

Simulation On Education: Improving Education System By Using Simulation Based Applications

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

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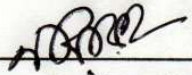
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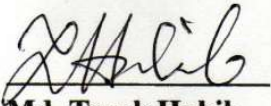
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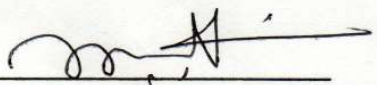
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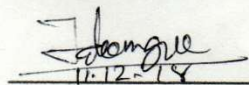
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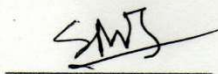

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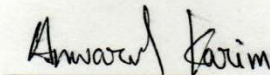
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ABSTRACT

The purpose of this study is to compare the effectiveness of traditional instruction based education towards understanding the concepts of science versus simulation based education using simulation based desktop and mobile applications. It also examines how to improve education system using more sophisticated way with simulation based classroom tools and personal handheld devices like smartphones [1]. Qualitative and quantitative methods of research is made in this study. The participants of this study are students from Ideal Institute of Science and Technology and anonymous peoples over the internet. A set of questions were provided to them which evaluates their understanding towards physics. The online participants were asked if simulation is necessary on education.

TABLE OF CONTENTS

CONTENTS	PAGE
Approval	i
Declaration	ii
Acknowledgements	iii
Abstract	iv
CHAPTER	
CHAPTER 1: INTRODUCTION	1
1.1 Introduction	1
1.2 Motivation	1
1.3 Expected Output	1
CHAPTER 2: BACKGROUND	2-3
2.1 Related Works	2-3
CHAPTER 3: RESEARCH METHODOLOGY	4-8
3.1 Introduction	4
3.2 Survey	4-6
3.2.1 Evaluation Questions	4-6
3.3 Statistical Analysis	6-8

CHAPTER 4: EXPERIMENTAL RESULTS AND DISCUSSION	9
4.1 Results	9
4.2 Discussion	9
CHAPTER 5: SUMMARY, CONCLUSION, RECOMMENDATION AND IMPLICATION FOR FUTURE RESEARCH	10-14
5.1 Summary	10
5.2 Conclusion	10
5.3 Recommendations	10-14
5.4 Implication for Further Study	14
REFERENCES	15

LIST OF FIGURES

FIGURES	PAGE NO
Figure 3.3.1: Effectiveness metrics	6
Figure 3.3.2: Student's preference towards simulation based education vs. traditional instruction based education	7
Figure 3.3.3: Student's thoughts about the necessity of simulation based education	7
Figure 3.3.4: Necessity ratings of simulation based education by the students	8
Figure 5.3.1: CISCO Packet Tracer	11
Figure 5.3.2: Stellarium	11
Figure 5.3.3: Calculating and simulating displacement of an object with simulation based smartphone app	12
Figure 5.3.4: Calculating and simulating fall duration of an object with simulation based smartphone app	13
Figure 5.3.4: Calculating and simulating gravitational force between two objects with simulation based smartphone app	14

CHAPTER 1

INTRODUCTION

1.1 Introduction

Simulation and motion graphics are useful tools to present a model of a system without physically involving the system. Such features allow us to better understand the system and analyze it without actually interacting to it. Some real world process may take long period of time to happen by comparison of the average human life, thus make them hard to observe and thus hard to understand. For example, the Halley's Comet shows up in a time period of 76 years thus make it near impossible to observe in real life. Another example would be the collision of the Milky Way and Andromeda galaxy which will happen around 2.5 million years from now. It's impossible to know what will happen in that time and in aftermath as it will happen long time in future. Simulation gives us the ability to fast forward and rewind backward in time and analyze the real world process which happened earlier or will happen far future. But the most important thing is, it enables us to change the parameters of the process and observe it with the changed parameters.

1.2 Motivation

We believe the effects of change of parameters of the process makes us able to better understand the process or system as they show us the role of the different parameters of the process. Whereas motion graphics enables us to visually observe the simulated system or process. We believe simulation and motion graphics can be a great tool to improve our education system.

1.3 Expected Output

We expect that simulation based education will be more effective than traditional instruction based education.

Simulation and motion graphics can be useful to understand concepts of science. Our education system will be benefitted largely. Students will be more focused and able to understand the concepts clearly than just memorizing.

CHAPTER 2

BACKGROUND

2.1 Related Works

One study suggests that computer simulation can help students to better understand the basics of probability [2].

Simulation based education is being used on some sector like Medical and Aviation technology.

