Wisdom is not the product of schooling but the lifelong attempt to acquire it.
- Albert Einstein

Enhancing Self-Directed Learning with Contextualized Tutoring

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Passion for Learning — Beyond Tests
Lifelong Learning

- **phases:**
  - intuitive learner (home)
  - scholastic learner (school)
  - skilled domain worker (workplace)

- **lifelong learning is more than “adult education”:** applicable to the educational experience of both children and adults
  - bring the child's experience closer to meaningful and personalized work
  - bring the adult's experience closer to one of continued growth and exploration

- **possible hypothesis:**
  - tutoring most important for scholastic learner (school)
  - self-directed learning most important for skilled domain worker (workplace)
    including learning on demand, integration of working and learning, collaboration

- **problem:** a “big switch” must be changed at some point of time
# New Forms of Learning Contributing to Lifelong Learning

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<td>authentic problems</td>
<td>problem framing</td>
<td>understanding evolving tasks</td>
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<td>learning on demand</td>
<td>learning in advance</td>
<td>coverage is impossible; obsolescence is guaranteed</td>
<td>identifying breakdowns; integration of working and learning</td>
<td>critics; supporting reflection-in-action</td>
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<td>informal learning</td>
<td>formal learning</td>
<td>learning by being in the world</td>
<td>larger, purposive activities provide learning opportunities</td>
<td>end-user modifiability</td>
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<td>collaborative and organizational learning</td>
<td>individual learning</td>
<td>the individual human mind is limited</td>
<td>shared understanding; exploiting the &quot;symmetry of ignorance&quot; as a source of power</td>
<td>externalizations understandable by all stakeholders</td>
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New Forms of Learning Contributing to Lifelong Learning

- Learning when the **answer is known**
  - model on which schools are based

- Learning when the **answer is not known**
  - many real life situations
  - exploiting the symmetry of ignorance as a source of creativity
Trade-Offs

- trade-offs are the most basic characteristics in education / design: they are universal

- there are no best solutions ("sweet-spots") independent of goals and objectives

- trade-offs are often characterized and conceptualized as binary choices representing the endpoints of a spectrum

example:

tutoring ↓--X-----------------------X---------------------------- self-directed learning
Sweet Spots

HEAD: You can virtually draw a line from the center of Federer's head to a spot right in the middle of his feet. This produces an incredible center of gravity that allows him to move like a ballet dancer on the court.

CHIN: Federer's chin is practically touching his right shoulder as he watches the ball into the sweet spot. Many players prematurely pull their heads away to watch the volley and end up shanking the shot.

WRIST: By keeping his racquet head above his wrist, Federer can volley with power and control. This kind of technique promotes a stable racquet face.

LEFT FOOT: Notice that Federer's left foot is off the court at impact. This means he's transferring his weight forward through the shot by pushing off his back leg.
Example: Novice Skiers ☀️ Tutoring

☀️ basic scenario:
- a person has never skied before
- goes for a 5 day ski vacation
- takes a class with a ski instructor

☀️ a standard, curriculum-driven set of lessons
- gliding
- stopping
- making turns
- exploiting the terrain

☀️ tutor/coach exploits:
- power of a good learning environment
- takes into account personal strength (e.g.: physical fitness, experience with water skiing, ...)
- takes into account personal objectives (recreational skier, staying on blue slopes)
Example: Intermediate Skier ♣ Self-Directed Learning

♣ an intermediate tennis skier
- has skied for 10 years
- feels that she got stuck on a suboptimal plateau
- a standard curriculum is of little value

♣ objectives:
- uncomfortable to ski on non-groomed slopes (including powder)
- ski with less effort in moguls
- control speed in very steep terrain
- what to do when one ends up in unexpected difficult situations?

♣ question: is the skier able to articulate these objectives or does the coach need to infer the underlying weakness from her/his performance?
Skiing — A Technology Enhanced Learning and Performance Environment

得意な特性:
- 低い基準 + 高い天井：ますます複雑なマイクロワールド
- 提供時間（スキー・リフトで上り坂）
- 簡略化：スライディングとストッピングの脱域
- 錯誤は決して惨事を引き起こさない：安全性のビンディング

ソース:
High-Functionality Applications (HFA)
(e.g.: MS-Office, Photoshop, Software Reuse Libraries)

♣ why are HFA an interesting application domain?
  - people use them but only partially know them
  - people get stuck at suboptimal plateaus
  - new functionality is learned in self-directed learning processes and supported by learning on demand

