

SSTRF 2020 PROJECT FINAL REPORT

Project Title	
Designing Interactive e-Assessment Test Items using Open Source Tools Is this project confidential or contains sensitive information/content? Yes ☐ No ☒	
Project Team	
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Abstract	
The purpose of this study is to examine the use Student Learning Space for piloting electronic school based assessment (e-SBA) for the theory paper 1 for O-Level Exercise and Sports Science (ESS) as ESS will be deploying Paper 1 in e-mode at the National e-Exam level. We hope to add ESS simulations, inside SLS that would promote critical thinking and support interactive assessment types designed using an open source tool called Easy JavaScript Simulation (EJSS¹) toolkit. Findings from the study will inform the design and development of the e-SBA platform. Specifically, it will provide insights on how to 1. Improve the teaching and learning experiences of teachers and students in using e-SBA platforms; 2. Design interactive assessment item types through the development of	This will be published in the T.H.I.N.K. portal for reference. The abstract should be no more than 300 words and include: (a) research

¹ <https://gitlab.com/ejsS/JavaScriptEditor/release>

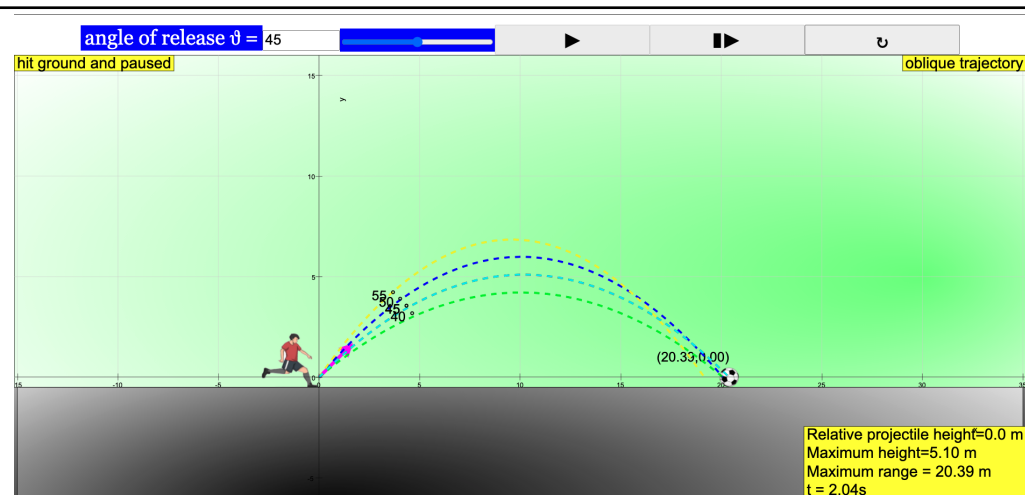
a new EJSS plugin for SLS that allows Exercise and Sports Science simulations to run inside SLS as a virtual laboratory The project conceptualized and developed 6² interactive based on ESS teaching notes, assessment officer and interactive designers in SEAB. The test is a tightly coupled 6 interactive and 22 questions ranging from basic to more advanced concepts in ESS using SLS³ as the platform for delivery e-SBA. Three schools, 3 teachers, and 51 out of 65 'invited' students attempted the e-SBA of which the assessment types are multiple choice questions (a,b,c,d one correct) and short structure questions(0 mark for incorrect, 0.5 partial correct and 1 mark for correct response)) and 38 students provided feedback on their experiences. Finding suggests these ESS students were not disadvantaged during eSBA with range of correct answers from 29% to 98% for the 6 simulations and 22 questions. Survey results suggest simulations been time dependent are more real life-like (Agree 55%, Disagree 13%), able to show visualization based on varying variables(Agree 68%, Disagree 3%), are suitable tools for depicting real life motion (Agree 55%, Disagree 5%), supports better sense and provide a more engaging experience (Agree 71%, Disagree 11%) and students do recommend more use of simulation is e-SBA (Agree 74%, Disagree 8%) and normal teaching practices. The test results and good percentages of agreement suggests that the project is successful in supporting interactive assessment types. However, some students also highlighted that video to be an appropriate tool when trying to show ESS phenomena when there is audio to explain, which the simulation didn't have. The future iterations could explore using videos to guide the students to do productive noticing under the SLS hints.	questions, (b) brief description of the research methodology, and (c) brief summary of the research findings and their impact.
Purpose and Objective(s) / Research Questions	
RO1: To create a new plugin for the insertion of existing Easy JavaScript Simulation (EJSS) into the SLS platform for better e-SBA and Teaching and Learning (T&L) RO2: To pilot/trial crafted 6 interactive with 22 questions in 3 schools to understand the 51 students' user experience for better T&L and the 38 students' user experience.	State the purpose and objectives/ research questions.
Research Design and Methods	
Research Goal This exploratory research aims to generate insights on the degree to which EJSS was able to perform the role of interactive question type when using SLS as the platform to deliver school-based assessments.	<u>Briefly</u> describe the research design and

² <https://iwant2study.org/ospsg/index.php/interactive-resources/physical-sports-education>

³ <https://vle.learning.moe.edu.sg/my-library/lesson/view/303c5407-17a8-4df3-9c3b-775c04c9c133>

Data collection We selected these 3 schools based on their students' spread of ability and express and normal academic streams to address the data collected to be free from bias and is fairly neutral.				methods of data collection and analysis.																				
<table><tr><th>School</th><th>Number of students</th><th>Normal Academic Steam</th><th>Express Stream</th></tr><tr><td>1. CHS</td><td>17</td><td>0</td><td>17</td></tr><tr><td>2. WWS</td><td>35</td><td>18</td><td>17</td></tr><tr><td>3. STC</td><td>10</td><td>0</td><td>0</td></tr><tr><td>Total</td><td>51</td><td>18</td><td>34</td></tr></table>					School	Number of students	Normal Academic Steam	Express Stream	1. CHS	17	0	17	2. WWS	35	18	17	3. STC	10	0	0	Total	51	18	34
School	Number of students	Normal Academic Steam	Express Stream																					
1. CHS	17	0	17																					
2. WWS	35	18	17																					
3. STC	10	0	0																					
Total	51	18	34																					
<u>Table RDM1: Breakdown of students in different schools (anonymous) and their streams</u>																								
The project team regularly conducted research and design of interactive, thus we crafted the research questions and interactive to ensure the reliable standard of student data and survey results. The team crafted the 22 questions in sync with the interactive design and tried 2 rounds of internal testing of the questions and interactive before fielding the e-SBA to the teacher and students to test on. The survey questions were internally vetted by members of the team as well as inputs from the mentor so that our survey results are more likely to be asking what the team intended for. We hope to be able to reach the expected results as we have several rounds of checks to ensure the research design is reliable.																								
Our survey questions⁴ were crafted with 5 points (1-Strongly Disagree, 2-Disagree, 3-Neutral 4-Agree and 5-Strongly Agree) to allow students to choose targeted responses as well as the ability to stay neutral if they have no opinion on any survey questions for higher validity. With every choice on the Linkert scale survey question, an optional free text response serves to allow the team to get more qualitative details on why the students selected so to support our reliability of survey data and generalization claims.																								
Findings																								
Learning data Simulation S1, requires students to use the interactive/simulation to estimate the angle of release of the football when the range is the greatest.				Describe the key research findings and the extent to which the objectives of the research have been achieved. Where appropriate, relate																				