The project called PhET from the University of Colorado which is an advanced simulation based learning system. This project focuses on to provide simulations for various scientific and engineering department like physics, chemistry, computer science, electrical and electronics.

Another study examines the effect of computer simulation on the fields of anatomy and morphology [3].

This study reviewed empirical and theoretical/speculative papers on simulations in science education.

The finding of this study was that the effectiveness of simulations is dependent upon the sequence of presentation of learning activities to students.

A study was made to examine if simulation-based medical learning with deliberate practice yields better results than traditional clinical education or not [4].

The results show that simulation based medical education with deliberate practice is better than the traditional medical education.

Another medical study examines the effects of simulation technology for skills training and competency assessment [5].

They concluded that medical simulation is becoming increasingly popular among the tools for teaching and assessment. Also simulation can improve training without impacting patient safety.

A study was made to examine the effects of a computer simulation to students' learning physics concepts [6].

The study was conducted by using the software Modellus. By which the researchers created simulations used to teach 7th grade students the concepts of weight and mass.

The study concluded that findings favored simulation based teaching as the result showed computer simulation helps the students to learn physics concepts regardless of hands on activities.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This is an analysis which is done by teaching approach using both sample simulation based application and traditional instruction based teaching. Main outcome measures were the effectiveness of both strategies by evaluating the understanding of the basics of physics of the participants.

Also the quantitative analysis is done with the online participants.

3.2 Survey

We have conducted a survey involving 144 students from different skill levels from Ideal Institute of Science and Technology, Mirpur, Dhaka, Bangladesh. First we taught them three elementary physics topics: the Newton's Law of motion, Newton's Law of Gravity and The Laws of Falling bodies with one group consisting randomly selected 72 students by the traditional instruction based system and another group consisting other 72 students by the simulation based system. We then evaluated them by asking a set of 9 questions (3 questions on each topic). The result showed the effectiveness metrics. Then we asked them if they think whether or not simulation based education is necessary. Then asked them to provide a rating of necessity.

We also asked the online participants whether simulation based applications is useful on education and if they think simulation is necessary. This is done by using Google Forms. A total 648 person participated on the online survey.

3.2.1 Evaluation Questions

The following multiple choice questions are asked to the participants of the survey.

Questions	Answers			
	Option A	Option B	Option C	Option D
What is the displacement of any object when $t = 0$?	10m	3m	0m	100m

When acceleration of an object is not equal to 0 (zero)	Will continue to move	Will stop moving	Velocity will increase	Velocity will decrease
If $u = 0$ then displacement is dependent on	u & a	t & u	a & t	None
If two objects having mass of 1kg, are in a distance of 1m then gravitational force (F) between them is	1 N	Infinite	9.8 N	G
If two objects having infinite mass, are in a distance of 1m then gravitational force between them is	0	g	G	Infinite
If two objects having infinite mass, are in an infinite distance then gravitational force between them is	0	G	Undetermined	G
Which has no impact in falling bodies	Gravitational acceleration	Height	Mass	None
In how much time an object with infinite distance from the earth will fall	0s	100s	Infinite	10^{27}
If u is not equal to 0 (zero)	The object is not still	The object is still	Both	None

3.3 Statistical Analysis

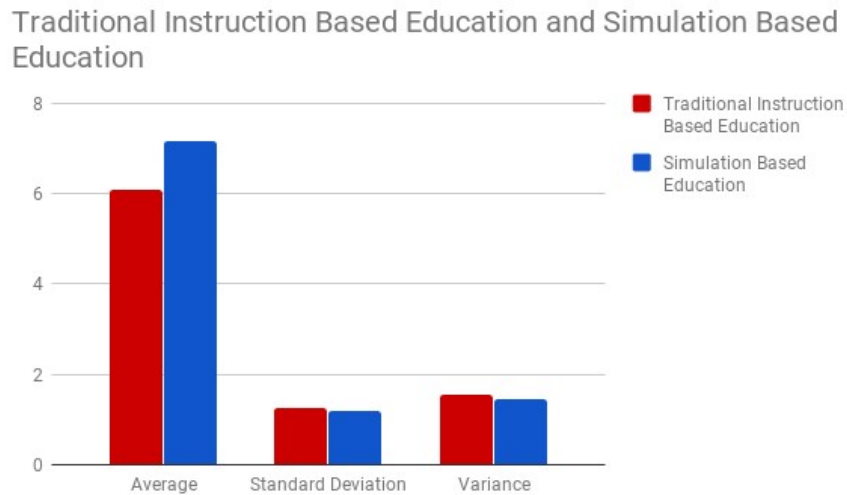


Figure 3.3.1: Effectiveness metrics

Students involving simulation based education with our sample simulation application scored in average 7.17 as opposed to 6.08 of students involving in traditional instruction based education out of 9. The higher is better. Also the standard deviation and variance was slightly better for simulation based education as opposed to traditional instruction based education having standard deviation 1.20 and 1.25, variance 1.45 and 1.56 respectively. Lower is better.

