Exploring Students' Patterns Of Reasoning

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Introduction- What is Content Question

- A type of assessment
- Open ended question
- Elicit s

Newly learnt concept

Predeter
- Cognitiv
- Type of
- Knowledge types
- Required skills

New Context

Example question in Biology

- You are given four plants with different seed… …llow and whi… …he s… …o the pl… …llow flowe… …plants with swollen po… …ite flowers and others with swollen pods and yellow flowers. Predict which trait is dominant and recessive?

How to determine the cognitive load and level of abstraction?

Bloom's revised taxonomy for classifying the components of reasoning [1]

Table 1- Selection from Knowledge Dimension	
Factual knowledge	Knowledge of elements and essential facts
Conceptual knowledge	Knowledge of classification ,principles , theories and structures, Conceptual schema
Procedural knowledge	Knowledge of subject-specific skills, algorithms, techniques, methods and procedures

1-Anderson et. al, 2001

Bloom's revised taxonomy for classifying the components of reasoning, Cont.

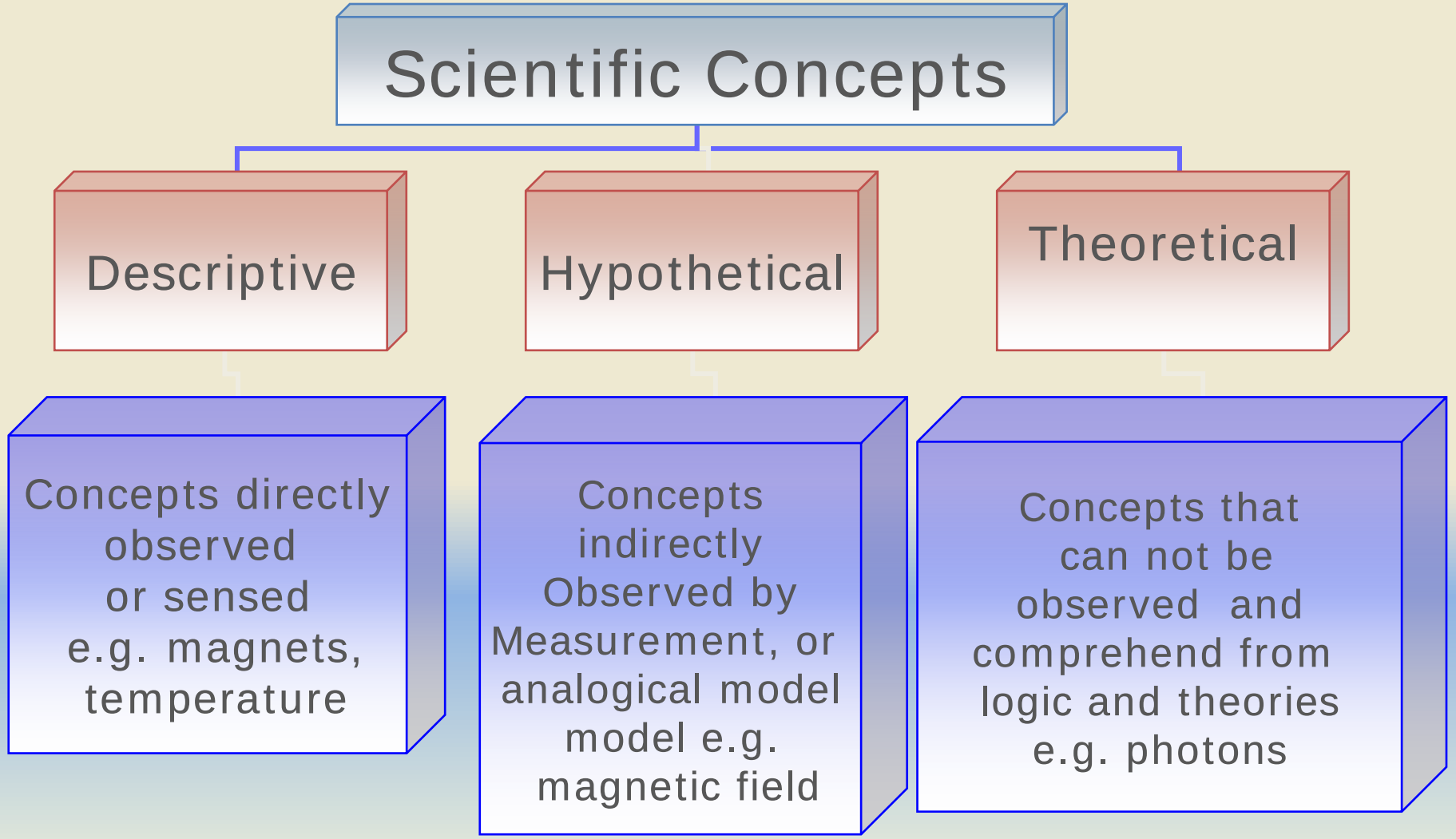
Table 2- Selection from Cognitive Dimension	
Remember	Recognize (identify), Recall (retrieve from memory)
Understand	Interpret (paraphrase, change representation), Infer (draw logical conclusion), Classify (categorize),Compare and Contrast, Explain (construct cause and effect model)
Apply	Implement (apply a procedure to an unfamiliar task), Execute (apply a procedure to a familiar task)