⁴ https://docs.google.com/forms/d/1AFi2Avb55XQka7W2U_xYkN-aeVjedToL7WPDAaSGYyw/edit



the significance of the findings to other research work in the field.

Figure S1: Simulation showing angle of projectile at 40, 45, 50, 55 degree paths, where angle 45 degree has the greatest range.

Question 1 is in Figure below.

Q1. MCQ
Tries: 1 [1]

➤ Use the interactive/simulation above to estimate the angle of release of the football when the range is the greatest.

☐ 40 degrees

☒ 45 degrees

☐ 50 degrees

☐ 55 degrees

Figure Simulation 1:Question 1

Table 1.1 shows the school and multi-choice options, with the option in italics as correct. 41 (80%) out of 51 students were able to get the correct option b.

School /MCQ	a	<i>b (correct) 45 degrees</i>	c	d	Grand Total
1	1	13	2	1	17
2	2	18	3	1	24
3	0	10	0	0	10
Grand Total	3	41 (80%)	5	2	51

Table 1.1: Breakdown of students in different schools and the MCQ options that choose. note that b is the correct answer in italics

Question 2, requires students to agree or disagree(0.5 mark, correct) with the statement and explain (0.5 mark, correct) if the angle of release of the football does not affect the maximum time of flight of the football. Prepopulate student response is suggested to aid students in disagreeing and draw evidence from the simulation that the maximum time of flight increases with increasing angle of release of the projectile.

✓ **Sam claimed that the angle of release of the football does not affect the maximum time of flight of the football. Do you agree? Explain.**

PREPOPULATE STUDENT RESPONSE

You may choose to edit and prepopulated suggested answers and edit it to suit your purpose.
Agree/Disagree.
From the simulation, as the angle of release changes from ?? to ?? degrees, the maximum time of flight ????

SUGGESTED ANSWER

Disagree. From the simulation, as the angle of release changes from 0 to 90 degrees, the maximum time of flight also increases.

Explanation

Vertical component of the balls motion increases with the angle of release, thus increasing time of flight.

Figure Simulation 1:Question 2

Table below shows 31 (62%) out of 50 students who completed the question got the full marks for both disagree and explanation, 13 (26%) achieved partial correct either disagree was correct, or the explanation is correct, and 6 (12%) got both disagree and explanation wrong.

School / Free response	0 (wrong)	0.5 (partial)	1 (full mark)	Grand Total
1	1	6	10	17
2	5	5	13	23
3		2	8	10
Grand Total	6 (12%)	13 (26%)	31 (62%)	50 (100%)

Table 1.2: Breakdown of students in different schools and correctness in their free response question FRQ. 1 mark for full credit and 0.5 mark for partial credit.

To help the reader to make sense of the grand total being 50 instead of 51, one student didn't complete S1-Q2.

Question 3, requires students to use the simulation and select the correct multiple choice option (a) as the maximum height increases (a) as the angle of release increases from 0 to 90 degrees.

q3.MCQ

Tries: 1 [1]

> Using the interactive tool above, suggest whether the maximum height increases/decreases/remains constant, as the angle of release increases from 0 to 90 degrees.

- ☒ Increases
☐ Decreases
☐ Remains constant

Figure Simulation 1:Question 3

Table shows 41 out of 50 students choose MCQ option a as correct

School/ MCQ	a (correct) Increases	b	c	Grand Total
1	13	2	2	17

2	19	4		23
3	9	1		10
Grand Total	41 (82%)	7	2	50

Table 1.3: Breakdown of students in different schools and the MCQ options that choose, note that a is the correct answer in italics

Simulation S2, requires students to use the interactive/simulation with the default settings (angle of launch = 45 degrees and relative projection height =0) in the tool, to estimate the greatest possible range of the ball by varying the velocity of release from 0 to 20 m/s via the slider.

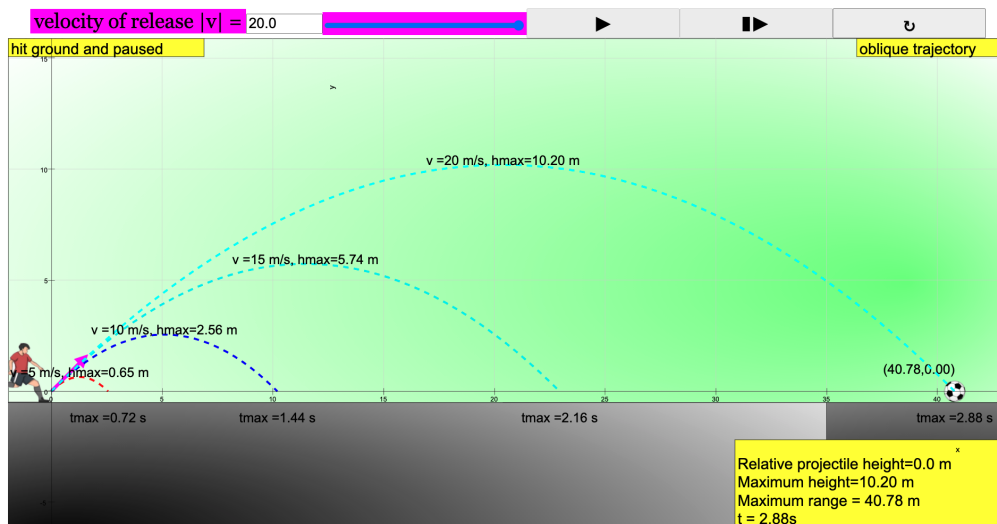


Figure S2: Simulation showing different initial velocity paths where velocity = 20 m/s result in the greatest range of 40.78 = 41 m.