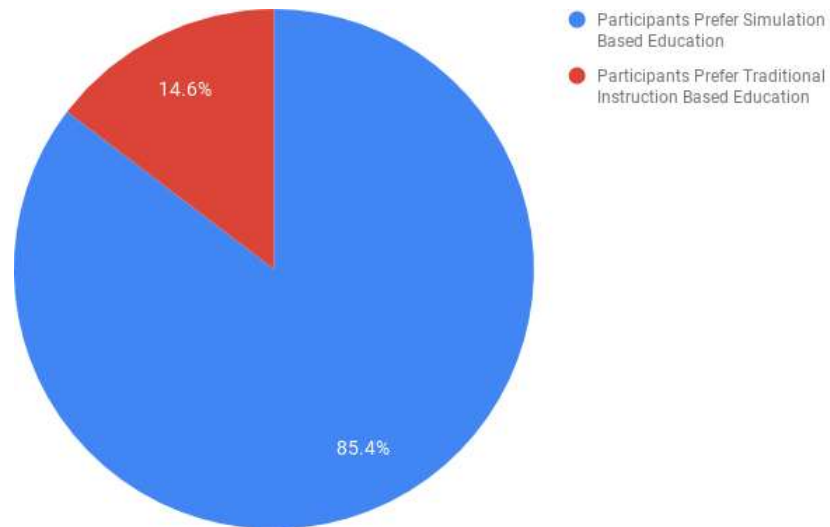


Figure 3.3.2: Participant's preference towards simulation based education vs. traditional instruction based education.

Approximately 85.4 percent (123 students and 553 online participants) prefers simulation based education as opposed to 14.6 percent (21 students and 95 online participants) for traditional instruction based education.

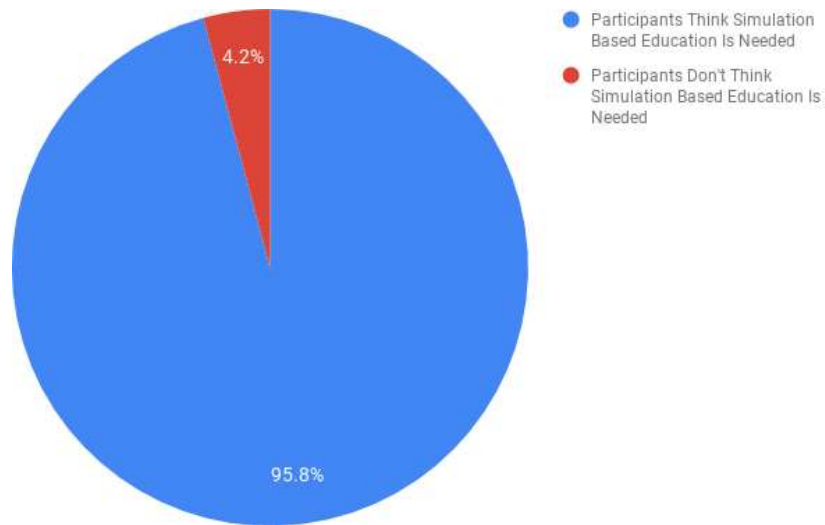


Figure 3.3.2: Participant's thought about the necessity of simulation based education

Also 95.8 percent (138 students and 621 online participants) think that indeed simulation based education is needed as opposed to 4.2 percent (6 students and 27 online participants) who don't.