Factual	***Heterozygous, homozygous, recessive, and dominant***
Conceptual	***Interaction between member alleles of the pair that produce outcome pair of alleles***
Classifica	
Procedure	
Compare	
Infer	***Justify how and why cause related to the effect***
Apply	***Apply the multiplication rule of probability to the cross of two traits to interpret the outcome phenotypes***

Rubric(*In-depth, developed, Naïve*)[1] for each component of Bloom's Taxonomy

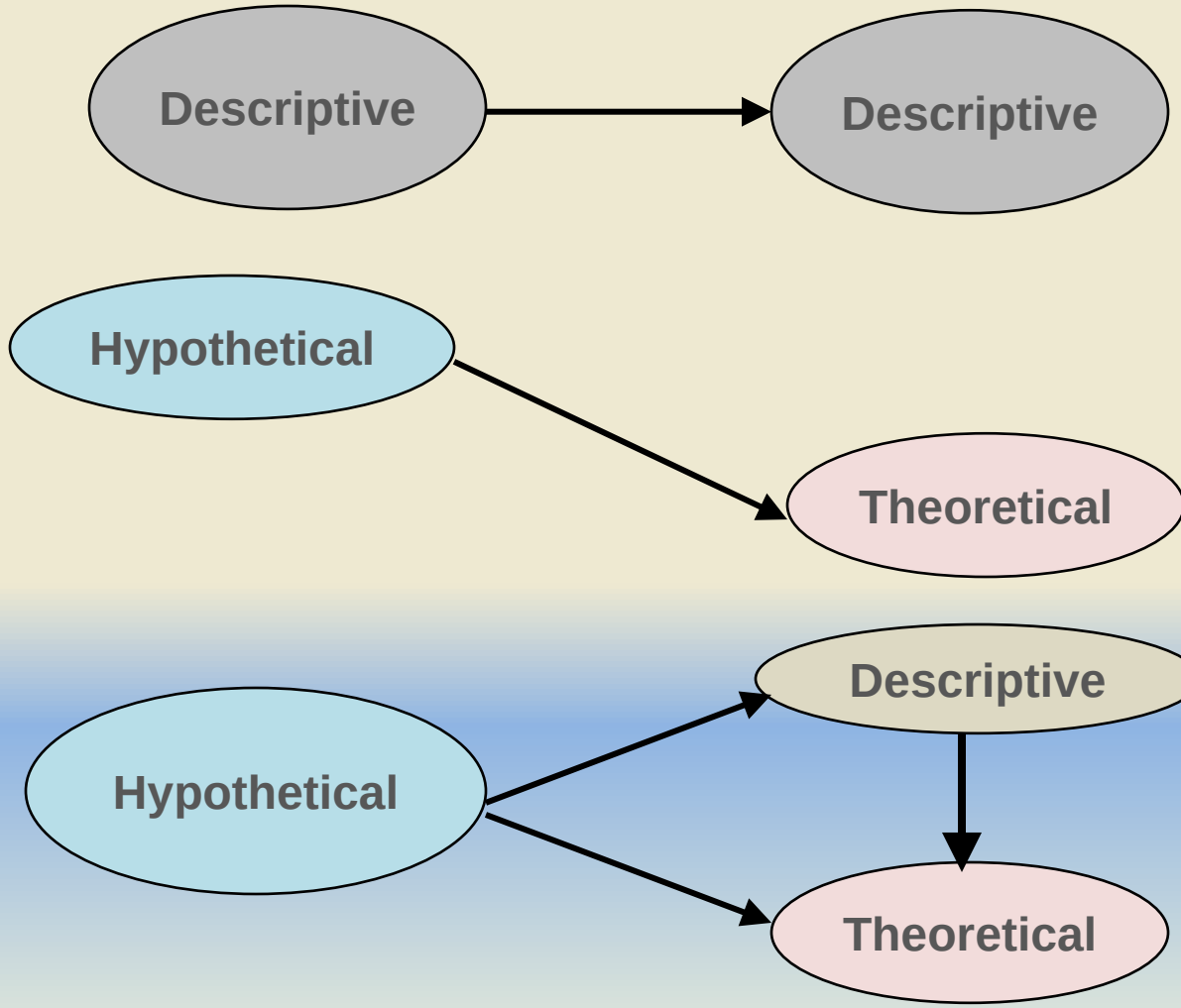
4-Wiggins and J. McTighe (1998)

