Adaptive Learning Environments Based on IRT: Possibilities and Challenges

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Outline

- Adaptive e-learning environments
- IRT in learning environments
  - Motive
  - Item difficulty
  - Learner’s ability
  - Item selection algorithm
- Conclusion
Adaptive e-learning environments
Adaptive e-learning environments

- **Form of adaptivity:**

- **Source of adaptivity:**

- **Medium of adaptivity:**
Adaptive e-learning environments

Form of adaptivity:

- Adaptive form representation (pictures, videos, hyperlinks,...)
- Adaptive content representation (intelligent help, discover misconceptions,...)
- Adaptive curriculum sequencing (dynamic selection of optimal item for each learner)

Source of adaptivity:

Medium of adaptivity:
Adaptive e-learning environments

- **Form of adaptivity:**
  - Adaptive form representation
  - Adaptive content representation
  - Adaptive curriculum sequencing

- **Source of adaptivity:**
  - Course/item features *(difficulty level, topic, ...)*
  - Person features *(ability level, cognitive load, interests,...)*
  - Context features *(device, time, location,...)*

- **Medium of adaptivity:**
Adaptive e-learning environments

- **Form of adaptivity:**
  - Adaptive form representation
  - Adaptive content representation
  - Adaptive curriculum sequencing

- **Source of adaptivity:**
  - Course/item features
  - Person features
  - Context features

- **Medium of adaptivity:**
  - Task-based (e.g. ASSISTment [1])
  - Item-based (e.g. Franel [2])
Cochez la bonne réponse.

Voici le logo de 'Gîtes de France'. Cette organisation:

- regroupe tous les hébergements de vacances à la campagne en France.
- accueille des jeunes en difficulté.
- construit des maisons modestes pour des familles nombreuses françaises.
- regroupe toutes sortes de logements qui accueillent des touristes en France.
- regroupe toutes les agences immobilières en France.
Adaptive learning environments

• Form of adaptivity:
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  - Adaptive curriculum sequencing

• Source of adaptivity:
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  - Person features
  - Context features

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  - Task-based
  - Item-based

Adaptive curriculum sequencing in item-based learning environments by matching the item difficulty level to the learner’s ability level
Adaptive learning environments

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Adaptive curriculum sequencing in item-based learning environments by matching the item difficulty level to the learner’s ability level.

- IRT in testing environments
- Efficient testing
- IRT in e-learning environments
- Efficient learning
IRT in learning environments

Extrapolation of the ideas of IRT and CAT to learning environments

- Learning gain per time unit
- Motivation

IRT in learning environments
IRT in learning environments

Extrapolation of the ideas of IRT and CAT to learning environments

Learner’s ability level  
Item difficulty level

Learner 1’  
Learner 2  
Learner 1

Learning gain per time unit

Motivation

IRT in learning environments

Motive
Item difficulty
Learner’s ability
Item selection algorithm

Conclusion

Learner 1’
Learner 2
Learner 1
Item 1
IRT in learning environments

Extrapolation of the ideas of IRT and CAT to learning environments

- Motive
  - Item difficulty
  - Learner’s ability
  - Item selection algorithm

IRT in learning environments

- Extrapolation of the ideas of IRT and CAT to learning environments

- Motivation

- Assessment within assistance

- Learning gain per time unit

- Learner’s ability level

- Item difficulty level

- Learner 1

- Learner 2

- Learner 1'

- Item 1
IRT in learning environments

Feasible?
Item difficulty estimation

- Existing learning environments:
  - Proportion correct
  - Learner’s feedback (“How difficult did you find this item?”)
  - Expert rating (“What is the percentage of learners who will answer this item correct?”)
  - Paired comparison
Item difficulty estimation

- Why not based on IRT calibration?

  Item-based learning environments: Franel/BLCC/De post
Item difficulty estimation

- Why not based on IRT calibration?

Item-based learning environments: Franel/BLCC/De post

Missing values
Item difficulty estimation

Why not based on IRT calibration?

Item-based learning environments: Franel/BLCC/De post
Item difficulty estimation

- Why not based on IRT calibration?

Item-based learning environments: Franel/BLCC/De post
Item difficulty estimation

- Why not based on IRT calibration?

Item-based learning environments: Franel/BLCC/De post

- Missing values

- Amount of data
  - Item exposure control

- Structure of data
  - MNAR

- Motive
  - Item difficulty
  - Learner's ability
  - Item selection algorithm

Conclusion
Learner’s ability estimation

- Cold start problem
  Group adaptation

- Change in ability level
  Knowledge gain/loss
Item selection algorithm

- **Objective**
  
  Optimize learning efficiency

- **Means**
  
  Item difficulty level *(difficult, moderate, easy)*

  Learner’s control *(shared control)*
Conclusion

IRT in learning environments?

Yes, but...
- adaptation of the existing algorithms
- combination of existing methods

Further research in progress
Thank you!
Questions and suggestions

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References
