The role of **interesting topics and contexts** in **physics** education

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Motivation

Previous studies show that **students' interest differs across physics contents** (e.g. mechanics), **contexts** (e.g. biological) and **activities**. However, students' **interest types** were mainly described in terms of **gender**, even though **other factors** (e.g. self-concept) might have a strong influence. Moreover, previous studies did not include **modern physics** or **open questions of current research**, which might be particularly interesting contents for students.

Research aims

This poster provides a **literature review** as a basis for a **PhD research project**.
New **research** will be conducted to figure out which topics and activities **arouse interest** in **physics** among todays' **high school students**.

Moreover, **interest types** will be described while considering various factors of influence.
The results will be used to develop **a learning intervention** equally interesting for all types of high school students.

Interest – Structure of the construct

Person-object-theory [1]

What is interest?

- specific **relationship** between a person and an object [2]
- **content and domain specific** [2]
- **multidimensional** (cognitive/epistemic, emotional and value-related components) [2]

2 levels of interest

1) **Individual interest**
2) **Operational interest:** caused by
   i. individual interest
   ii. external factors, i.e. **interestingness** [2]

Interest vs. attitude

- **attitude** = general, non-personal evaluation [2]
- **interest** = subjective value attached to knowledge about an object [2]

What is an **object of interest**?

Certain **part** of the **cognitively represented environment** [2]

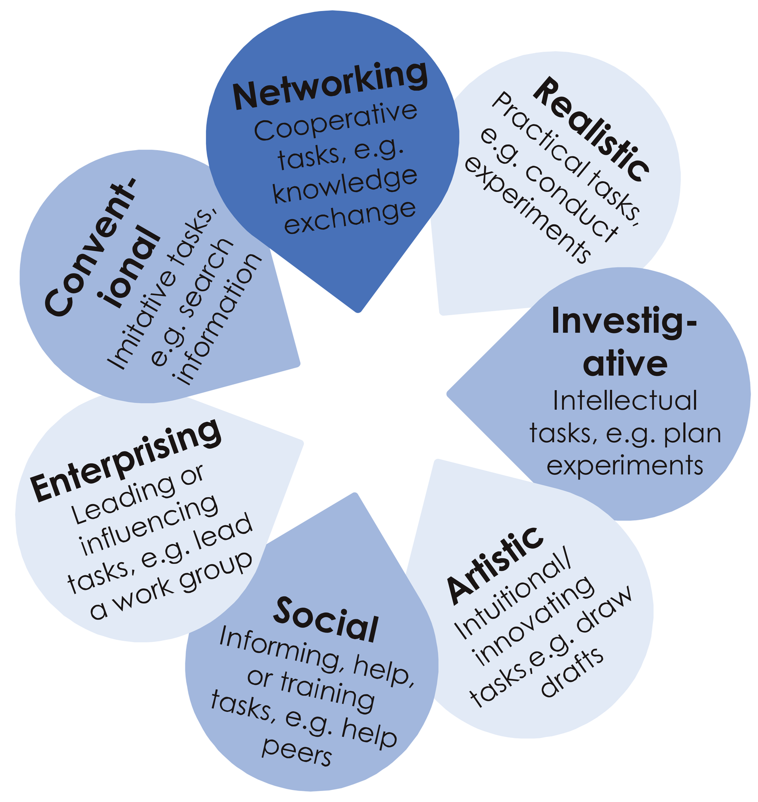
Which **object of interest** is **interesting for PER**?

General interest in science, or interest in a domain, a subject, a content, a context, a task, a learning environment, ...

Object of *interest* – Activities

RIASEC+N-model

- RIASEC-model originally developed for categorizing vocational interests [3]
- **Adaption** for education research [4, 5]
- Interest in different activities is measured in
  - 7 **categories** (additional category *Networking*)
  - 3 learning environments (**school, vocational** interests, and **enrichment**) [4, 5]



