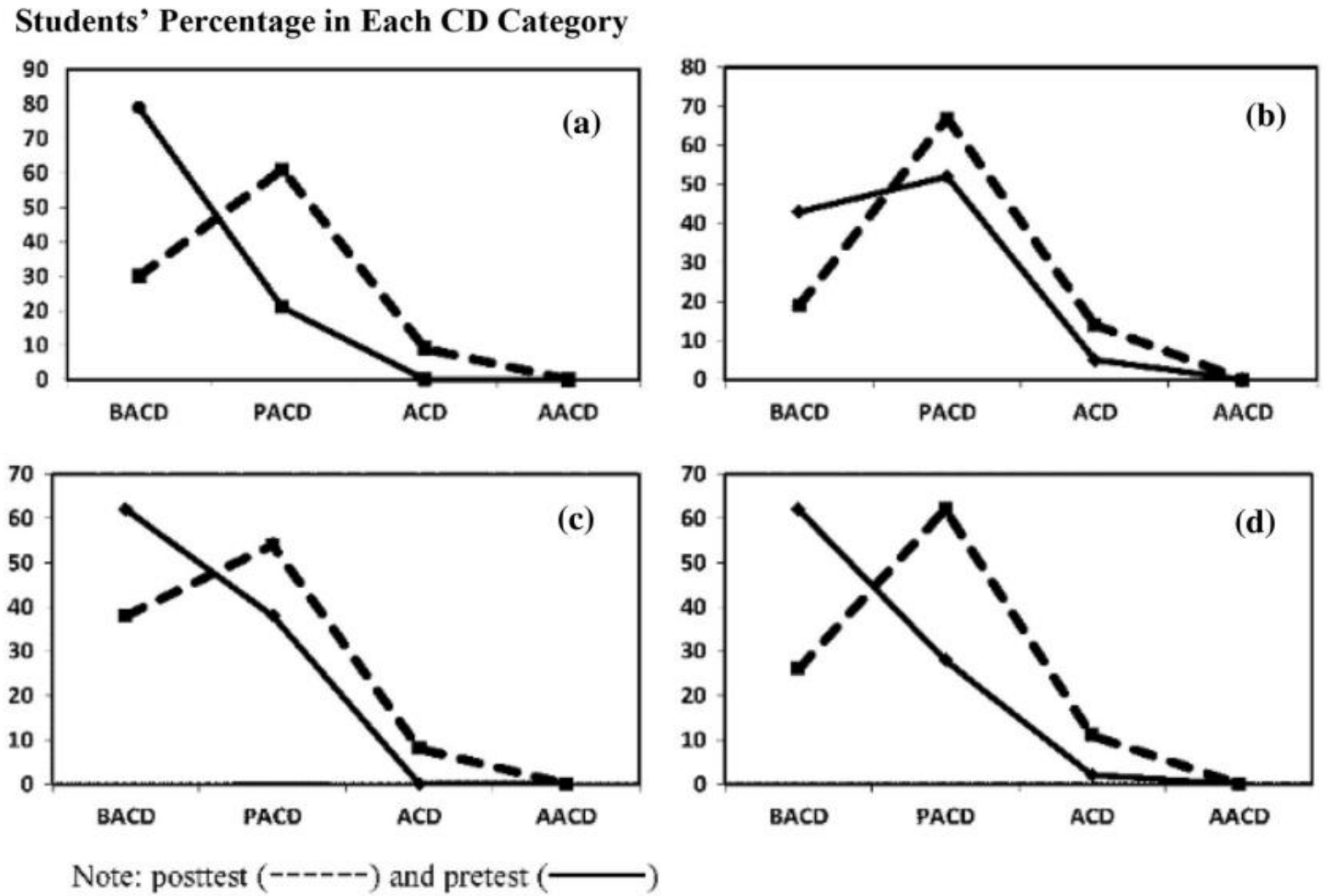


Fig. 5 Percentage of students in Cognitive Development Category: BACD, PACD, ACD, and AACD before and after CPs in CS (**a**), RS (**b**), SS (**c**), and average of the three location environments (**d**)

ACD and AACD are required

(*Erman & Wakhidah, 2021)*

Educational innovations for SDGs

The education is not just focus on how to enhance student's knowledge but also should have a significant contribution to economic prosperity and social cohesion