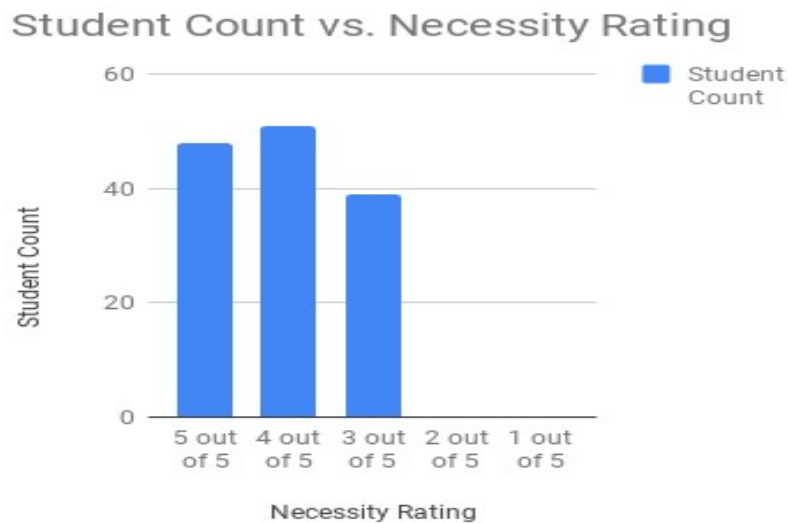


Figure 3.3.4: Necessity ratings of simulation based education by the students

From 138 students who think simulation based education is necessary, 48 rated 5 out of 5, 51 rated 4 out of 5 and 39 rated 3 out of 5 in a scale of 5 in respect to urgency of necessity.

CHAPTER 4

EXPERIMENTAL RESULTS AND DISCUSSION

4.1 Results

The survey result shows us that overall simulation based education outlasts traditional instruction based education although effectiveness varies slightly.

4.2 Discussion

Simulation is being used as a great tool in the field of networking, aviation, cosmology etc. in some extent. We thought it can also be a good tool for elementary school and high school science education. This led us to this study to testify whether or not simulation is useful.

We found out that despite having some limitations, simulation is actually useful for our education and teaching. Some of the limitations we found are lack of technology, lack of proper deployment platform, lack of required infrastructure and last but certainly not least, lack of awareness. Most of the people, even most of the educator and experts in our education sector seems to don't know what simulation actually is.

CHAPTER 5

SUMMARY, CONCLUSION, RECOMMENDATION AND IMPLICATION FOR FUTURE RESEARCH

5.1 Summary

In this modern world everything is being digitalized. But most of the educational institutes are applying the traditional instruction based approach to teach the students. But if we can make some differences in education system, the students can be able to understand better. Computer simulation and motion graphics can be used in education system besides traditional instruction based approach to illustrate all the theoretical topics where possible. Visualization can make us better understand. Textbook topics can be simulated and visualized besides theoretical teaching. This research shows difference of effectiveness between traditional instruction based education and simulation based education. After the research it is proven that simulation based education is more effective than traditional instruction based education.

5.2 Conclusion

Although the sample simulation based application by which the survey is completed by far less sophisticated, we found that simulation can be a very good tool for education. In various department simulation is used to train the students for real life situation like for pilot training and also in health training. This is the most effective and efficient way to represent a problem to train the students for a better solution.

Our study concludes that simulation based education is more effective than traditional instruction based education.

5.3 Recommendations

As the survey results suggest, simulation based education is more effective than traditional instruction based education. We are proposing a model to implement simulation based tools besides traditional instruction based education both in classroom and in personal study.

Our model involves deploying simulation based desktop and handheld applications. Some of them exists in some extent in some fields of education like CISCO Packet Tracer in

Computer Networking. Stellarium is another simulation based astronomy application which simulates the sky in real time.

