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Game of Lazybones
Computer-Assisted Exercises with Automatised Feedback and Evaluation

The teaching- and feedback-system

tguishiny

Popularity of blended learing

- Increasing importance of "Statistics in education and training"
- Increasing interest in blended and digital learning

Sub-Classification	Year Range	Number of articles
First attempts	1999-2002	125
Definition period	2003-2006	1200
Popularity period	2007-2009	1460
Recently	2010-2012	1660

from Güzera and Caner (2014)

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Introduction

We extend existing concepts.

- **New possibilities** and **new ideas** make it possible to improve these systems in order to maximize the effectivness of teaching.
- The aims is both,
  - a systematic **implementation** of teaching concepts in software using **modern interactive tools** and
  - to invent **new ways** to teach

Content: the **tguishiny**, a digital learning tool developed by us for feedback-based interactive teaching

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Elements of computer-assisted feedback learning

Zürcher Hochschule für Angewandte Wissenschaften
School of Engineering

Exercises: Allows to repeat and present topics and to execute exercises

Visualisation: Interactive graphics and animations to understand complex topics and relationships

Integration of student surveys: Questionaires integrated - resulting data can be integrated into exercises

Interactive feedback: Client to server - everything done by the students, saved in a data base and summaries are presented to the teacher

Gaming: Interactive features supports a gaming character and rewards are also possible

Monitoring: Which student has finished which exercise? Forces lazybones to be active during the class.

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Technical implementation - History

Teaching with TGUI (Trainings GUI) and developments

- from **2005 to 2009** first `tcl/tk` version used at all courses in Statistics Austria
  - Info: `http://www.stat.tugraz.at/AJS/ausg091/091DingesTempl.pdf` (Dinges and Templ 2009)
- from **2009 to 2011** the system is provided via R packages (GUI in `Gtk2`)
  - Info: `http://www.jstatsoft.org/v39/i07` (Dinges, Kowarik, Meindl, and Templ 2011b)
- from **2011 to 2017** online version via `RApache`, demo version **TGUI**$_{\text{online}}$ as *showcase* online
  - Info: `http://www.statistik.at/TguiOnline` (Dinges, Kowarik, Meindl, and Templ 2011a)
- from **2017 to 2018** a new project from ZHAW/SoE helps to modernize the teaching environment and to implement new ideas.

The new implementation: tguishiny

Technical issues

- R package **tguishiny**.
- strickly objekt-orientierted programming of exercise types (using R6 reference classes and R modules)
- Web-application with R package `shiny`.
  Advantages: easy to write web-applications, LaTeX (over MathJax), JavaScript, HTML, d3, R, markdown, ... can be used.
- Installations on a server or locally on the PC

Basic features of the system

- **Surveys:** possible to collect information about the course participants through questionaires and integration of the results into exercises
- **(interactive) Exercises:** different kind of excercise classes (next slide)
- **Feedback-tool:** tracks and stores all activities from the students (mouse clicks, answers, R code, ...) to predefined tasks
- **Evaluation:** e.g. visualization of the distribution of answers for exercises
- **Dynamic counter:** for each unlocked exercise it counts, how many students have solved which exercises
- **R:** integration of R for exercises with R

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Important question classes for exercises

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question class	details	user task	evaluation
`(ShinyQuestion)`	(parent class)		
`McQuestion`	multiple choice	choice of answer(s)	distribution of given answers
`RQuestion`	R exercises	R code	evaluation of resulting R object
`DfQuestion`	data manipulation tasks	R code	evaluation of resulting object or code lines
`PlotQuestion`	plotting task	produce a plot	evaluation of plot
`LmQuestion`	exercises for linear models	estimating a linear model	evaluation of the resulting object
`MarkdownQuestion`	combines previous question classes	depends on class	depends on question class

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A brief demonstration of **tguishiny**

Some notes:

- **tguishiny** also runs on ZHAW and Statistics Austria servers, whereby teachers and students have access and everybody make the exercises on the given server.
- here we show the local version.
- the server version has serveral benefits, e.g. full control of the R installation.
- to run smoothly on a server, RStudio's shiny server must be installed.
- for using it in the class, always the server version is used.

Key features of **tguishiny**

- **Students view**:
  - view on exercises unlocked by the teacher
  - summary statistics: *my* performance in comparison to other students (work-in-progress)
- **Teachers view**:
  - Lock/unlock of exercises or questionaires
  - Link to evaluations for each exercise
  - Counter that shows the progress of the group (how many students have completed which exercise)
- **Under the hood**:
  - collection of all actions from students in a data base
  - any evaluation is thus supported, even gamification and any statistics presented to studends and teachers possible
  - user management and access rights
  - could be in priciple be used also for automated exams (and correction)

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Writing your own exercises

Core system: approx. 8000 lines of efficient R code in order

- to easily create new exercises
- to automatically bind them to the web-interface
- to provide questionaires and feedback
- to deal with multi-user issues
- to integrate  for  related questions

Writing your own exercises

- With the current version, one needs to have minimal R knowledge.
- In future versions this should be possible online by point-and-click and simple text input without any R knowledge

First we want to start R and the **tguishiny** package. Each question type is documented.

```
library("tguishiny")
?ShinyQuestion
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...
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Hint: Use `show_interactive()` to test new questions

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After writing questions

```
tguiApp(questions = 'path/to/questions',
        db_path = 'path/to/database.db')
```

By default the working path is used. You can place questions and databases separated from **tguishiny**.

```
# questions, exercises and data base within tguishiny:
tguiApp()

# ZHAW course:
tguiApp(questions = "../tguicoursesrepo/ZHAW/")

# Statistics Austria course ST03:
tguiApp(questions = "../tguicoursesrepo/ST03/")
...
```

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Experience with TGUI$_{\text{online}}$ and tguishiny

- forced automatised feedback (from everybody) essential for classes $>$ 8-10 students
- linking individual data from students with exercises makes students more interested
- dynamic counter essential
- through on-the-fly evaluations, the teacher has full control if students have understood the topics
- students have been very positive about the tool

Summary & outlook

Actual situation

- basic **programming** of **tguishiny** is more or less done
- system is running on server and local

Things to be done with additional funds

- **tguishiny** can be in principle used for automated exams, but some security issues must be solved
- any kind of gamification can be implemented, because all necessary data are stored. If so, **tguishiny** can be relatively straightforward re-written using dashboards to present figures, smileys, statistics to students permanently.
- more complex evaluations, comparison of students, Rasch models to evaluate the difficulty of questions, etc.

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thats all . . .

Teaching interactively

with the teaching and feedback system

tguishiny

- Many thanks to **SoE Lehre** (ZHAW) for the grant "*Digitale Lehrformen*"
- Many thanks to my students Gregor De Cillia (TU Wien) for his excellent contribution to the R code, Tamara Ganz and Stevan Ljubomirovic (ZHAW) for tranfering many examples to **tguishiny**. Thanks to Bernhard Meindl (Statistics Austria) for helpful discussions and contributions.

your FEEDBACK is not forced but welcome

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