CHALLENGE 1

Curriculum is designed as mono discipline orientation

Competences (KI/KD) in science curriculum of primary, secondary, and high schools are commonly designed to understand subject content knowledge using scientific inquiry practices

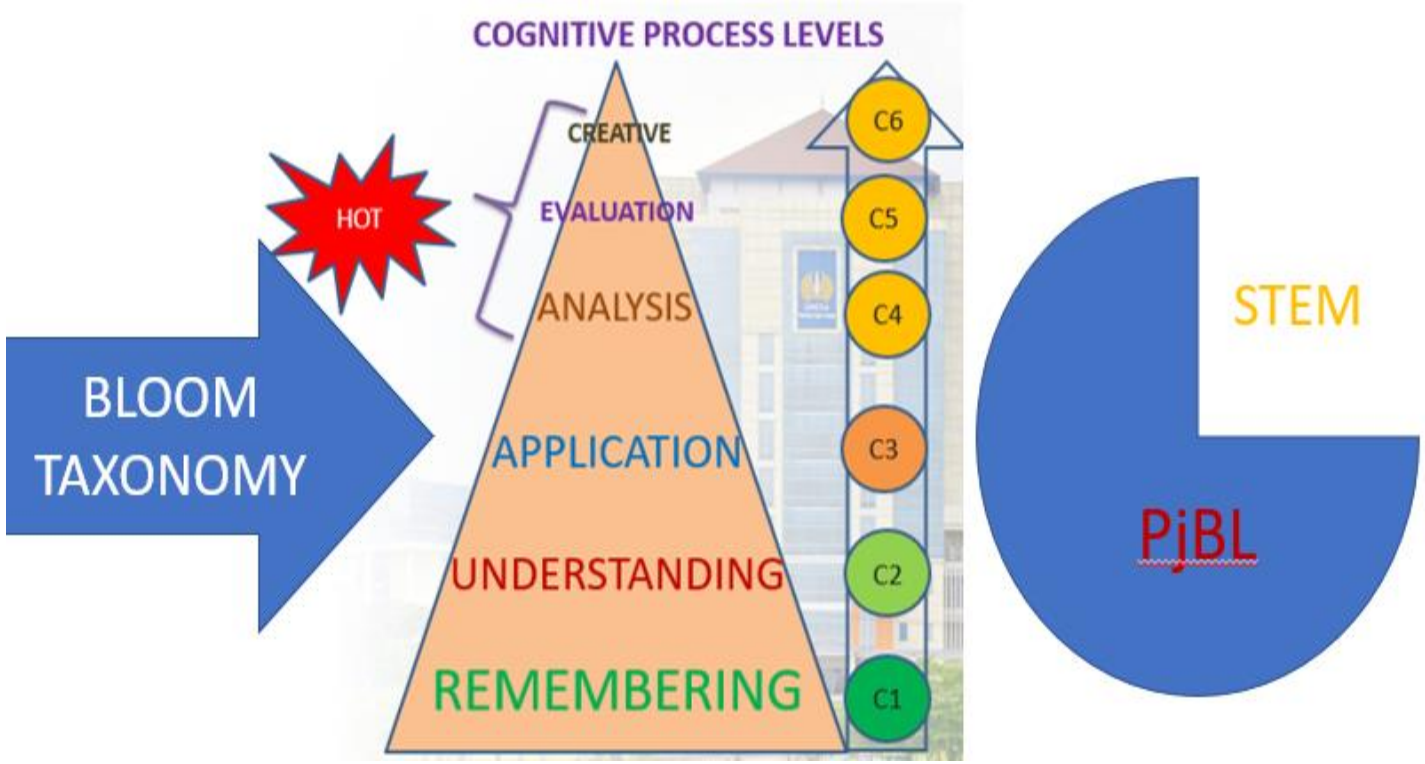
Teachers are difficult incorporating STEM and engage student to learn science using PBL or PjBL