Q1. MCQ

Tries: 1 [1]

> Using the default settings (angle of launch = 45 degrees and relative projection height =0) in the tool, estimate the greatest possible range of ball by varying the velocity of release from 0 to 20 m/s via the slider.
(You will need to drag on the interactive to change the view widow or read off the maximum range on the bottom right display message.)

☐ 35m

☐ 39m

☒ 41m

☐ 45m

Figure Simulation 2:Question 1

Table shows 21(43%) out of 49 students choose option c as the correct answer.

School /MCQ	a	b	c (correct) 41m	d	Grand Total
1	3	3	7	4	17
2	3	4	9	6	22
3	1	1	5	3	10

Grand Total	7	8	21 (43%)	13	49
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Table 2.1: Breakdown of students in different schools and the MCQ options that choose, note that c is the correct answer in italics

In Question 2 of Simulation 2, the question asked students the following.

Q2. FREE RESPONSE

Tries: 1 [1]

▼ **Sam claimed that the velocity of release of the football does not affect the maximum time of flight of the football. Do you agree? Explain.**

PREPOPULATE STUDENT RESPONSE

You may choose to edit from the prepopulated response
Agree/Disagree. From the simulation, as the velocity of release changes from ? to ?? m/s, the maximum time of flight ??.

SUGGESTED ANSWER

Disagree. From the simulation, as the velocity of release changes from 5 to 20 m/s, the maximum time of flight also increases.

Figure Simulation 2:Question 2

Table shows 35 (71%) out of 49 students got full 1 mark, 10 students partially correct 0.5 mark and 4 completely wrong, zero mark.

	Incorrect	partial correct	fully correct disagree and explanation	
<i>school / marks</i>	0	0.5	1	Grand Total
1	1	3	13	17
2	3	7	12	22
3			10	10
Grand Total	4 (8%)	10 (20%)	35 (71%)	49

Table 2.2: Breakdown of students in different schools and correctness in their free response question FRQ, 1 mark for full credit and 0.5 mark for partial credit.

In Question 3 of Simulation 2, the question asked students the following.

Q3. MCQ

Tries: 1 [1]

► **Using the interactive tool above, suggest whether the maximum height increases/deceases/remians constant, as the velocity of release increases.**

☒ Increases

☐ Decreases

☐ Remains constant

Figure Simulation 2:Question 3

Table shows 37 (76%) out of 49 students choose a as the correct answer.

<i>School/ MCQ</i>	<i>a (correct)</i>	b	c	Grand Total
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	<i>Increases</i>			
1	11	4	2	17
2	16	5	1	22
3	10			10
Grand Total	37 (76%)	9	3	49

Table 2.3: Breakdown of students in different schools and the MCQ options that choose. note that a is the correct answer in italics

Simulation S3, requires students to use the interactive/simulation to explore the concept of relative projection height via the combo box or varying the slider.

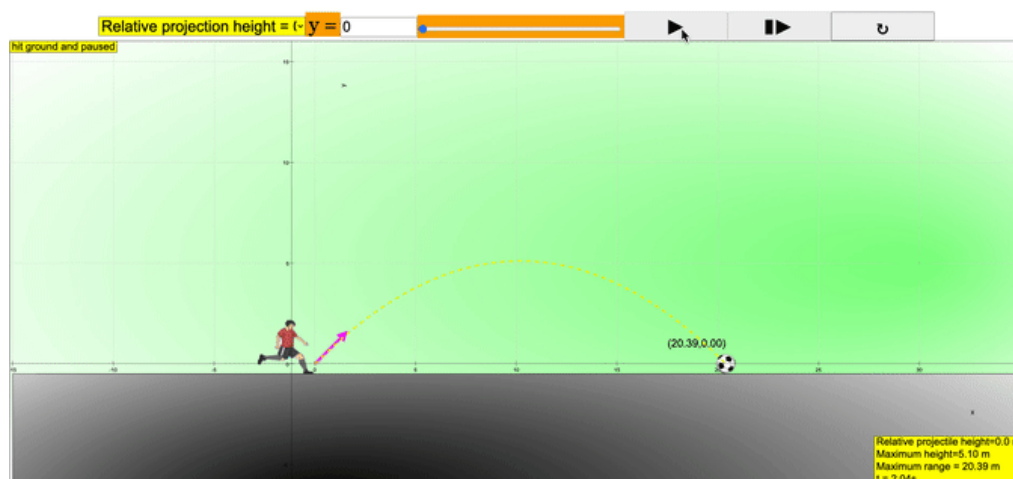


Figure S3: Simulation shows different relative projection height and the paths.

In Question 1 of Simulation 3, the question asked students the following.

Q1. MCQ

Tries: 1 [1]

› **Estimate the maximum range of the football when the relative projection height is 0 m.**

☐ 18m

☐ 15m

☒ 20m

☐ 25m

Figure Simulation 3:Question 1

Table shows 42 (86%) out of 49 students choose c as the correct answer.

School/MCQ	a	b	<i>c (correct)</i> 20m	d	Grand Total
1			15	2	17
2	1	1	18	2	22
3	1		9		10
Grand Total	2	1	42 (86%)	4	49

Table 3.1: Breakdown of students in different schools and the MCQ options that choose. note that c is the correct answer in italics

In Question 2 of Simulation 3, the question asked students the following.

Q2. FREE RESPONSE

Tries: 1 [1]

✓ **Sam claimed that the relative projection height does not affect the maximum range of the football. Do you agree? Explain.**

PREPOPULATE STUDENT RESPONSE

You may choose to use the prepopulated suggested response.
Agree/Disagree.
From the interactive simulation, as the relative projection height increases from ?? to ?? m, the maximum range also ?? from ?? to ?? m.

SUGGESTED ANSWER

Disagree. From the simulation, as the relative projection height increases from 1 to 5 m, the maximum range also increases from 20 to 24 m.

Explanation

A greater relative projection height will increase the maximum distance and flight time of the projectile.

Figure Simulation 3: Question 2

Table shows 39 (80%) out of 49 students got full marks, 7 got partial correct (0.5 mark) and 3 incorrect (zero mark).

School/marks	0	0.5 (partial mark)	1 (full mark) Disagree and correct explanation	Grand Total
1		3	14	17
2	3	4	15	22
3			10	10
Grand Total	3	7 (14%)	39 (80%)	49

Table 3.2: Breakdown of students in different schools and correctness in their free response question FRQ. 1 mark for full credit and 0.5 mark for partial credit.

In Question 3 of Simulation 3, the question asked students the following.

> Using the interactive tool above, suggest whether the time of flight increases/decreases/remains constant, as the relative projection height increases.

