BI Serious Game based on Microsoft BI: Fast Track and Demo

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The Challenges in Teaching and Learning BI/A

What are the greatest challenges you face in delivering BI/BA within your curriculum?

- Other BI/BA education challenges: 5%
- Separating, overlap from other classes in curriculum: 9%
- Finding speakers who can talk about BI/BA in the real world: 10%
- Faculty acceptance of BI/BA as a curriculum topic: 13%
- Finding suitable content in general: 16%
- Marketing the topics to students: 18%
- Students do not have the interest: 21%
- No room in the curriculum: 23%
- Access to contemporary, enterprise software: 26%
- Providing realistic, meaningful experiences: 26%
- Technical Support and Training: 29%
- Staying current with practice: 29%
- Finding suitable cases: 31%
- Finding a suitable textbook: 33%
- Students’ aversion to statistics: 33%
- Finding faculty who can teach the content: 35%
- Students do not have the skills: 39%
- Access to data sets: 45%

Wixom et al., 2013. The State of Business Intelligence and Business Analytics in Academia 2012.
Some findings from Wixom et al. 2013

- The demand for BI students has surpassed the supply
- The foundational skills are still the most critical for new BI technology
- Employers were not satisfied with the graduates’ practical skills
- Students should have experiences with real data, real tools, reporting, and dashboard
Skills Gap in BI/A

~60% based on the responses from 2,053 CIOs of 36 industries across 41 countries

(Gartner, 2013)
The Shortage of Professionals with BI/A Skill

• McKinsey's report: the shortage of ~200,000 professionals with BI/A skill by 2018 (Andoh-Baidooh et al., 2014)
BI/A Skills needed for Graduated Students

• **Analytical skills** – e.g., data mining, statistical analysis

• **IT skills** – e.g., data mart modelling, ETL process

• **Business knowledge & Communication skills** – e.g., business functions, ability to explain what is being analysed

(Chiang et al., 2012)
Literature Search

(“teaching” AND “simulation games” AND “business intelligence”)

▪ **Labonte-LeMoyne et al. (2017)** developed a serious game named “ERPsim for big data” for teaching BI concepts and providing hands-on experience to students.

▪ **Dunaway (2015)** used a simulated ERP environment named “ERPsim game” to teach students about ERP, business process, BI and decision making using situational learning theory.

▪ **Pittarese (2015)** employed a semester-long BI-focused lab sequence alongside an ERP-based simulation game to develop student skills in real-time BI.

▪ **Babin et al. (2011)** developed a simulation game named “ERPsim” to teach BI using a problem-based learning (PBL) approach.
Literature Search

(“teaching” AND "business intelligence")

- **Podeschi (2015)** offered a BI course to an undergraduate information systems program, introducing the concept of data warehousing, data mining, visualisation and how to use BI tools for decision-making.


- **Yang and Liu (2013)** developed hands-on labs (data integration, data warehouse and business analytics) to teach Business Analytics (BA) for students in Computer Science, Information Technology and Software Engineering.

- **Presthus and Bygstad (2012)** implemented a BI course using problem-based learning and puzzle-based learning principles for the third-year students of an e-business programme.
Literature Search

- **Rob and Ellis (2007)** developed a graduate level course on data warehousing and data mining to provide theoretical knowledge and hands-on practice with a case project from a real business.

- **Mrdalj (2007, 2011)** developed an applied BI course for a graduate programme to teach students about concepts, techniques and tools.
Literature Search
Literature Search

- Using ERPsim – an ERP-based simulation game – for teaching ERP system, ERP software (SAP) and BI/A tasks using SAP HANA
- Do not focus only BI concepts but also on ERP concept, manufacturing or production processes and business processes
- No (generalise) frameworks for teaching BI ("teaching framework" AND "business intelligence")
Conceptual & Technical Framework of Blsim
Architecture of Blsim (based on MSFT BI)
## Components of BIsim Architecture and Framework

<table>
<thead>
<tr>
<th>Component</th>
<th>The Corresponding Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management process &amp; Decision Making</td>
<td>Phase diagram for managerial decision-making process (Gluchowski, Gabriel and Dittmar, 2008)</td>
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<tr>
<td>Business Activities and its cycle</td>
<td>BI Academy</td>
</tr>
<tr>
<td>Assignments</td>
<td>Data Mart Modelling concept (Jensen, Pedersen and Thomsen, 2010)</td>
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<td></td>
<td>DFM concept (Golfarelli, Maio and Rizzi, 1998)</td>
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<td></td>
<td>Data Cube Modelling (Jensen, Pedersen and Thomsen, 2010; Rizzi, 2007)</td>
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<td></td>
<td>OLAP (Albelló and Romero, 2009; Moody and Kartink, 2000)</td>
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<td></td>
<td>CRISP-DM for Data Mining Process (Wirth and Hipp, 2000)</td>
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<tr>
<td></td>
<td>BI Creation and BI Consumption concept (Olszak and Ziemba, 2007)</td>
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<td></td>
<td>Hands-on Lab from BI Academy</td>
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Components of BIsim Architecture and Framework