CHALLENGE 2

Competencies are cognitively ranging from understanding to analysis levels

Science in K-13

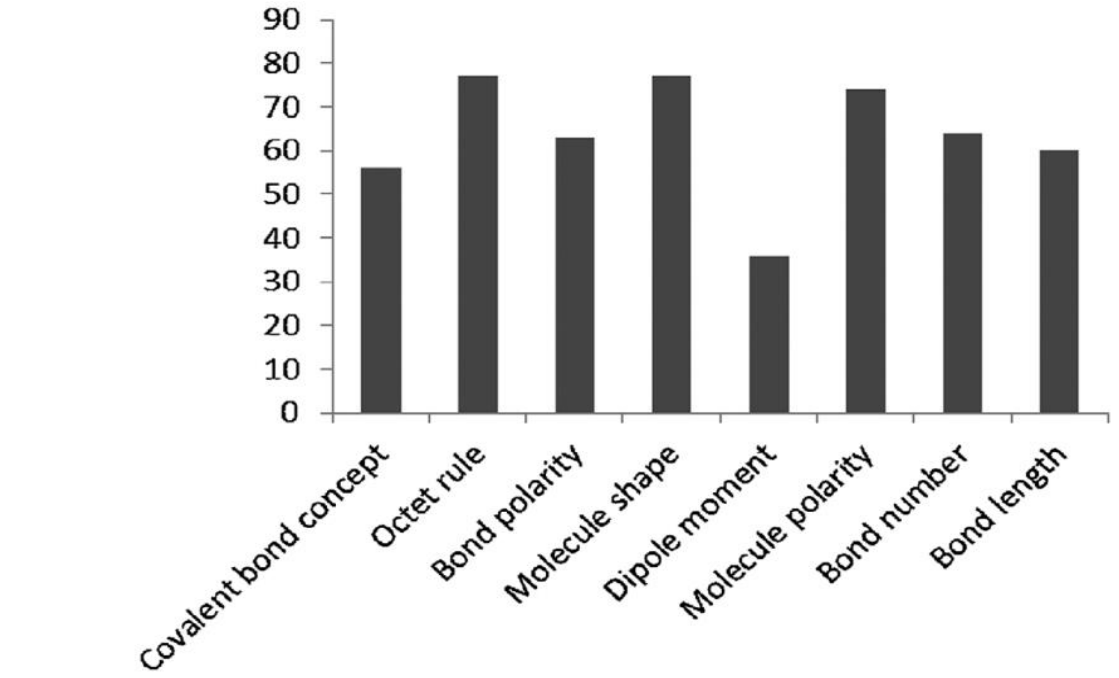
- Primary school
- Secondary school
- High school



CHALLENGE 3

Students have difficulty learning science, even misconceptions

Students are focused on how to understand declarative knowledge (science) to describe science objects, facts, or phenomena



Student percentage experience misconception in each subtopics of covalent bonding.

(Erman, 2017)

CHALLENGE 4

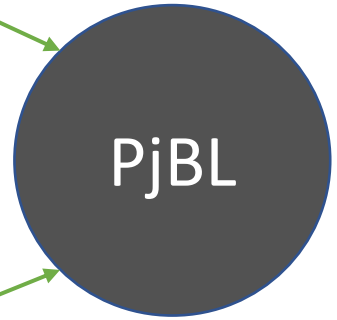
Most student perform rote or surface learning

Mayer (2002)

- No learning
- Rote learning
- Meaningful learning

Fullan & Langworthy (2014)

- Surface learning
- Deep learning



Learning category	Superior class (%)	Non-superior class (%)
No learning	0	0
Rote learning	0	0
Surface learning	100	100
Deep learning	0	0