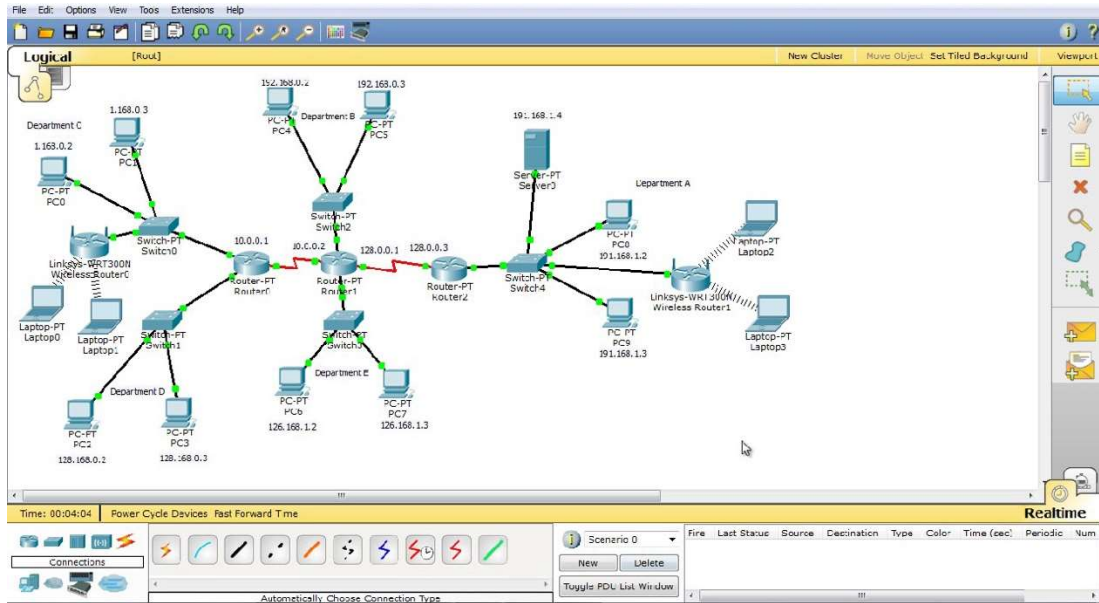


Figure 5.3.1: CISCO Packet Tracer



Figure 5.3.2: Stellarium

We can use similar applications in other fields of education, especially in scientific education. We can also provide simulation based learning smartphone applications to the students.

A smartphone application can be developed which can help students at their self-study. As use of smartphones is increasing day by day, it will be much easier and effective to access simulation based learning.

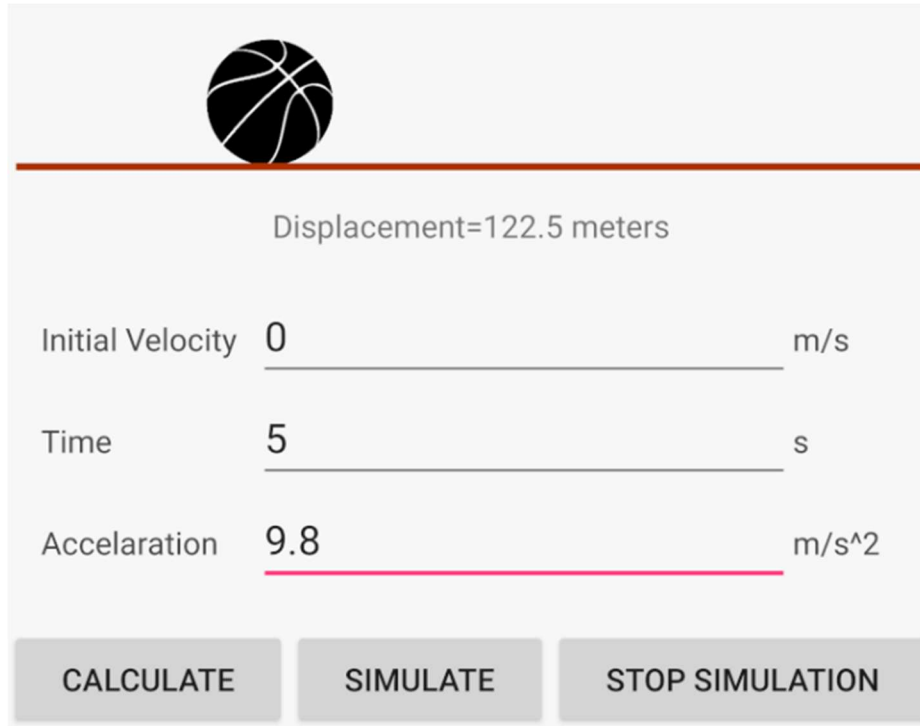


Figure 5.3.3: Calculating and simulating displacement of an object with simulation based smartphone app