- ☒ Increases
- ☐ Decreases
- ☐ Remains constant

Figure Simulation 3: Question 3

Table shows 45 (92%) out of 49 students choose a as the correct answer.

School/MCQ	<i>a (correct) Increases</i>	b	c	Grand Total
1	17			17
2	19	3		22
3	9	1		10
Grand Total	45 (92%)	4	0	49

Table 3.3: Breakdown of students in different schools and the MCQ options that choose. note that a is the correct answer in italics

Simulation S4, requires students to use the interactive/simulation to explore the concept of Magnus's effect that explains commonly observed deviations from the typical trajectories or paths of spinning balls in sports.

Ball traveling to the right with Angular Velocity= 1   

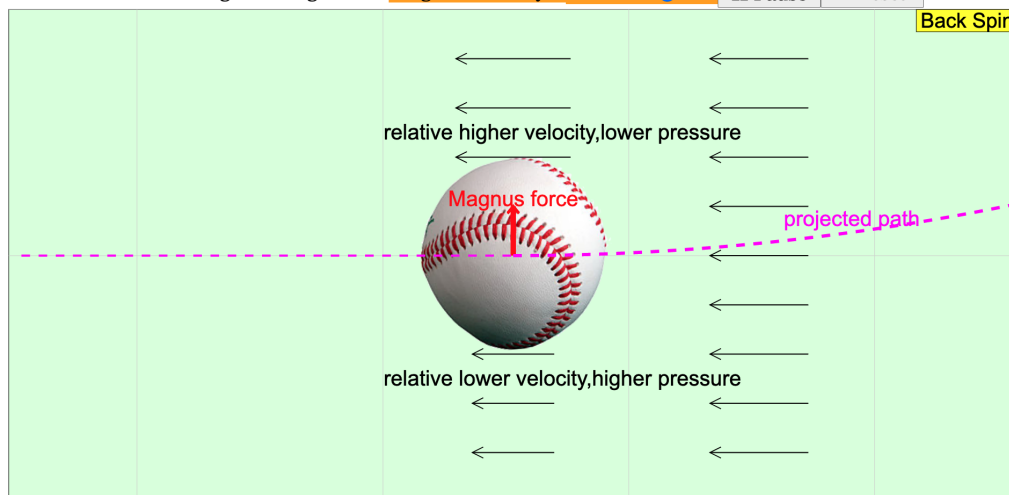


Figure S4: Simulation showing a baseball travelling to the right with an angular velocity (anti-clockwise) = 1 that results in a Magnus force upwards for a back-spin for an upwards projected path that likely will result in a further horizontal distance travelled.

In Question 1 of Simulation 4, the question asked students the following.

Q1. MCQ

Tries: 1 [1]

✓ A student claims that when there is higher velocity between the motion of the ball and wind, there is a higher pressure zone created. True or false?

☐ True

RESPONSE FEEDBACK

Observe the simulation again by clicking reset and click play

☒ False

RESPONSE FEEDBACK

Higher velocity leads to lower pressure zone created.

Hint

Change the variables in the interactive/simulation and observe the descriptions under and above the ball.

Figure Simulation 4:Question 1

Table shows 18 (37%) out of 49 students choose false as the correct answer.

School/Choice	True	False (correct)	Grand Total
1	11	6	17
2	17	5	22
3	3	7	10
Grand Total	31	18 (37%)	49

Table 4.1: Breakdown of students in different schools and the MCQ options that choose. note that c is the correct answer in italics

The number of correct is 37% probably because students didn't see the hint of the screen "higher velocity, lower pressure" above the baseball.

In Question 2 of Simulation 4, the question asked students the following.

Q2. MCQ

Tries: 1 [1]

▼ **A softball pitcher wishes to ground the ball as fast as possible. Should the pitcher throw the ball with no spin, top spin or backspin?**

☐ No spin

RESPONSE FEEDBACK

Observe projected motion again. Notice the ball is spinning clockwise/anti-clockwise as it moves to the right?

☒ Top spin

RESPONSE FEEDBACK

Correct! Top spin will more likely produce a projected path that curved downwards to the ground more quickly.

☐ Back spin

RESPONSE FEEDBACK

Observe projected motion again. Notice the ball is should be spinning clockwise as it moves to the right with a path that result in reaching the ground more quickly?

Hint

Change the variables and observe the projected path of ball.

Figure Simulation 4:Question 2

Table shows 31 (63%) out of 49 students choose b as the correct answer.

School/MCQ	a (No spin)	<i>b (Top spin)</i>	c (Back spin)	Grand Total
1	2	10	5	17
2	1	12	9	22
3	1	9		10
Grand Total	4	31 (63%)	14	49

Table 4.2: Breakdown of students in different schools and the MCQ options that choose, note that b is the correct answer in italics

In Question 3 of Simulation 4, the question asked students the following.

Q3. FREE RESPONSE

Tries: 1 [1]

▼ **When a backspin is applied to the ball, what is the trajectory of the ball? Explain your answer.**

PREPOPULATE STUDENT RESPONSE

Upwards/Downwards.
A higher pressure zone is created above/below the ball whereas a lower/higher pressure zone is created above/below the ball.

SUGGESTED ANSWER

Upwards. A higher pressure zone is created below the ball whereas a lower pressure zone is created above the ball.

Figure Simulation 4:Question 3

Table shows 34 (69%) out of 49 students got full marks for the free response question, 9 (18%) achieved partial correct.

School/Marks	0	0.5 (partial correct)	1 (correct) Upwards and explanation	Grand Total
1	1	1	15	17
2	5	4	13	22
3		4	6	10
Grand Total	6 (12%)	9 (18%)	34 (69%)	49

Table 4.3: Breakdown of students in different schools and correctness in their free response question FRQ, 1 mark for full credit and 0.5 mark for partial credit.

In simulation S5-Q1

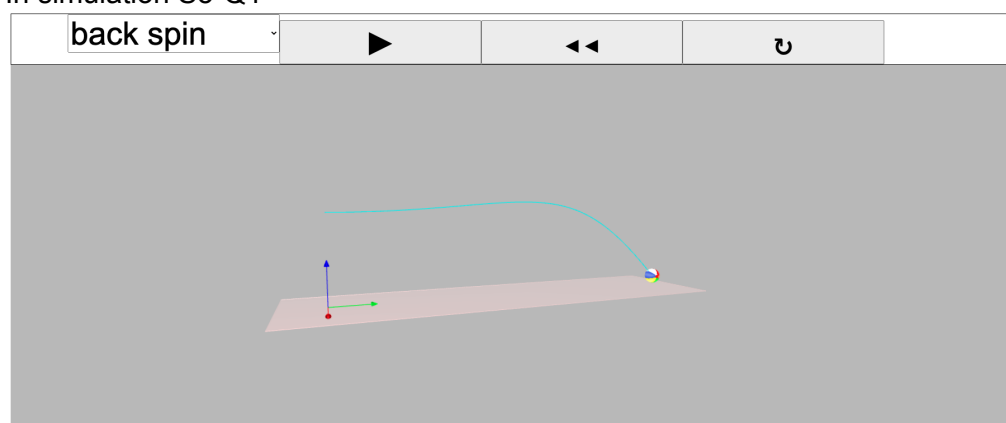


Figure S5: Simulation in 3D showing a beach ball travelling to the right with back spin that results in a Magnus force upwards for an upwards projected path that result in a further horizontal distance travelled.