♣ the major challenges:
  - developing systems which are learner centered and supportive
  - contextualized tutoring is only possible within a context and this context is provided by the (self-directed) activities of active learners
  - capturing context and intent not at design time but at use time
  - plan recognition: actions by the learner inferred task suggested actions or information
Effective Support for Self-Directed Learning Activities with Contextualized Tutoring

- inferring and understanding what task the learner is pursuing (by relying on: domain-orientation, task modeling, user modeling, context awareness, analysis of partial products created by learners, and specification components)

- supporting learning opportunities at different levels (simple fixes, localized explanations, and contextualized tutoring) from which the learner can choose

- identifying the most task-relevant existing tutoring episode

- presenting a tutorial contextualized to the specific task and individual learner

- seeding and evolving an information repository of tutoring episodes
## Three Levels of Self-Directed Learning

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<tr>
<th>Level</th>
<th>Description</th>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
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<tr>
<td>Fix-It</td>
<td>fix the problem by giving a solution without understanding</td>
<td>keep focus on task; learning does not delay</td>
<td>created no or little understanding</td>
</tr>
<tr>
<td>Reflect</td>
<td>explore argumentative context for reflection</td>
<td>understanding of specific issues</td>
<td>piecemeal learning of (disconnected) issues</td>
</tr>
<tr>
<td>Context-Tut</td>
<td>provide contextualized tutoring (not lecturing on unrelated issues)</td>
<td>systematic presentation of a coherent body of knowledge</td>
<td>substantial time requirements</td>
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Conclusions

Learning, teaching, educational theories, and instructional models are multi-faceted, complex phenomena.

The different dimension can be characterized as trade-offs and the endpoints represent binary choices.

Socio-technical environments enhancing these activities must support
- not only one end of the spectrum of the binary choices
- but the “sweet-spots” for a particular situation depending on the domain, tasks, and objectives of the involved stakeholders.
Examples for Self-Directed Learning

A Real Story about Learning

- course for gifted high-school students
- student\(_x\): no interest in math
- project: computer-generated poetry
- sentence structure: \(<\text{article}> <\text{adj}> <\text{noun}> <\text{verb}> <\text{art}> <\text{noun}>\)
- noun: = "house mouse spouse .......
- use of a random number generator which returns values between 0 and 9
- noun list contains 18 objects -----> student\(_x\) uses: SUM RANDOM RANDOM
Das dumme Stubenmaedchen verflucht die Schlampe
das lustige Kindermaedchen verbrennt keine Pampe
jedes kluge Maedchen ionisiert den Tresen
ein verschrumpeltes Maedchen verbrennt das Wesen
kein ausgereifter Professor kocht den Wurm
kein aufgespiesster Student besteigt den Turm.

Der kleine Hausmeister elektrisiert einen Ball
jedes schweinslederne Maedchen seziert einen Knall
der gefriergetrocknete Bergsteiger erfreut das Bier
jede erdrosselte Jungfrau untersucht einen Stier
ein kleiner Computer massakriert jede Flasche
jeder erdrosselte Mann bearbeitet die Asche.
Random 0 to 9

![Bar chart](image)
Sum of Random and Random

![Bar chart showing the sum of random values.](chart.png)
Word of Random and Random

!f r e q u e n c y

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Lessons to Be Learned from the Story

- student_\textsubscript{x} learned some aspects of probability theory grounded in a self-directed learning activity.

- provide opportunities which change people's lives
  - intrinsic motivation is crucial
  - “falling in love” with something \( \therefore \) student_\textsubscript{x} ended up studying computer science.

- “normal” learning experience: learners work hard because they have to (extrinsic motivation).

- our goal: learners work hard because they want to (intrinsic motivation).
User Modeling and Identification of the Task at Hand in HFAs

L4: Unanticipated information

L3: Belief

L2: Vaguely Known

L1: Well Known

Task-relevant information

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Space of Concepts

- low threshold / high ceiling (increasingly complex micro-worlds)

- active help systems / knowledge delivery / information volunteering

- critiquing
  - differences in performance, quality, and creativeness as a function of critics
  - trade-offs between critiquing (breakdowns occur) versus constraint (breakdowns are prevented)
  - trade-offs between different intervention strategies (active versus passive)

- extracting context and intent
  - does “making information relevant to the task at hand” prevent serendipity?

process model: seeding, evolutionary growth, reseeding