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<th>Components</th>
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<tr>
<td>Tools for BIsim</td>
<td>BIsim (Adventure Bikes Web Application (BI Academy))</td>
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<td></td>
<td>BI Modeler or DFM tool (Cazzella, 2016)</td>
</tr>
<tr>
<td></td>
<td>Other tools (Microsoft SQL Server, Excel and Power BI)</td>
</tr>
<tr>
<td>Data Warehouse Architecture for BIsim</td>
<td>Data generator, ERP, CRM, EDW, OLAP database (BI Academy)</td>
</tr>
<tr>
<td></td>
<td>Data Warehouse Architecture (Kimball et al., 2008; Inmon, 2005)</td>
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</tbody>
</table>
# Traditional Approach VS BIsim Approach

<table>
<thead>
<tr>
<th>Learning Aspects</th>
<th>Traditional Approach</th>
<th>BIsim Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Realistic and Actual Data</strong></td>
<td>Students use synthetic and simulated data from a system.</td>
<td>Students use their own original data from their business plan and initial parameters.</td>
</tr>
<tr>
<td><strong>Decision-making</strong></td>
<td>Students work through hands-on lab without the involvement in decision making for the business.</td>
<td>Students are involved in the decision-making process based on their own data and have opportunities to improve their decision-making for the business.</td>
</tr>
<tr>
<td><strong>End-to-end scenarios and simulation</strong></td>
<td>Students learn from each assignment separately without the end-to-end scenario and simulation integrated into the assignments.</td>
<td>Students practice in the labs with the end-to-end scenarios and simulation designed and integrated into the assignments.</td>
</tr>
<tr>
<td><strong>BI Tools</strong></td>
<td>Real BI tools for all assignments.</td>
<td>Real BI tools and more features within the simulation.</td>
</tr>
</tbody>
</table>
Learning Outcomes

- For **business knowledge and communication skills**, students will be able to:
  - use search engine and presentation tools to develop and present a business plan (relevant information: cities, shop location, competitors, target groups, employees, product mix, marketing mix, cost plan)
  - enter business parameters based on the business plan via BIsim web application
  - present the business results and explain the business situation, how to adjust the business parameters to increase the business profit or decrease the business cost
Learning Outcomes

▪ For **Information Technology (IT) knowledge and skills**, students will be able to:
  ▪ use DFM tool to develop a multi-dimensional/data mart model, convert to a logical model and generate a DDL script for the physical model
  ▪ use DBMS software to develop and modify the data mart database
  ▪ use DBMS and ETL tool to develop ETL package and populate data into the data mart database
Learning Outcomes

- For **analytical skills**, students will be able to:
  - use analytics tools to develop data cube
  - use OLAP and dashboard tools to develop OLAP reports and dashboards
  - use ETL and analytics tool to develop a data mining application based on CRISP-DM concept
Learning Outcomes Assessments

- assignment completeness
- results from the Bisim
- student’s self-evaluation
- final exam
The International Week 2017, Stuttgart Media University, Germany, 27.11.-01.12.17

Sukhothai Thammathirat Open University (STOU)
Requirement 1: Sales Subject

“I need to analyse Monthly Sales.”

Sample report 1:

“I want to see Sales Amount, Revenue, Gross Profit, and Gross Profit per Bike by Price Segment and Product Category. I want to filter by Price Segment. Gross Profit can be calculated by Revenue – Discount – Transfer Price. Gross Profit per Bike can be calculated by Gross Profit / Sales Amount.”
Mailing Campaign

- 5,000 contacts * 2€ = 10,000 €
- 5,000 flyers * 5€ = 25,000€

35,000 € per month

Blsim

Decision Tree
Clustering
Naïve Bayes

Profile/Segmentation

Actual Customer

Cl

DT

NB

Predict

write back

>= 70% Probability

Marketing Data
PLZ

CRM

XLS

Web

Prospective Customer

Sukhothai Thammathirat Open University (STOU)

The International Week 2017, Stuttgart Media University, Germany, 27.11.-01.12.17
Research Methodology

- **Experiment**
  - Two groups: control group (traditional approach) and experimental group (Bsim approach)
  - 30 students for each group
  - Pretest and posttest questionnaires for students’ self-evaluation

- **Interview**
  - Five students from experimental group
Research Methodology

- **Experiment**
  - Two groups: control group (traditional approach) and experimental group (Blsim approach)
  - 30 students for each group *(57 students for control group, 49 students for experimental group)*
  - Pretest and posttest questionnaires for students’ self-evaluation *(next slide)*

- **Interview**
  - Five students from experimental group *(three students)*
## Results

<table>
<thead>
<tr>
<th>Groups</th>
<th>Questionnaires</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-test</td>
</tr>
<tr>
<td>Control Group 57 (53.77%)</td>
<td>49 (46.23%)</td>
</tr>
<tr>
<td>Experimental Group 49 (46.23%)</td>
<td>46 (43.40%)</td>
</tr>
<tr>
<td>Total 106 (100%)</td>
<td>95 (89.63%)</td>
</tr>
</tbody>
</table>
Results: pre-test vs post-test scores (experimental group)

<table>
<thead>
<tr>
<th>Skills</th>
<th>Higher</th>
<th>Lower</th>
<th>No Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>OLAP</td>
<td>24</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Multi-Dimensional Modelling</td>
<td>21</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>ETL</td>
<td>19</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Data Mining</td>
<td>22</td>
<td>4</td>
<td>6</td>
</tr>
</tbody>
</table>

This might happen because students thought that they have high knowledge or understanding, but they found out after learning with BIsim assignments that they have lower knowledge and skills in BI than they have thought. Moreover, the results from interviews were support that students felt better to learn with BIsim approach.
Results: pre-test vs post-test scores (experimental group)

- The teaching methods with Blsim produced a statistically significant change in OLAP skills, Multi-Dimensional Modelling skills, ETL skills and Data Mining skills.