Q1. MCQ

Tries: 1 [1]

▼ **A student claims that having a backspin on the ball increases the distance travelled by the ball as compared to having a top spin. True or false?**

☒ true

RESPONSE FEEDBACK

correct!

☐ false

RESPONSE FEEDBACK

Change the spins and run again.

Hint

Observe the different trajectories with the different spins.

Explanation

Backspin causes the ball to travel further than with having a top spin.

Figure Simulation 5:Question 1

Table shows 45 (92%) out of 49 students choose a as the correct answer.

School/Marks	true (correct)	false	Grand Total
1	17		17
2	19	3	22
3	9	1	10
Grand Total	45 (92%)	4	49

Table 5.1: Breakdown of students in different schools and the true/false option, note that true is the correct answer in italics

In simulation S5-Q2

Q2. FREE RESPONSE

Tries: 1 [1]

- ✓ **By using the 3D interactive, and taking the default point of reference from the sim (blue arrow points up, red arrow points towards user, and green arrow towards right of user), how does having a left spin affect the trajectory of the ball?**

PREPOPULATE STUDENT RESPONSE

Ball moves to the left/right and also nearer/away from the user.

SUGGESTED ANSWER

Ball moves to the right and also away from the user.

Figure Simulation 5:Question 2

Table shows 21 (43%) out of 49 students got full marks for the free response question, 22 (45%) achieved partial correct.

School / Marks	0	0.5 (partial correct)	1 (correct) move right and away from the user	Grand Total
1	1	8	8	17
2	5	9	8	22
3		5	5	10
Grand Total	6 (12%)	22 (45%)	21 (43%)	49

Table 5.2: Breakdown of students in different schools and correctness in their free response question FRQ. 1 mark for full credit and 0.5 mark for partial credit.

In simulation S5-Q3

✓ If a tennis player hit the ball with a certain spin and it reached the ground faster than expected, what type of spin did the ball experience? (assuming the tennis ball in this case is modelled by the same ball in the sim)

☐ Back spin

RESPONSE FEEDBACK

Compare the range with other spins.

☒ Top spin

RESPONSE FEEDBACK

This exerts a downward force on the ball and thus makes it hit the ground faster

☐ Left spin

RESPONSE FEEDBACK

Compare the range with other spins.

☐ Right spin

RESPONSE FEEDBACK

Compare the range with other spins.

Figure Simulation 5: Question 3

Table shows 48 (98%) out of 49 students choose b as the correct answer.

school / Marks	Back spin	Top spin (correct)	Left spin	Right spin	Grand Total
1		17			17
2	1	21			22
3		10			10
Grand Total	1	48 (98%)	0	0	49

Table 5.3: Breakdown of students in different schools and the true/false option. note that top spin is the correct answer in italics

In simulation S6-Q1

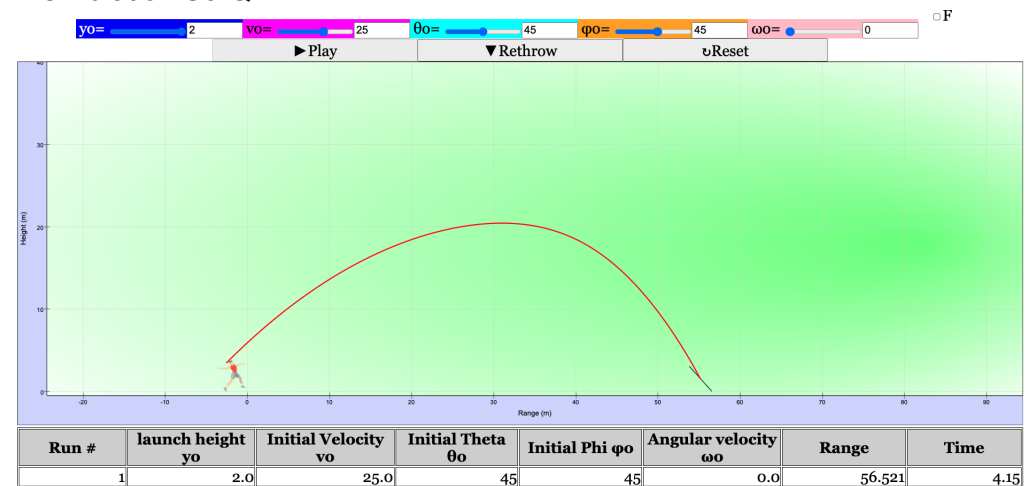


Figure S6: Simulation showing a man throwing a javelin to the right with a realistic path predicted by launch height, initial velocity, initial angle of javelin's body to horizontal, initial angle of throw to the horizontal, angular velocity of javelin, range and time taken to hit the ground.

Q1. FILL-IN-THE-BLANKS Tries: 1 [6]

> By trying out three different values of angular velocity (ω_0) between 0 to 10° per second, record the results of the distance travelled by the javelin in the table below.

You will need to move your cursor to the spot where the tip of the javelin lands to find the distance travelled.

Throw number	1	2	3
angular velocity, ω_0 (° per second)	<u>Answer 1</u>	<u>Answer 2</u>	<u>Answer 3</u>
distance travelled by javelin	<u>Answer 4</u>	<u>Answer 5</u>	<u>Answer 6</u>

1.

2.

3.

4.

5.

6.

Figure Simulation 6:Question 1

Table shows 14 (29%) out of 48 students got all 6 parts correct, while 13 (27%) got none of the parts correct.

School /Marks	0 (none correct)	1	2	3 (three questions correct)	4	5	6 (all correct)	Grand Total
1	2	1	3	3		2	5	16
2	7	3	2	2	2		6	22
3	4	1		1	1		3	10
Grand Total	13 (27%)	5	5	6	3	2	14 (29%)	48

Table 6.1: Breakdown of students in different schools and number of correct answers in all the sub parts, so 29% of students got all 6 sub parts correct.