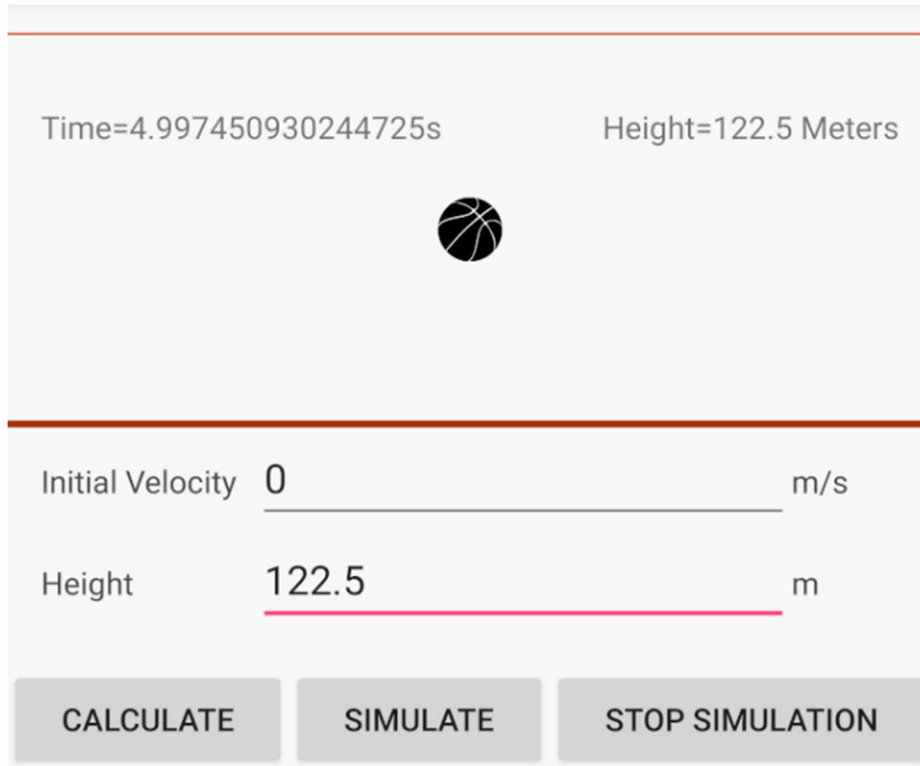


Figure 5.3.4: Calculating and simulating fall duration of an object with simulation based smartphone app

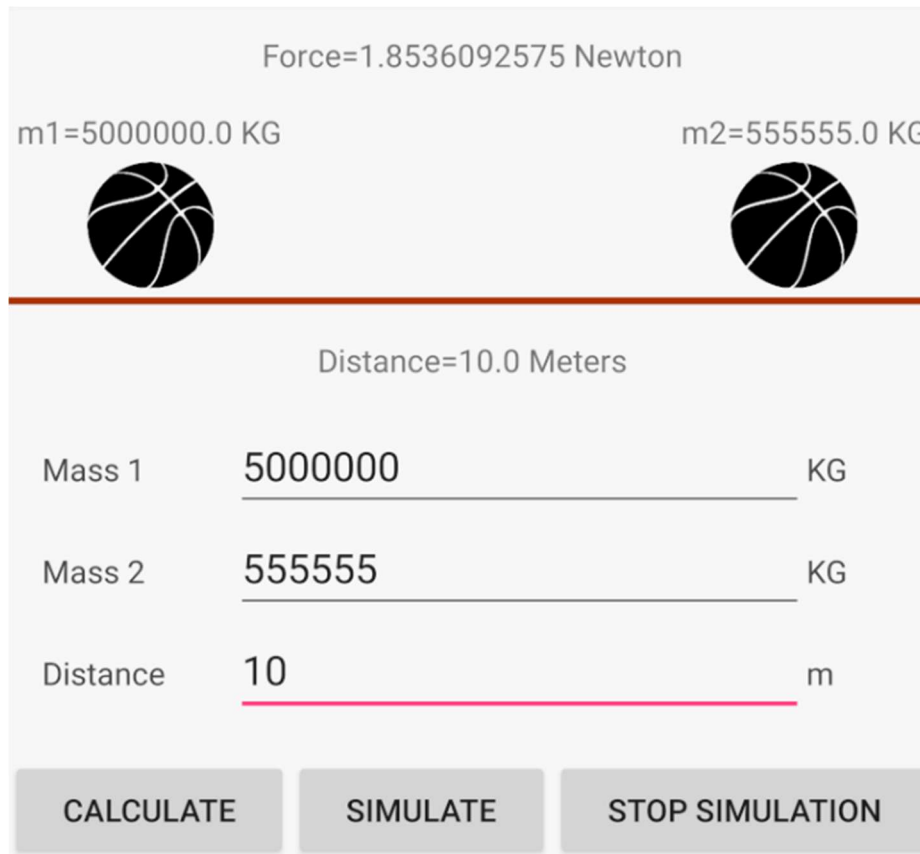


Figure 5.3.5: Calculating and simulating gravitational force between two objects with simulation based smartphone app

Figure 5.3.3, 5.3.4 and 5.3.5 illustrates the sample application “SIPLA – Simulated Interactive Physics Learning Assistant”, which was used in our survey.

5.4 Implication for Further Study

A standalone simulation based learning device for students can be developed. Which can make them able to better understand the lessons in an effective way. Also a more sophisticated and efficient way to implement simulation based tools in classroom can be developed.

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