- Students evaluated themselves as having more skills in OLAP, multi-dimensional modelling, ETL process and data mining after learning with the Blsim approach.
Results: Control Group VS Experimental Group

- **Pre-test:** the experimental group had a higher mean rank than the control group for all BI skills – OLAP skills, Multi-Dimensional Modelling skills, ETL skills and Data Mining skills.

- **Post-test:** the control group had a higher mean rank than the experimental group on OLAP skills, multi-dimensional modelling skills and ETL skills, except Data Mining skills the experimental group had a higher mean rank than the control group.

This might happen because the hands-on labs and the lectures for control group were more details, while the guidelines and the lectures for experimental group were brief.
Results: Learning Effectiveness, Learning Content, BI Maturity Model

- After getting the treatment with BIsim, the students evaluated themselves that
  - for learning effectiveness, they had more **understanding in BI projects** than the students in the control group
  - for learning content, they had **engaged with their own data** better than the control group
  - and they had better BI Maturity Model level
Results: Qualitative Data (Like)

Students liked the BIsim approach for several reasons

- using real BI tools
- combining theoretical part and practical part
- using realistic and understandable business scenario
- learning by doing
- more interesting than traditional approach that they have learned before
- seeing the results and impacts from their decision-making
- knowing several tools and it was not easy to forget learning with this approach
- appreciating that BIsim was very good, interesting, and important for learning how BI tools can and should be used
Results: Qualitative Data (Comments)

- getting teaching materials to prepare for the examination
- listening more lectures before working on BIsim
- Wanting more time to make decisions during the game

However, the BIsim approach offered only the guidelines and let students spend more time to learn by doing or playing game.
Results: Interview

Students agreed that

▪ BI skills had improved - technological skills and analytical skills (using and understanding how real BI tools are used in a BI project and how to analyse and make decisions based on their own data)

▪ They had more confidence to apply the experiences in a real BI project, but they had less confidence for data mining applications.

▪ The lessons learned:
  ▪ the importance of BI for business
  ▪ the experience of applying the concepts and theory to practice
  ▪ the usage of real BI tools, and the closed-loop concept for data mining applications
Results: Interview

- Students liked learning with BIsim approach even though their scores from the self-evaluation was not high and they felt that the BIsim approach could be offered to students in subsequent semesters.

- Students were not satisfied with the inadequate PC pool and would like to have a more realistic or wider scope of BI projects.
Results: Learning Outcomes Assessments

- assignment completeness *(all students could complete)*
- results from the BIsim *(each groups/cities had different profit/cost results)*
- student’s self-evaluation *(some students did not do questionnaires)*
- final exam *(evaluated together with other topics)*
Conclusions

▪ **BIsim** approach offers the first in-depth business simulation game which is developed for BI teaching framework and architecture and generalisable for BI learning modules (e.g., ETL process, data mart modelling, data mining solution, etc.) and similar business types (e.g., seasonal products, low diversity, etc.)

▪ **BIsim** approach can be used as an initiative for future empirical studies concerning improvement of student BI knowledge and skills.
Limitations

▪ A quasi-experimental study was chosen as randomisation could not be used because several reasons
  ▪ there were only one or two BI-related courses in each semester, about 15-25 students for each class, students from each class had a set curriculum and could not be transferred to a different class
  ▪ The findings are based on the students who did not major in BI, but they were selected from BI-related courses.
  ▪ Each experiment period was in one semester, therefore, some students were distracted by other subjects alongside this experiment and may not have been able to connect the concepts and the assignments from each session continuously.
Limitations

▪ Most students were not available to participate in the interview because they did not meet the conditions and they were busy preparing for their final exams and internships at the end of semester.

▪ The results from final examination were ignored to use for learning assessment because the university decreased the number of final examinations so that BI applications course were combined with another courses and final marks were mixed.
Future Research Directions

May look at the grounded components of the BI simulator approach to be refined empirically for other students, other instructors or other institutions:

- tracking students’ performance in decision making
- creating other business data
- using other business scenarios
- using different infrastructures or platforms
- using different BI tools
- preparing a pre-configured sample for demonstration
Future Research Directions

- running several games parallelly across institutes
- developing an instruction for naïve instructors
- adding more advanced assignments
- applying other learning assessment methods, for instance, using BI concepts itself to monitor and measure students behaviour and learning performance or apply data mining for learning analytics
Next: BI Game Fast Track and Demo