Source: Erman et al., 2021

CHALLENGE 5

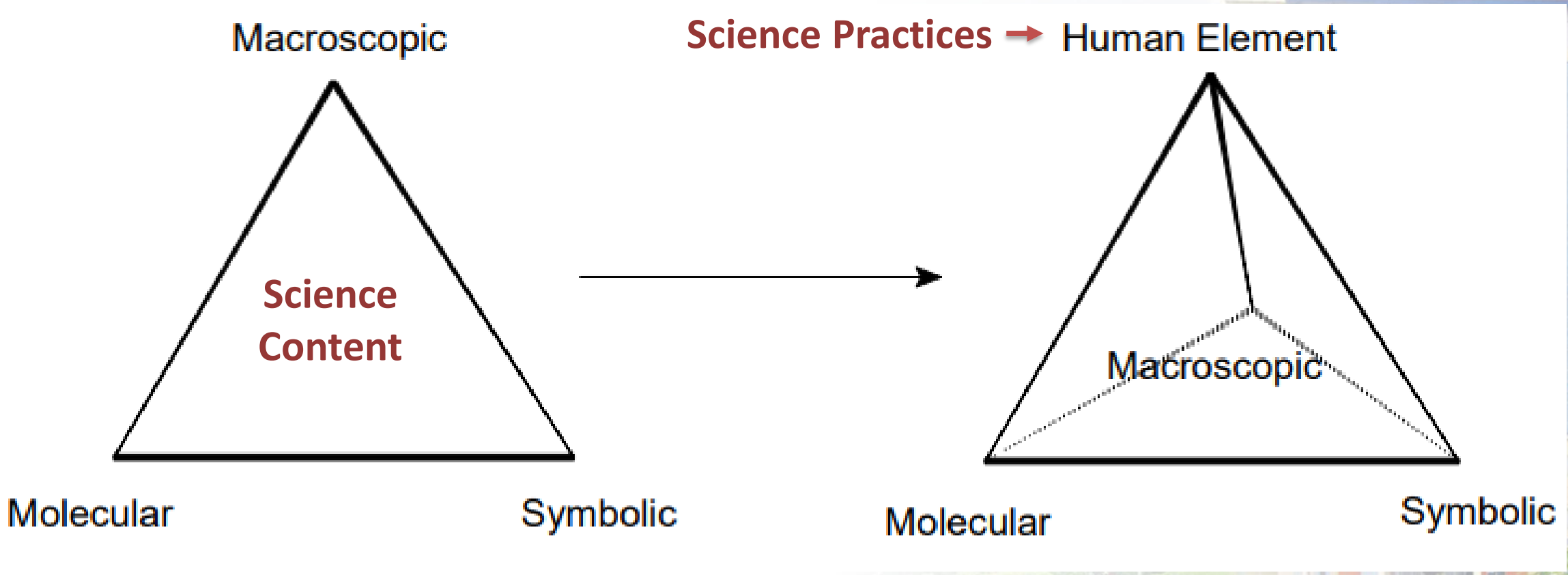
Technology and engineering have not been incorporated in science curriculum (e.g. How to prevent rusty fence)

Students are found:

- Lack of vocabulary,
- Lack of knowledge,
- Lack of conceptual knowledge

All are not incorporated in the topic of simple machine such as lever

Use a context-based learning: From Triangle Johnstone (1991) to Tetrahedron Mahaffy (2004)



Teaching should be changed from Textual to Contextual to solve authentic problems

CHALLENGE 6

Teachers are lack of experiences to engage students in interdisciplinary subjects

Science classroom:

- Primary school
- Secondary school
- High school

Sources: Regional.compass.com

CHALLENGE 7

The lack of implementation of student-centered learning

- PBL
- PjBL
- Cooperative Learning
- Collaborative learning

CHALLENGE 8

Teachers have not experience performed PjBL

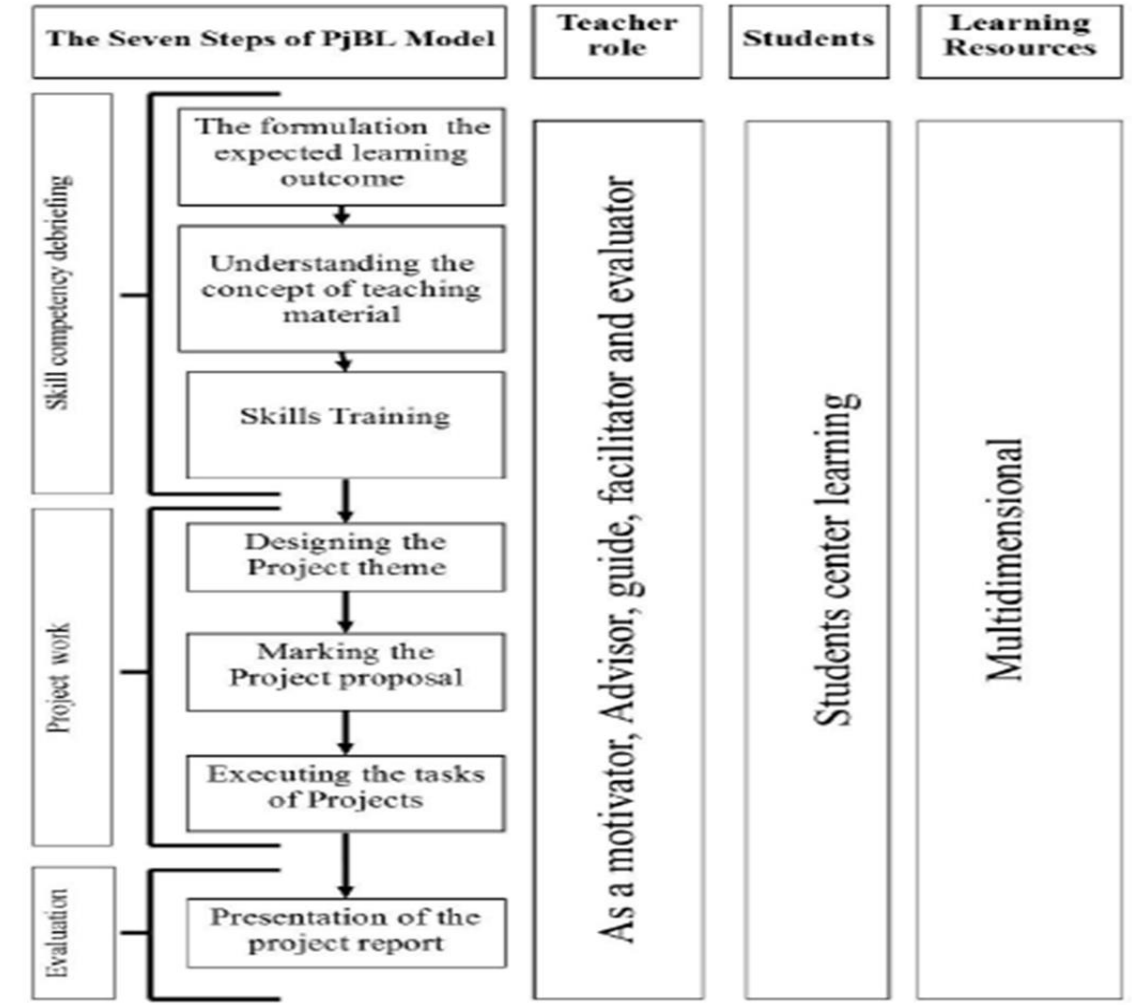
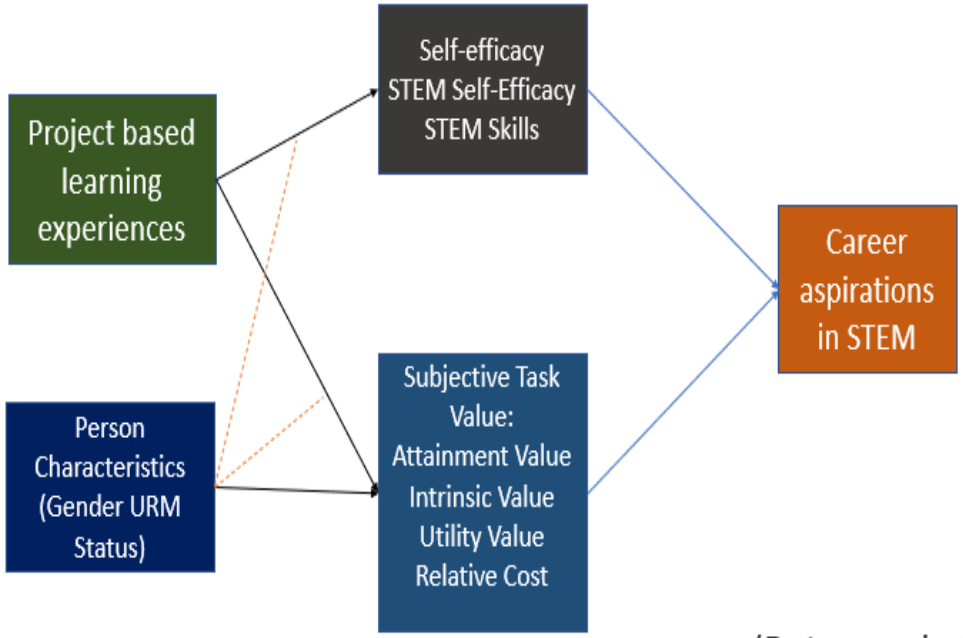