In simulation S6-Q2

Q2. FREE RESPONSE

Tries: 1 [1]

✓ With reference to your recorded values, do you agree with the claim made by this student?

PREPOPULATE STUDENT RESPONSE

please edit the prepopulated suggested response.

Yes/No,

the recorded values agree /do not agree with the claim made by the student.

As angular velocity increases, the javelin's range or distance travelled decreases/increases.

SUGGESTED ANSWER

No, the recorded values do not agree with the claim made by the student.

As angular velocity increases, the javelin's range or distance travelled decreases.

Figure Simulation 6: Question 2

Table shows 13 (28%) out of 47 students got full marks for the free response question, 19 (40%) achieved partial correct.

School /Marks	0	0.5 (partial correct)	1 (correct)	Grand Total
1	3	7	5	15
2	10	6	6	22
3	2	6	2	10
Grand Total	15	19 (40%)	13 (28%)	47

Table 6.2: Breakdown of students in different schools and correctness in their free response question FRQ. 1 mark for full credit and 0.5 mark for partial credit.

In simulation S6-Q3

Q3. MCQ

Tries: 1 [1]

✓ In practise, it takes many years to train in order to launch a javelin under ideal conditions.

The current school record for the javelin throw event is 30 m.

You are presently able to launch a javelin with the following conditions:

1. at a **height** (y_0) of 2 m using an overhand grip
2. with a **release speed** (v_0) of 20 m/s
3. **holding** the javelin at a 45° **angle** (θ_0)
4. while **releasing** the javelin at a 45° **angle** (ϕ_0)
5. with no **angular velocity** (ω_0).

By using the simulation of the conditions above, deduce if you will be able to break the current school record.

- ☐ No, the javelin will **not** be able to travel further than the current school record of 30m.
- ☐ Yes, the javelin will be able to travel to a new record range of 30.1m.
- ☒ Yes, the javelin will be able to travel to a new record range of 36.7m.
- ☐ Yes, the javelin will be able to travel to a new record range of 46.7m.

Hint

Run #	launch height y_0	Initial Velocity v_0	Initial Theta θ_0	Initial Phi ϕ_0	Angular velocity ω_0	Range	Time
1	2.0	20.0	45	45	0.0	36.707	3.26

Figure Simulation 6: Question 3

Table shows 38 (81%) out of 47 students choose c as the correct answer out of 4 possible options.

<i>School/MCQ</i>	a	b	<i>c (correct)</i> Yes, 36.7m	d	Grand Total
1		3	12		15
2	1	4	16	1	22
3			10		10
Grand Total	1	7	38 (81%)	1	47

Table 6.3: Breakdown of students in different schools and the MCQ option, note that c is the correct answer in italics

In simulation S6-Q4

Q4. FREE RESPONSE

Tries: 1 [1]

✓ By making observations of the current conditions of your javelin throw, state how you can improve the distance that the javelin travels, and the type of training you can perform to achieve this improvement.

PREPOPULATE STUDENT RESPONSE

I will need to increase/decrease the release speed of the javelin. [1]
suggest one way to achieve the above? [1]

SUGGESTED ANSWER

I will need to increase the release speed of the javelin to above 20 m/s. [1]
I can do this by engaging in upper body training such as (any relevant upper body exercises) or by having a running start. [1]

Figure Simulation 6:Question 4

Table shows 45 (92%) out of 49 students choose a as the correct answer.

<i>School /Marks</i>	0	1 (partially correct)	2 (fully correct) increase and exercise upper body	Grand Total
1		5	9	14
2	3	5	14	22
3			10	10
Grand Total	3	10	33 (70%)	46

Table 6.4: Breakdown of students in different schools and correctness in their free response question FRQ, 2 mark for full credit and 1 mark for partial credit.

In simulation S6-Q5

Q5. FREE RESPONSE

Tries: 1 [1]

- It was also suggested that the height that the javelin is launched affects the amount of **time** that the javelin stays in the air after release.

Suggest and explain how the change in the initial height of release affects the amount of time that the javelin stays in the air.

PREPOPULATE STUDENT RESPONSE

By increasing/decreasing the initial height (such as through an overhand grip throw), the javelin has a greater/lower distance from the ground [1], allowing it to stay for longer/shorter in the air before hitting the ground. [1]

SUGGESTED ANSWER

By increasing the initial height (such as through an overhand grip throw), the javelin has a greater distance from the ground [1], allowing it to stay for longer in the air before hitting the ground. [1]

Explanation

Run #	launch height y_0	Initial Velocity v_0	Initial Theta θ_0	Initial Phi ϕ_0	Angular velocity ω_0	Range	Time
1	2.0	25.0	45	45	0.0	56.521	4.15
2	1.0	25.0	45	45	0.0	56.084	4.10
3	0.0	25.0	45	45	0.0	55.632	4.04

Figure Simulation 6:Question 5

Table shows 36 (78%) out of 46 students got fully correct marks and 7% achieved partial correct.

School /Marks	0	1 (partial correct)	2 (fully correct) increase initial height and time longer	Grand Total
1		2	12	14
2	5	1	16	22
3	1	1	8	10
Grand Total	6	4 (7%)	36 (78%)	46

Table 6.5: Breakdown of students in different schools and correctness in their free response question FRQ. 2 mark for full credit and 1 mark for partial credit.

Survey

We present the survey questions and sample qualitative text comments to give the readers a favour of the quantitative survey data.

1a) These (e-SBA) electronic School Based Assessment-interactive improve my learning experiences even during test.

38 responses

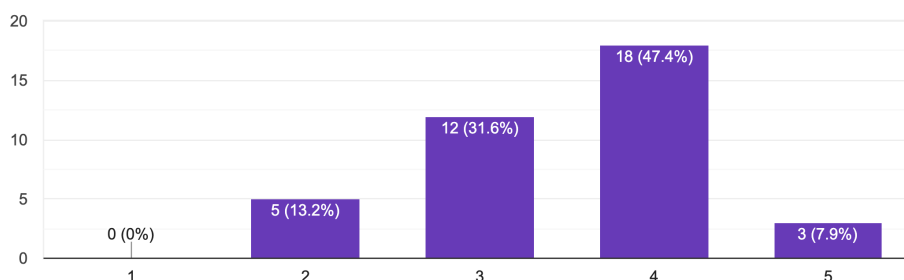


Figure S1: Google survey showing 1-Disagree to 5-Strongly agree to the

question 1a)

Survey 1a) ask if these (e-SBA) electronic School Based Assessment-interactive to improve students' learning experiences even during tests.