Modification to Lawson's[2] definition to make it appropriate for physics contexts



2-Lawson et. al (2000)

Type of concept links[3]



One Concept-Level link

Cross Concept-Level link

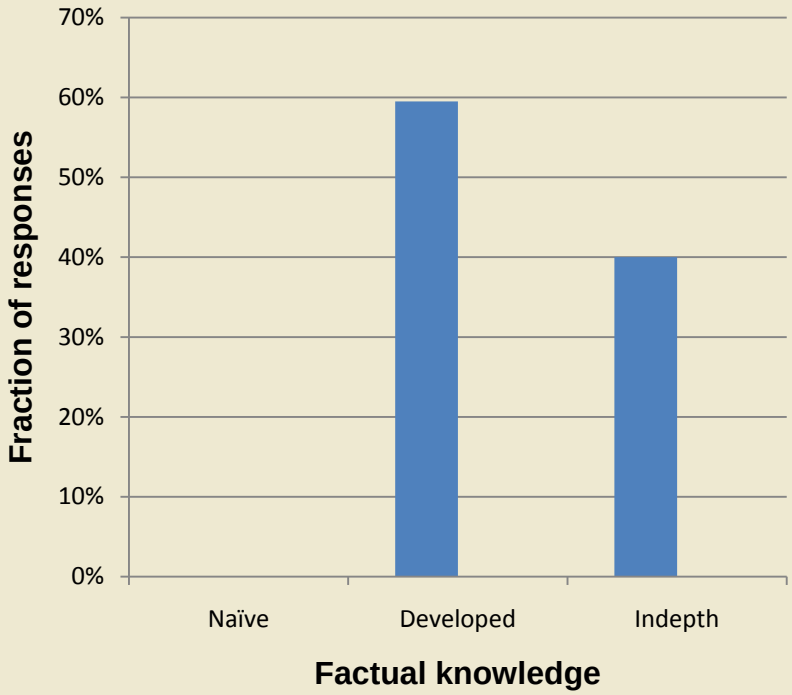
Multi Concept-Level links

3-Neiswandt & Bellemo 2009

Type of Reasoning	Rubric	Concept link
"Yellow is dominant and swollen is dominant"	Naive	T,D
"I predict that swollen are dominant and white is recessive because you had no pinched pods after the cross and still have yellow flowers"	Factual, Conceptual, (Developed) Others(Naïve)	T-D
"Both swollen pods and white flowers are dominant. Swollen pods are offspring while pinched are flowers come from the reces of the yellow"	Factual.	T, D
"When both yellow were bree appear which seems to claim that only when 2 heterozygous plants cross the white recessive gene can appear"		