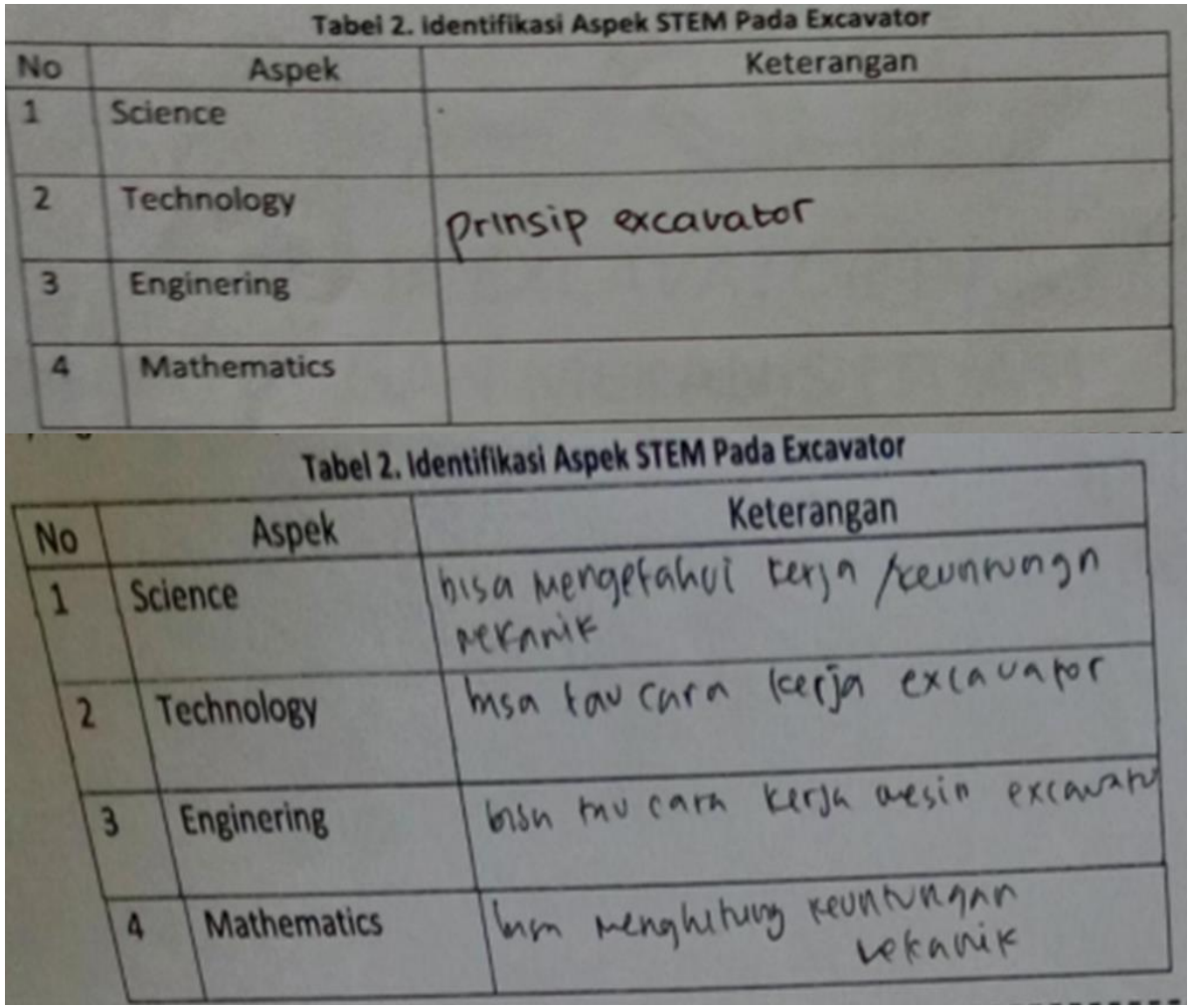
Fig.1. The Seven Steps of PjBl model



(Beier et al., 2018)

