Cognitive Load & Goal Based Scenario Centered
3D Multimedia Learning Environment: Learners’
Satisfaction, Motivation and Mental Effort

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1. PURPOSE OF THIS STUDY

2. REVIEW OF LITERATURE

3. METHOD

4. RESULT

5. DISCUSSION
This study attempts to reveal how learners’ motivation, satisfaction and mental efforts are affected by goal based scenario centered two different multimedia learning environments which were designed with CLT principle and without CLT principles.
 Goal Based Scenario
Motivation in GBS and CLT
GBS emphasizes developing a model in which “learning goals aim for learner to learn how to rather than know that” (Schank, Berman & Macpherson, 1999, p.165).

They know not only why they need to know something but also how to use the knowledge (Schank, Fano, Bell & Jona, 1994).
GBS is an effective way of teaching by providing opportunities for learners to know why and how they use the knowledge they learn (Schoenfeld, Persichitte & Jones, 2001; Zumbach & Reimann 2002; Bell, Bareiss & Beckwith 1993).
Motivation is defined as a construct “which is primarily concerned with activation and persistence of behavior, is also partly rooted in cognitive activities” (Bandura, 1977 p193).

Motivation can influence how, when and what we learn (Schunk, 1991).

It is agreed upon that behavioral indexes which are indicate the presence of the motivation (Wang et al., 2008)
Motivation in GBS

Goal based scenario has been developed based on a goal which assumes to increase intrinsic motivation.

Effective leaning environment which students have a goal creates conditions that produce strong intrinsic motivation to learn (Schank, Fano, Bell & Jona, 1994).
The research studies generally show that GBS has positive effect not only on teaching and learning process but also on students’ motivation.

Motivation in CLT

From the point of view of cognitive load theory, it is assumed that mental effort, performance and the motivation are positively related (Paas, Tuovinen, Van Merriënboer & Darabi, 2005)
The severe risk of this goal based scenario is the high task complexity. If the learners cannot handle with the task complexity, because of the overload on their working memory capacity, it may hinder learning (Van Merriënboer, Kirschner & Kester, 2003).
To eliminate the overload results from the task complexity, the limitation of learners’ working memory should be taken into account. Cognitive load theory provides valuable guidelines on how to deal with the overload (Van Merriënboer et al., 2003).
Although Van Merriënboer et al (2003) pointed out that this overload might hamper learning, it could be expected that this overload might affect students’ motivation and satisfaction in learning from goal based scenario in a negative way.
Many studies are conducted to find out ways to reduce extraneous cognitive load for meaningful learning in multimedia environment. (Clark & Mayer, 2002; Kalyuga, Chandler, Sweller, 2004; Mayer & Moreno, 2003; Seufert & Brünken, 2006; Tabbers, Martens & Van Merriënboer, 2004; Van Gerven, Paas, Van Merriënboer & Schmidt, 2002; Van Bruggen, Kirschner & Jochems, 2002).
Although there are many research studies conducted to find out the effects of instructional format that reduce extraneous cognitive load, there are very few studies that combine this instructional format with different instructional methods and investigate its impact in relation with students’ motivation, satisfaction and invested mental effort in teaching and learning processes.
Method

Research Ques & Design

Participants

Instruments

Analysis
METHOD

Research Questions

What are the students’ perceptions of goal based scenario designed multimedia?

What are the students’ opinions about their motivation and satisfaction of goal based scenario designed multimedia?

How does the cognitive load, in goal based scenario designed multimedia affect students’ motivation?

How does the cognitive load, in goal based scenario designed multimedia, affect students’ satisfaction?
Is there a significant difference between students’ mental effort invested in the first and second versions of GBSc3DM?
Qualitative and quantitative

To investigate how students’ motivation and satisfaction were affected by the extraneous cognitive load, reflective journals were gathered and semi-structured interviews were conducted as a qualitative method.

A subjective rating scale was used to investigate the difference between learners’ mental effort invested in the first and the second version of GBSc3DM as the quantitative method.
82 9th grade students (52 females and 30 males) from one of the Anatolian high schools in Ankara, Turkey,

Biology teacher had experience in using constructivist approach in teaching, and participated in constructivist curriculum

Additionally, the school’s computer laboratory infrastructure was appropriate to conduct this study
Subjective Rating Scale

mental effort with 9-point mental effort rating scale ranging from 1 (very, very low mental effort) to 9 (very, very high mental effort).

Reflective Journals

write reflective journals about their experiences on using the multimedia. There were 5 questions in reflective journals

Interviews

a semi-structured interview which consisted of 10 questions was conducted with 27 students in three groups, and each group included 9 students.
The reasons for preferring group interviews were that they allow the interviewees to reflect on what the others in the group articulate, and then may build upon those mutual opinions. This method provides a base for validation by quality control in data collection through multiple perspectives on the same issue. Lastly, group interviews can be used to identify strengths and weaknesses of a program (Patton, 1987).
Mitosis and Meiosis as a content

The study lasted two weeks.