55% agrees and strongly agrees, while 5% disagrees with 32% neutral.

Qualitative data are added to give a better representation of the 55% who agree and strongly agrees.

Added are some students' comments added with [] to improve readability, to give a better sense of the percentages and why the students rated that way in a theme that emerged after reading the comments.

Theme: More real life motion is easier to understand (55% A and SA)

"It[simulation] shows the students more real-life applications that can be used to revise and study for exams/tests."

"The websites [SLS lesson with e-SBA interactive] that simulate the release of the football and javelins allow me to understand more about why the motion of the object."

"Allows me to see for myself the changes when variables [in the interactive] are adjusted"

"The (e-SBA) interactive is helpful to imagine and visualize the situation of the assessment better."

2a) These School Based Assessment items are rich assessment item types compared to traditional text and picture assessment items. For example, was...r able to show the concept than a static picture?
38 responses

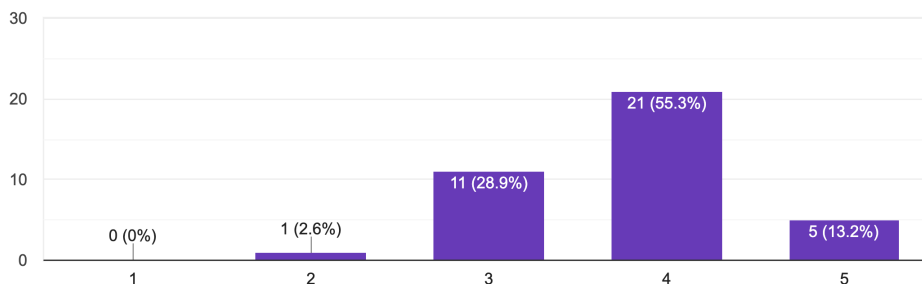


Figure S2: Google survey showing 1-Disagree to 5-Strongly agree to the question 2a)

Survey 2a) ask if these School Based Assessment items are rich assessment item types compared to traditional text and picture assessment items. For example, was the soccer ball being able to be simulated based on your selection of a variable say speed or angle of launch, and was better able to show the concept than a static picture?

68% agrees and strongly agrees, while 3% disagrees with 29% neutral.

Qualitative data are added to give a better representation of the 68%.

Again, below are some students' comments added with [] to improve readability, to give a better sense of the percentages and why the students rated that way in a theme that emerged after reading the comments.

Theme: Adjust a variable and be able to visual what is needed is clearer (68% A and SA)

"I am able to adjust the variables [in the simulation] myself instead of having fixed results from a textbook"

"The simulation gives a better idea for a student to better visualize and state[answer] what is needed."

"It[simulation] has a clearer description than on paper."

"Seeing the action [on the simulation] made me understand it[the sports motion] better rather than just seeing a picture."

3a) These School Based Assessment items are rich assessment item types compared to text and video based assessment items. For example, was th...the concept than a video of one particular case?

38 responses

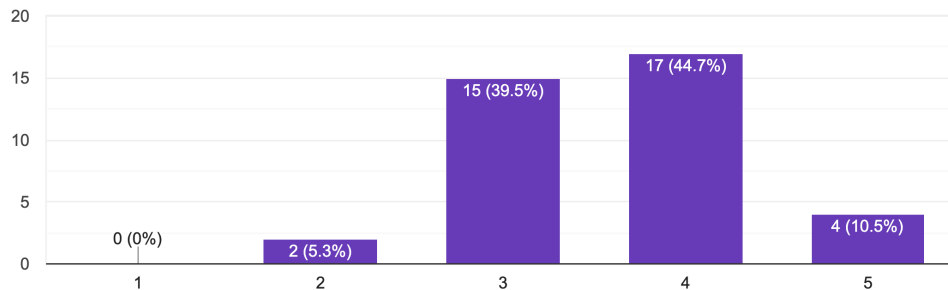


Figure S3: Google survey showing 1-Disagree to 5-Strongly agree to the question 3a)

Survey 3a) asks if these School Based Assessment items are rich assessment item types compared to text and video based assessment items. For example, was the soccer ball being able to be simulated based on your selection of a variable say speed or angle of launch, and was better able to show the concept than a video of one particular case?

55% agrees and strongly agrees, while 5% disagrees with 40% neutral.

Again, below are some students' comments added with [] to improve readability, to give a better sense of the percentages and why the students rated that way in a theme that emerged after reading the comments.

Theme: simulation can vary, while video can't (55% A and SA)

"A video only shows a specific angle etc, whereas this simulation can constantly be changed for more variety of results"

"The simulation allows students to know the variables well and select different variables."

Theme: video can explain better than simulation (40% N, 5% DA)

"If the video comes with an in-depth explanation, I think it will be more effective."

4a) I would recommend to my teachers to design and use such interactive in future school based assessment types for more interesting assessment.

38 responses

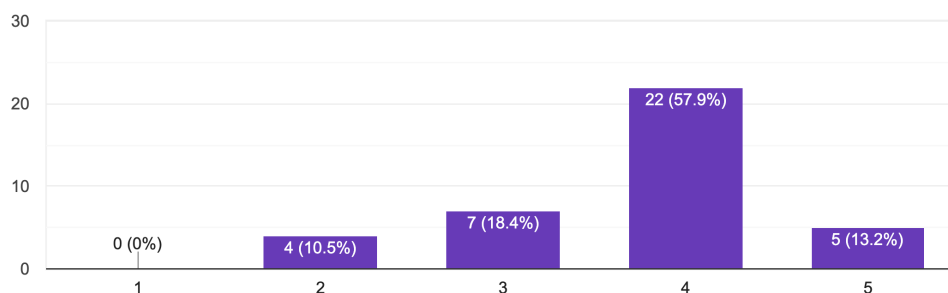


Figure S4: Google survey showing 1-Disagree to 5-Strongly agree to the question 4a)

Survey 4a) asks if I would recommend to my teachers to design and use such interactive in future school based assessment types for more interesting assessment.

71% agrees and strongly agrees, while 10% disagrees with 18% neutral.

Again, below are some students' comments added with [] to improve readability, to give a better sense of the percentages and why the students rated that way in a theme that emerged after reading the comments.

Theme: Simulation are more engaging and interesting than traditional picture (71% A and SA)

"These [simulations] engage us more and help us understand better compared to just reading from texts"

"The simulation can help me get more engage as it provides a different kind of learning"

"It would be more interesting for students to do more interactive assessment that they can do other than doing questions based on the classic picture and video."