CHALLENGE 9

Most science teachers are prepared only for subject content knowledge



Tabel 2. Identifikasi Aspek STEM Pada Excavator

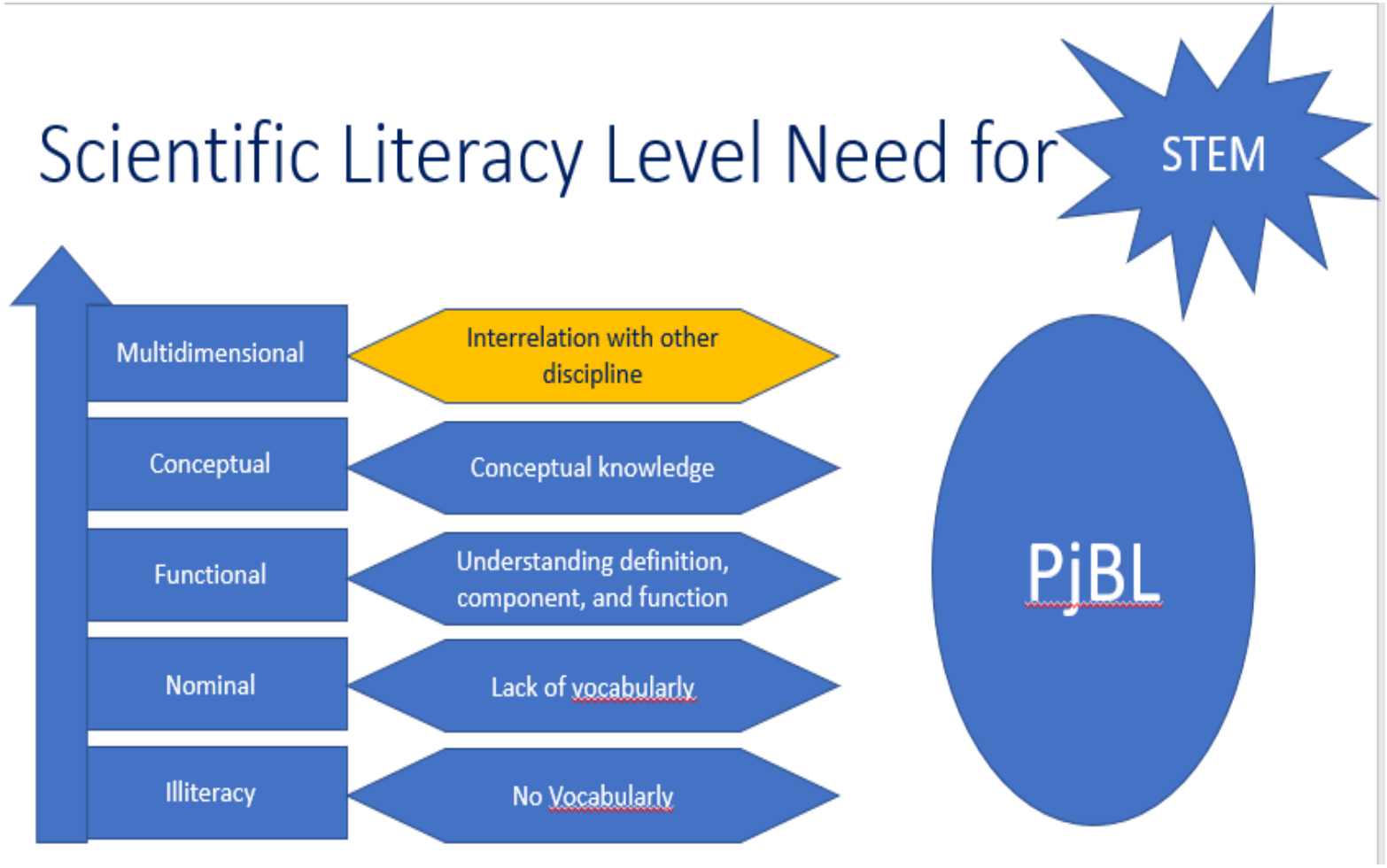
No	Aspek	Keterangan
1	Science	
2	Technology	Prinsip excavator
3	Enginering	
4	Mathematics	

Tabel 2. Identifikasi Aspek STEM Pada Excavator

No	Aspek	Keterangan
1	Science	bisa mengetahui kerja /keuntungan mekanik
2	Technology	bisa tau cara kerja excavator
3	Enginering	bisa tau cara kerja mesin excavator
4	Mathematics	bisa menghitung keuntungan mekanik