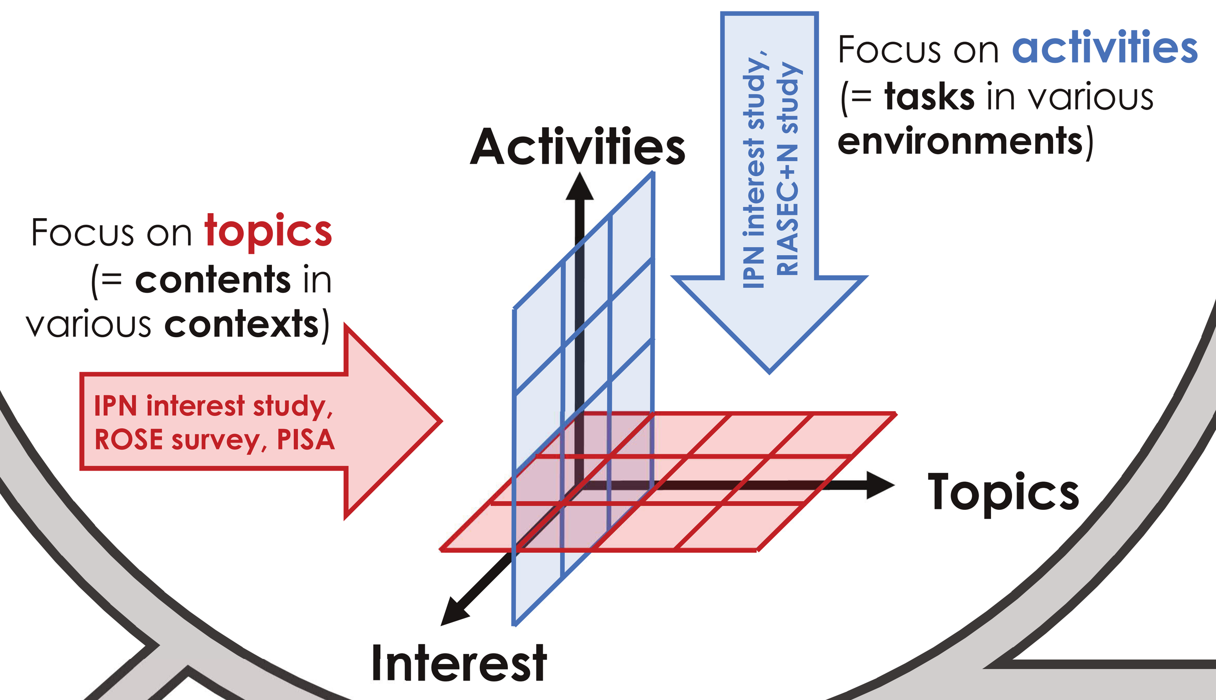
Object of *interest*

4 main facets:
content, context, task, learning environment

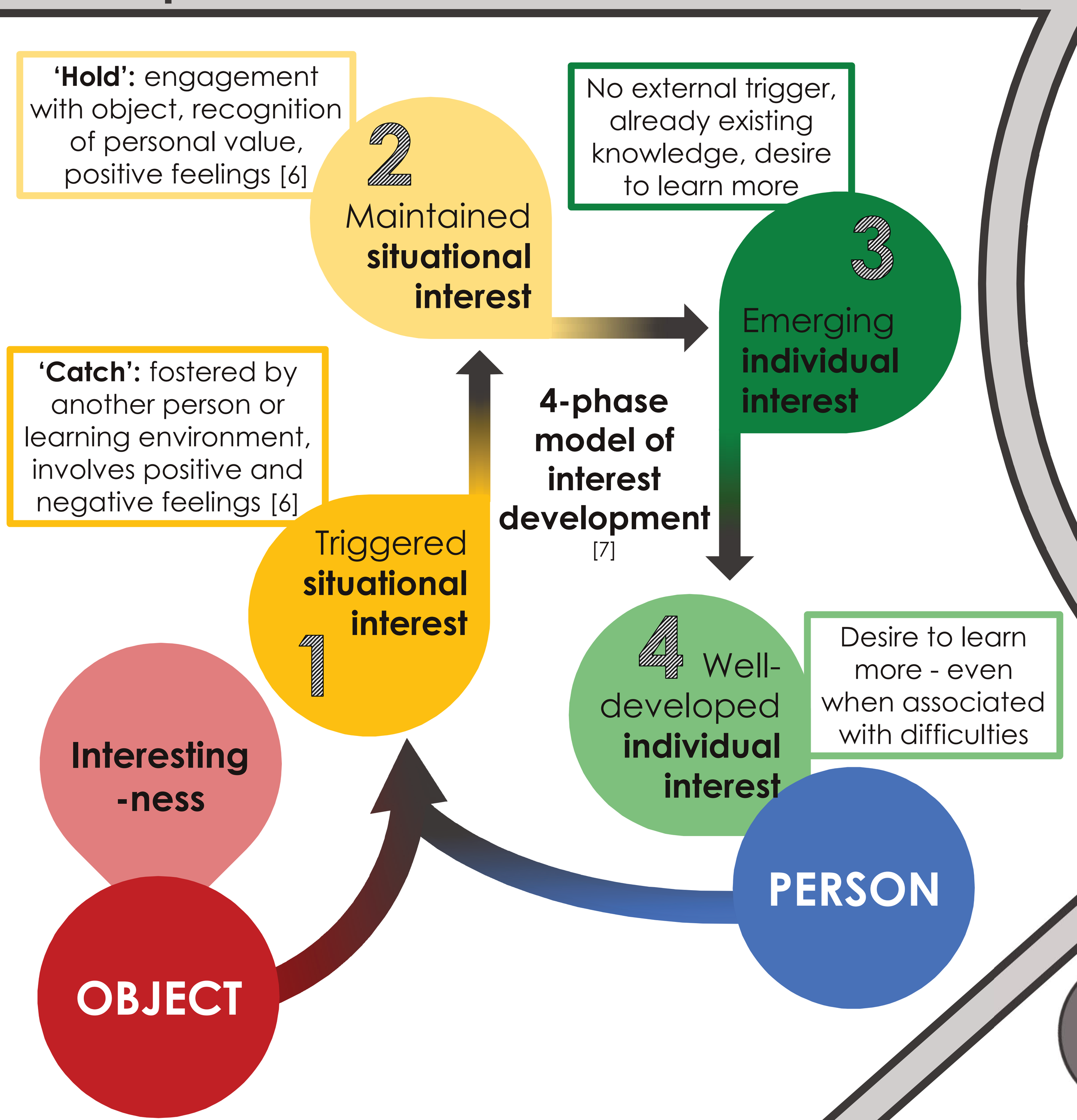
For analysing the structure of interest

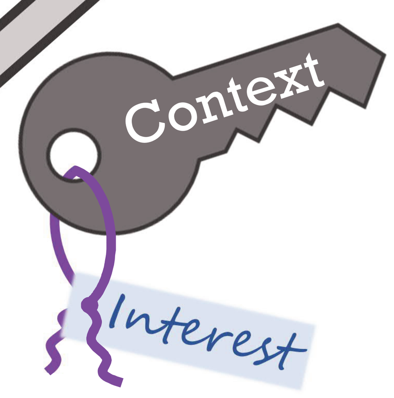
- **contents** can be grouped according to a **context**, subject, or domain, and
- **tasks** can be grouped according to **learning environments**.

Previous studies focused on **different aspects**:



Development of *interest*





Assessment of *interest*

Interest in **domains** and **subjects:**

- **PISA** 2006 [8]: (**content** and) **general interest in science**
- **PISA** 2015 [9]: **general interest in science**
  ⇨ **BUT: Interest** is **not equally high for all contents or tasks** of domain or a subject.

Topological structure of interest:

- **IPN interest study** [10]: **content, contexts**, and **tasks**
- **ROSE** survey [11]: **content** and **contexts**
- **RIASEC+N study** [4, 5]: **tasks** and **learning environments**
  ⇨ **BUT:** Students are **asked** about their interest **when** they are **not directly involved with** (contents or) **tasks.**
- PISA 2006 [8]: **content** (and **general interest in science)**
  ⇨ **Contextualised items** (stimulus text and task)

Have a look!

Previous findings – Activities

RIASEC+N study

8th - 12th graders [5]:

- **Most popular: social** and **networking**
- **High-achievers,** students with **high self-concept,** students with **high general interest:** higher interest in all activities and environments
- **Gender:**
  - **Girls:** higher interest in **social** (*school*) and **artistic** activities (*school, enrichment*)
  - Higher interest in **realistic** activities: **boys** (*vocation*), **girls** (*school, enrichment*)

6th graders [4]:

- **Most popular: realistic** and **investigative**
- **Least popular: social** and **enterprising**
- **Gender:**
  - **Girls:** higher interest in **artistic** activities (*physics, chemistry*)
  - **Boys:** higher interest in **social** activities (*physics*)

IPN interest study [10]

- **Boys:** higher interest in **calculation**
  ⇨ difference concerning **evaluation and discussion** disappears over time
- **General high interest** in **evaluation and discussion**, and **hands-on activities**

Previous findings – Topics

IPN interest study [4]