Presence-Dominance

Recessive-Recessive-White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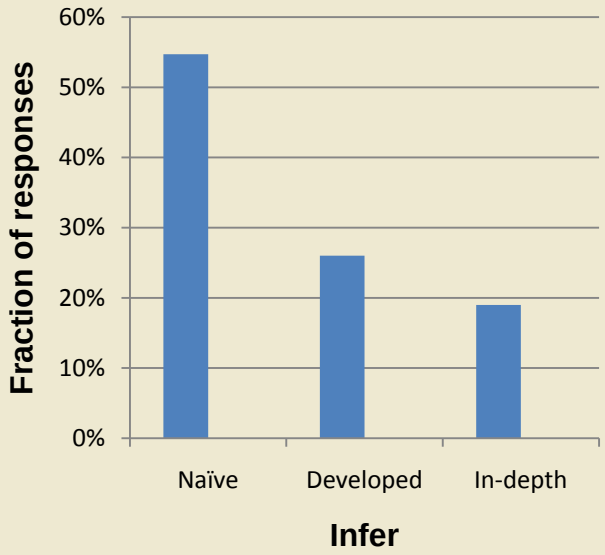
Fraction of responses
Naïve
Developed
Indepth
Factual knowledge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Fraction of responses
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Developed
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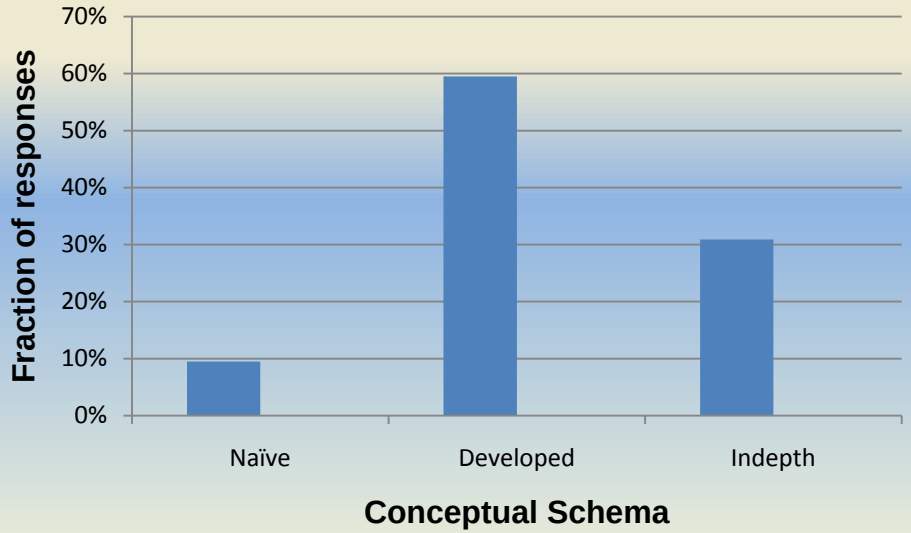
Infer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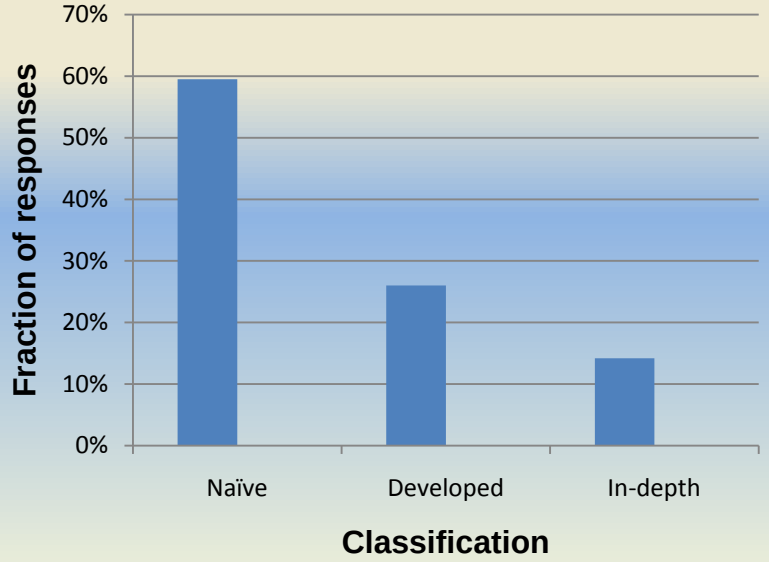
Fraction of responses
Naïve
Developed
Indepth
Conceptual Schema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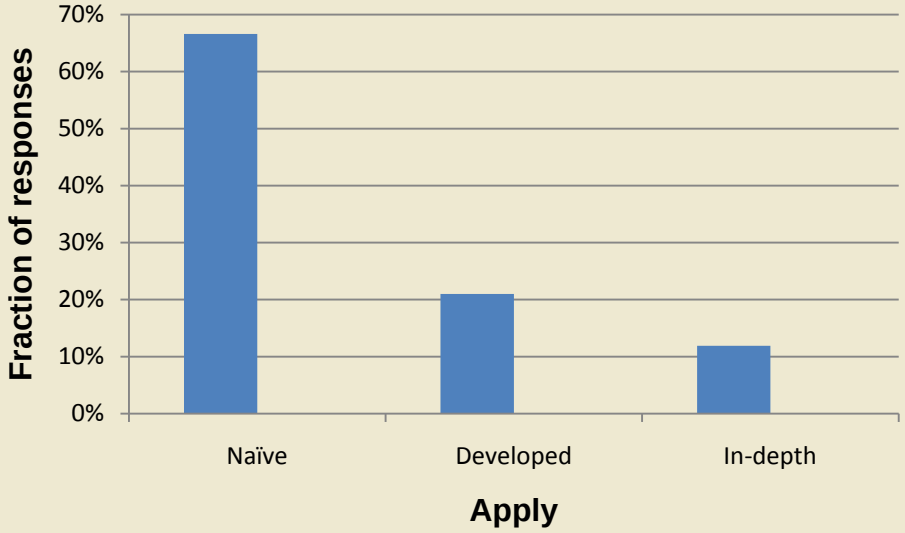
Fraction of responses
Naïve
Developed
In-depth
Classification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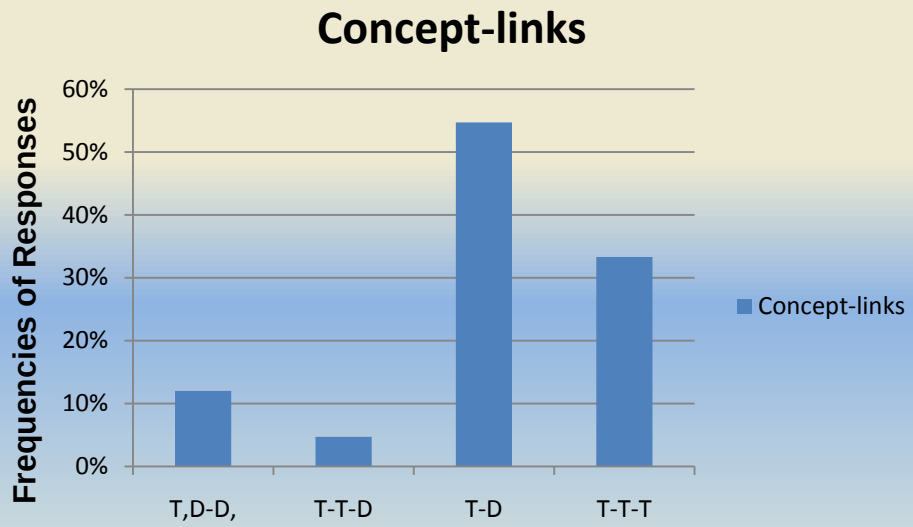
Fraction of responses
Naïve
Developed
In-depth
Apply


Concept-links
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Frequencies of Responses
T,D-D,
T-T-D
T-D
T-T-T
Concept-links

Conclusion

- ✓ We can devise content questions with predetermined level of thought processes
- ✓ Assessment tool that categorize different levels of thinking
- ✓ We can find the weaknesses and strengths of students' reasoning in our classification scheme(concept structure, type of knowledge or cognitive process)
- ✓ Students' performance decline when the higher hierarchies of knowledge is required
- ✓ As the answers display in-depth level of knowledge the conceptual structure is more shown to be multi-level link

Thank you

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