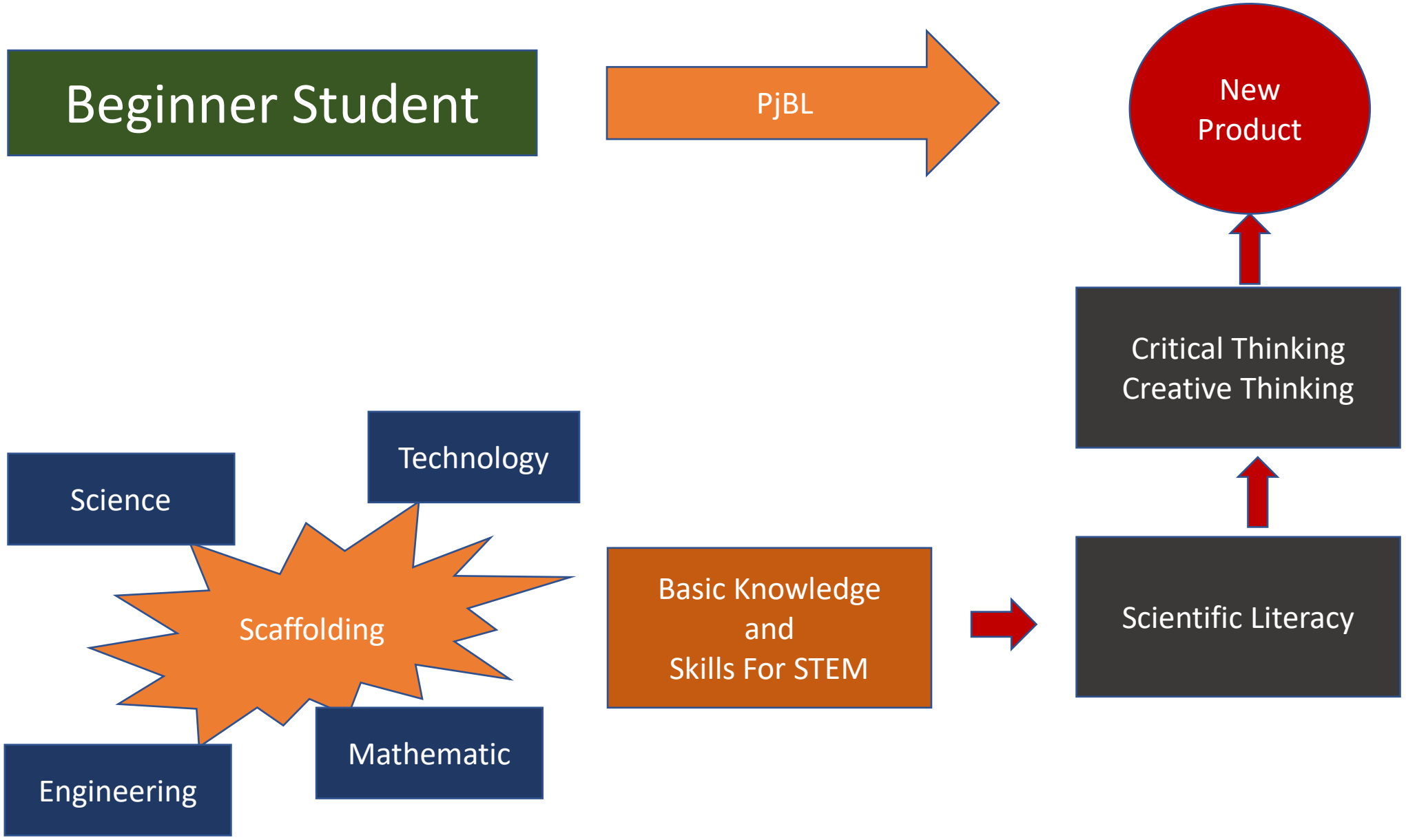
STEM ⬬ PjBL

CHALLENGE 10: STEM literacy



Student should be able to:

Identify
Define
Explain
Apply


Beginner Student
PjBL
New Product
Critical Thinking
Creative Thinking
Technology
Science
Scaffolding
Basic Knowledge and Skills For STEM
Scientific Literacy
Mathematic
Engineering

Conclusion

1. Teacher must be addressed knowledge (including concepts of the related science) and skills (STEM/STEAM) before implement PjBL based learning
2. Teacher should consider students learning capacity to participate in an interdisciplinary subject
3. Students must be engaged into student centered learning
4. Teachers must be able to implement PBL/PjBL in science classes
5. Both teacher and student should have STEM literacy

The important thing is...

Not to stop Questioning

- Albert Einstein

STEM

Because of not to stop observing

THANK YOU