Two groups were assigned to the first version (+CLT) and two groups were assigned to the second version (-CLT) of the material randomly.

To arouse students’ interests toward the topic, biology teacher made a brief introduction of the topic through a PowerPoint presentation for all groups.
## Developing Software

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<th>Principles</th>
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Selecting Characters
Each Phases

GBSdM+CLT
(Version I)

GBSdM-CLT
(Version II)
<table>
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<th>Week</th>
<th>Version I</th>
<th>Version II</th>
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<tr>
<td>Week 1 (mitosis)</td>
<td>Two groups</td>
<td>Two groups</td>
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<tr>
<td>Week 2 (meiosis)</td>
<td>Two groups</td>
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An independent sample t-test
- to find out difference in cognitive load between first (+CLT) and second version (-CLT) of the multimedia.

Content analysis
- research questions were focused and deductive coding
- main themes were withdrawn and then the data were interpreted under these themes.
- The conclusions drawn from this process were verified by the two researchers of the study.
Students’ perception on roles, goals and missions

Students’ Satisfaction and Motivation on Cognitive Load in Learning from Goal Based Scenario
missions

- 79 students expressed their positive opinions about learning the content with a mission and goals in reflective journals.
- Learning the content with a mission and goal increased their interest toward content.
- More enjoyable and long lasting.
Students’ perception on roles, goals and missions

“While you have a mission, you feel that you have responsibility, and so you should learn better and do your best. In such a condition, you will learn better.”

“make a mistake it does not make me sad, because I am aware of the fact that I learn something.”
Students’ perception on roles, goals and mission

- most of the students have good impression with their roles, about half of them (40 students) expressed that the role was easy and it would be better to allow them to define the role’s characteristics before starting the program.
Students’ perception on roles, goals and mission

- “The roles give me a sense of responsibility and makes me ambitious to complete the given task.”

- “The role is fun and exciting. It helps me to understand the content easily. Being a scientist in the program increased my curiosity, and at the last, when I finished the task, I proud of myself and I believed in my intelligence. In sum, giving roles is more instructive.”
Students’ Satisfaction and Motivation on Cognitive Load in Learning from Goal Based Scenario

Modality and Coherence Principle (Based on the 47 students response in reflective journal,)

- The students expressed that violating modality and coherence principles made it difficult for them to learn from the multimedia and decreased their motivation.
Modality and Coherence Principle

- “Yes, I could not focus my attention because of the classic music in the background of the program.”

- “For example, my interest was decreased when I learn meiosis. When I tried to read subtitles I felt that I could not catch up with the content and this made it even more difficult for me to learn.”
Modality and Coherence Principle

- “I believe that meioses should be designed as mitosis. The animations should be narrated, because narration makes learning easier.”
Multimedia Principle

From interviews,

- 14 students ----------------- text only.
- 8 students------------------- pictures.
- 5 students------------------- both

“When I worked with pictures, I invest more effort to understand.”

“If I know the content, I do not need to look at pictures to sequence the phases in correct order”
Split Attention
9 students expressed that it hurts their motivation and attention.

- “When each time a new page opens on the screen, this makes it stressful for me and seeing the information on the same page would be more beneficial for me.”
Redundancy Principle

11 students-------------------narration
2 students---------------------narration not text
8 students---------------------narration and text

- “The audio narration is enough for me to understand the animation. The voice tone that is used is very good so I can easily focus on the content.”
- “using both subtitles and voice make the content long lasting and helps me to ignore classroom noise.”
Students’ mental efforts spent for different versions of GBS c3DM for mitosis

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Students’ mental efforts spent for different versions of GBS c3DM for meiosis

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Cohen d effect size
Goal based scenario was perceived as an effective approach in designing multimedia learning environment.

Goal based scenario increased both intrinsic and extrinsic motivation of students in learning.

Applying cognitive load theory principles in designing multimedia learning environment affected students’ motivation and satisfaction in positive way.
Although GBSc3DM is considered as an effective instructional approach for most of the students, students who used the second version (-CLT) expressed that violating modality, coherence and split attention principles affected their motivation and satisfaction negatively in using the second version of the program.
Despite of the task complexity, applying cognitive load principle increased students’ motivation and satisfaction, and alleviated the amount of mental load that imposed by the learning material.

On the other hand, students invested higher mental effort in the second version of the material, and the material affected their motivation and satisfaction in negative ways.
In task involvement equation proposed by Paas, Tuovinen, Van Merriënboer & Darabi (2005), they indicated that motivation, mental effort, and performance are positively related.

As pointed out by Corbalan (2008), the mental effort is used as a general concept in task involvement, and there is no distinction between the invested mental effort of extraneous, intrinsic and germane load.
Germane load was used as a mental effort in adaptive learning system and produce significant result in terms of task involvement. (Corbalan, Kester & Merriënboer, 2008).
Therefore more research should be conducted to find out more comprehensive findings on the relationships between motivation, task involvement, performance and mental efforts resulting from different cognitive load for different instructional conditions. It is also suggested that experimental findings should be supported by qualitative data to validate and optimize the findings in depth.