An Empirical Investigation of the Effectiveness of eLearning Strategies in Higher Education: A Rasch-Model for Saudi Arabia

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High-impact effective eLearning applications in higher education are rarely reported (Allen, 2016).
Main Research Question

What are the interactive effects of instructional delivery modes and individual’s cognitive preferences on learners’ performance?

Research Aim

Improving the instructional design (ID) of the pedagogical environment for eLearning the in higher education (HE) institutions.

• Provide a set of IS-design specifications and guidelines to the effective application of eLearning technologies within the HE sector.
• Develop a framework, which defines and guides the best ePedagogical practices.
Research Design

- A series of quasi-experiments (pre-test-post-test comparison group).
- 2x3 factorial design.

<table>
<thead>
<tr>
<th>Cognitive style measure</th>
<th>Instructional delivery mode</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Conventional F-to-F</td>
<td>Computerised</td>
<td>Blended (F-to-F and Computerised)</td>
<td></td>
</tr>
<tr>
<td>Verbal</td>
<td>Group 1</td>
<td>Group 2</td>
<td>Group 3</td>
<td></td>
</tr>
<tr>
<td>Imagery</td>
<td>Group 4</td>
<td>Group 5</td>
<td>Group 6</td>
<td></td>
</tr>
</tbody>
</table>
Research Methodology

Pre-validation study: 11 participants

Participants and context: 167 undergraduates volunteered
Experimental Procedure

**Step-1**
- A. Registration
- 35 min

**Step-2**
- B. Briefing
- Participants’ allocation of instructional intervention
  - Conventional Instructor-led (T1)
  - Computerised (T2)
  - Blended (T3)
- 5 min

**Step-3**
- Instructional intervention Session independent variable 2
  - Conventional instructor-led (T1) Lecture Theatre
  - Computerised (T2) Computer Laboratory
  - Blended (T3) Normal Classroom
- 40 min

**Step-4**
- Post-test Dependent variable
- 40 min
Study Instruments—prior to experiments

The cognitive style analysis test (CSA)

Cognitive style (Riding & Cheema, 1991)

Allocation of instructional treatment
Study Instruments - during the design and development phase

Instructional materials

- The design of the Information Systems Analysis and Design (ISAD) course
- Task analysis
- Lesson plan

Application of Reigeluth’s (1983) elaboration structure

The lesson’s hierarchal task analysis

Nine events of instruction Gagné (1985)

1. Gain attention of the learner
2. Inform students of the objectives
3. Stimulate recall of prior learning
4. Present the content
5. Provide learning guidance
6. Elicit performance (practice)
7. Provide feedback
8. Assess performance
9. Enhance retention and transfer to the job
Study Instruments—during the design and development phase

Learning Measures and Cognitive Performance Assessment Instrumentation

- A skill development matrix
- The pre-and-post-tests

Table 2: Specification skill development matrix (McKay, 2000)

<table>
<thead>
<tr>
<th>Task No</th>
<th>Learning Domain</th>
<th>Task difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>DFD set development</td>
<td>Difficult</td>
</tr>
<tr>
<td>4</td>
<td>DFD validation check</td>
<td>Medium-to-difficult</td>
</tr>
<tr>
<td>3</td>
<td>DFD set classification</td>
<td>Medium</td>
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<tr>
<td>2</td>
<td>Understanding of different levels of DFD’s set</td>
<td>Easy-to-medium</td>
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<tr>
<td>1</td>
<td>DFD Symbols/notations understanding</td>
<td>Easy</td>
</tr>
</tbody>
</table>

Instructional Objectives: DFD set development

Table: Specification skill development matrix (McKay, 2000)
Study Instruments during the design and development phase

- Common items-linking
- Scoring techniques

```
1141100100001100000001101000100111011010002
11511010011101100011010011000122111021001
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Study Instruments - during the development phase

- The Design of the eTutorial Module

Instructions for e-Tutorial on levels of DFDs

The following instructions will provide you with an understanding of how to undertake the levels of a data flow module.

- **Table of contents** - opens the table of contents.
- **Level Indicator** - The blue level indicates the level of data flow that relates to the content.
- **Interaction** - This symbol next to a button indicates a button can be clicked.
- **Content Box** - Click the blue box to view content or information
  - **Balancing**
  - **Objective Buttons** - Click the 'target' buttons to view the objectives
  - **Home button** - Returns to the home page.
  - **Next and Previous Screen**
  - **Playbar** - You can navigate between slides using the arrows, view progress and close the module
Study Instruments during the development phase

- Verbalisers
- Imagers
Preliminarily Data Analysis

Establishing the validity of test-items (fit maps)

Validation study I (Pilot-1)

Validation study II (Pilot-2)

Validation study III (Pilot-3)

Main study
Item analysis table

<table>
<thead>
<tr>
<th>Item 1</th>
<th>Item 2</th>
<th>Item 3</th>
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<tbody>
<tr>
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<td><strong>1</strong></td>
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<tr>
<td><strong>Count</strong></td>
<td>31</td>
<td>39</td>
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<tr>
<td><strong>Percent (%)</strong></td>
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<td>72.3</td>
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<tr>
<td><strong>Pt-Biserial</strong></td>
<td>1.53</td>
<td>2.62</td>
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<td><strong>p-value</strong></td>
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<tr>
<td><strong>Mean Ability</strong></td>
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<td>-0.68</td>
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</tbody>
</table>

**Infit Mean Square (MNSQ)**: 0.85, 0.79, 1.03
**Discrimination (Disc)**: 0.54, 0.62, 0.28

**Key Finding**

All test-items are **valid and reliable** for further analysis.

**Mean test score**: 33.34

**Standard deviation**: 8.73

**Internal Consistency**: 0.88

The individual item statistics are calculated using all available data.

The overall mean, standard deviation, and internal consistency indices assume that missing responses are incorrect. They should only be considered useful when there is a limited amount of missing data.
Initial performance analysis (variable maps (post-tests))

(Pilot-1)

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(Pilot-2)

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(Pilot-3)

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(Main)

<table>
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<tbody>
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</table>
Tasks Difficulty and performance (kid-maps)

Key Findings

- All three instructional course delivery modes facilitate the acquisition of **Declarative knowledge**

- **Computerised** environment facilitates the knowledge required to answer tasks with medium-difficulty level

- The **blended** environment is the most effective delivery modes that enables the acquisition of **procedural** knowledge
Research Contribution

Theoretical

Resolve some of the inconsistencies regarding the evaluation of the effectiveness of ICT-based instruction in HE environments

Practical

Provide the instructional design community with a validated IS-design model and instruments for designing with ICT tools.

Institutional

Inform HE policy makers/ service providers with insights regarding the effective ePedagogical practices to customise the learning experience and reach a wider learner-base
Thank you

Reference List