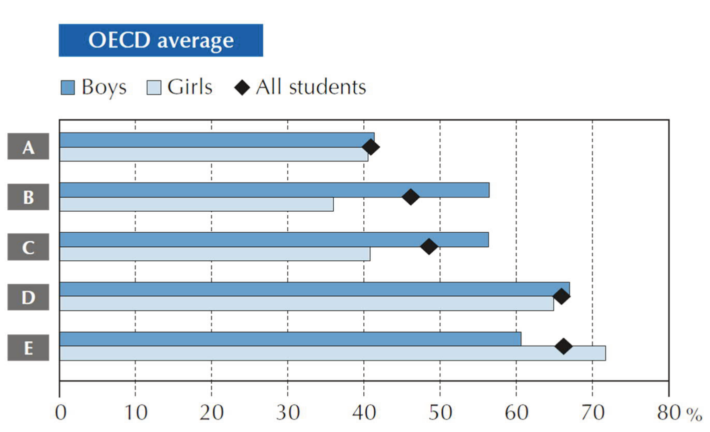
- **Gender:**
  - **Boys:** continuing higher interest in **optical instruments** and **thermodynamics**, and, in particular, in **motion of vehicles** and **electricity/electronics**
    ⇨ difference concerning **radioactivity** disappears over time
  - **Girls:** higher interest in **natural phenomena** and **medical devices**
- **General high interest** in **radioactivity, natural phenomena** and **medical devices**
- **3 types of students:**
  A. interested in **broad field of physics** (e.g. mathematisation, relevance for society), mainly boys/high self-concept
  B. interested in physics' applications for **humans and nature**
  C. interested in **relevance for society,** not at all interested in 'hard' physics, mainly girls/low self-concept

ROSE survey [12]

- **Gender:**
  - **Boys** (and NOT girls): technical, mechanical, electrical, spectacular, violent, explosive
  - **Girls** (and NOT boys): health and medicine, beauty, human body, ethics, aesthetics, wonder, speculation (and the paranormal)
- **Equal** AND **high interest:** space, life, wonder, openness (**winner:** possibility of life outside earth)
- The **more developed** the country, the **less** overall **interest** in science

PISA 2015 [13]

A. Biosphere (e.g. sustainability)
B. Motion and forces (e.g. velocity, friction)
C. Energy and its transformation (e.g. chemical reactions)
D. The Universe and its history
E. How science can help us prevent diseases



Literature: [1] Krapp, A. (2002). Structural and dynamic aspects of interest development: theoretical considerations from an ontogenetic perspective. *Learning and Instruction, 12*, 409. doi:10.1016/S0959-4752(01)00011-1. [2] Krapp, A., & Prenzel, M. (2011). Research on Interest in Science: Theories, methods, and findings. *International Journal of Science Education, 33*(1), 27-50. doi:10.1080/09500693.2010.518645. [3] Holland, J. L. (1997). *Making vocational choices: A theory of vocational personalities and work environments*: Psychological Assessment Resources. [2] Krapp, A., & Prenzel, M. (2011). [4] Blankenburg, J. S., Höffler, T. N., & Parchmann, I. (2016). Fostering today what is needed tomorrow: Investigating students' interest in science. *Science education, 100*(2), 364-391. [5] Dierks, P. O., Höffler, T. N., Blankenburg, J. S., Peters, H., & Parchmann, I. (2016). Interest in science: a RIASEC-based analysis of students' interests. *International Journal of Science Education, 38*(2), 238-258. doi:10.1080/09500693.2016.1138337. [6] Mitchell, M. (1993). Situational interest: Its multifaceted structure in the secondary school mathematics classroom. *Journal of educational psychology, 85*(3), 424. [7] Hidi, S., & Renninger, K. A. (2006). The Four-Phase Model of Interest Development. *Educational psychologist, 41*(2), 111-127. doi:10.1207/s15326985ep4102_4. [8] Frey, A., Taskinen, P., Schütte, K., & Deutschland, P.-K. (2009). *PISA 2006 Skalenhandbuch: Dokumentation der Erhebungsinstrumente*: Waxmann Verlag. [9] Mang, J. U., Natalia; Leßke, Ina; Schiepe-Tiska, Anja; Reiss, & Kristina (Eds.). (2019). *PISA 2015 Skalenhandbuch. Dokumentation der Erhebungsinstrumente*. Münster, New York: Waxmann. [10] Häußler, P., Lehrke, M., & Hoffmann, L. (1998). *Die IPN-Interessenstudie Physik*. Kiel: IPN. [11] Schreiner, C., & Sjøberg, S. (2004). Sowing the seeds of ROSE: Background, rationale, questionnaire development and data collection for ROSE (The Relevance of Science Education): A comparative study of students' views of science and science education. *Acta didactica http://urn. nb. no/URN: NBN: no-14449*. [12] Sjøberg, S., & Schreiner, C. (2012). Results and Perspectives from the ROSE Project: Attitudinal aspects of young people and science in a comparative perspective. In *Science Education Research and Practice in Europe* (pp. 203-236): Brill Sense. [13] OECD. (2016). *PISA 2015 Results (Volume I): Excellence and Equity in Education*. Paris: PISA, OECD Publishing.

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