"It is more interesting and will bring new ideas."

"I feel like this type of interactive assessments will help me understand the topic more."

5a) I would recommend to my teachers to design and use such interactive in future school based assessment for more realistic assessment in the context of exercise and sport science.

38 responses

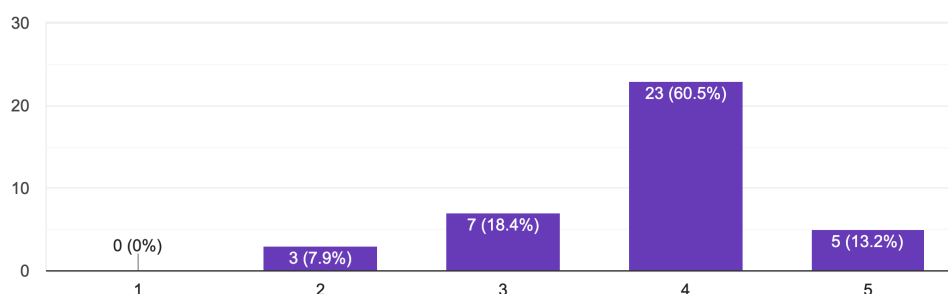


Figure S5: Google survey showing 1-Disagree to 5-Strongly agree to the question 5a)

Survey 5a) asks if the students would recommend to their teachers to design and use such interactive in future school based assessment for more realistic assessment in the context of exercise and sport science.

74% agrees and strongly agrees, while 8% disagrees with 18% neutral.

Again, below are some students' comments added with [] to improve readability, to give a better sense of the percentages and why the students rated that way in a theme that emerged after reading the comments.

Theme: Teachers should use simulation as after students explore the variables in the simulation, students can understand better (74% A and SA)

"Since our tests are already computer-based, we should be used to these functions. They also help us to understand better"

"There are many variables, such as angle of release, height of release and more, thus it is very realistic and can test my understanding"

"It allows us to understand the concepts visually"

Dissemination

This report serves as a dissemination for this research.

The team will publish on the link⁵ a summary of the findings for unclassified information public dissemination.

An SLS lesson is published in the Community Gallery⁶ to the benefit of the teacher community to edit and re-publish variant lessons using our SSTRF artefacts.

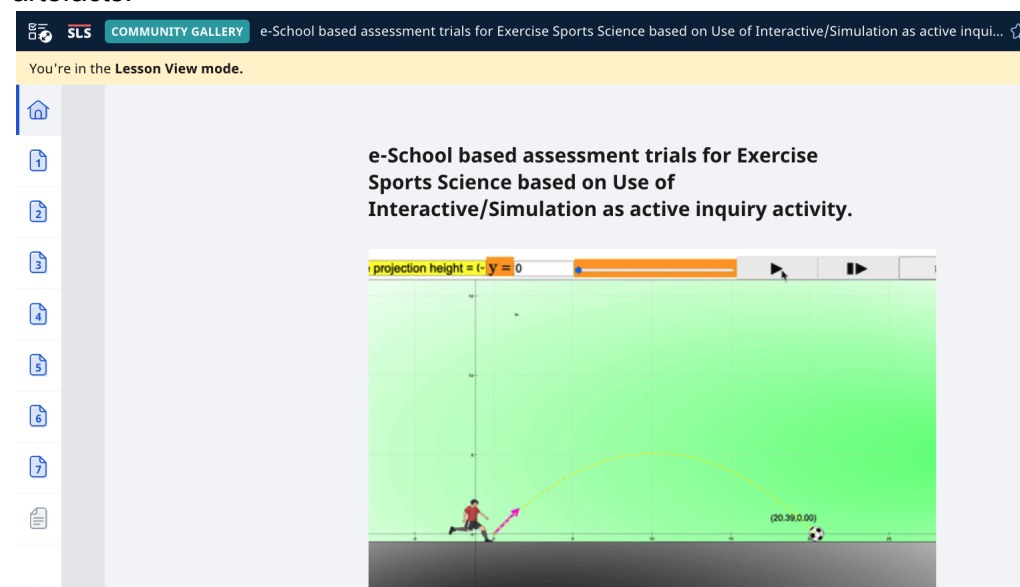


Figure D1: A community gallery lesson of the SSTRF project

List the various platforms at which the findings of the study have been shared, or will be shared. List publications, titles of papers and internal reports arising from the research.

⁵ <https://iwant2study.org/ospsg/index.php/projects/916>

⁶

<https://vle.learning.moe.edu.sg/mrv/community-gallery/lesson/view/3e2e32c2-0769-481a-bc35-daffa2cedb11/cover>

Application

The 6 interactive are open sourced and available for future customization or reuse, screenshots and title are included for illustration purposes.

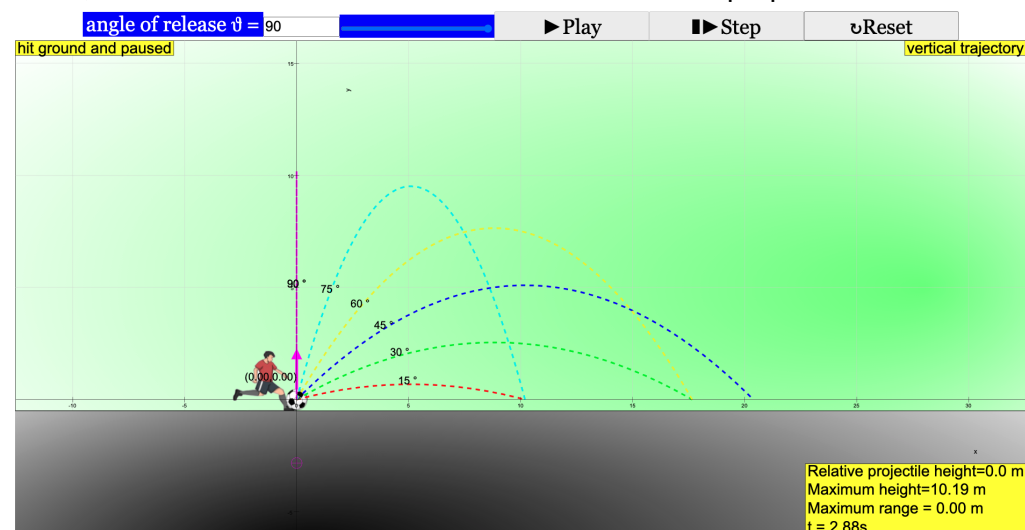


Figure A1: Simulation of 0,15,30,45,60,75,90 degrees of angle of release projectile motion model for exercise sports science⁷

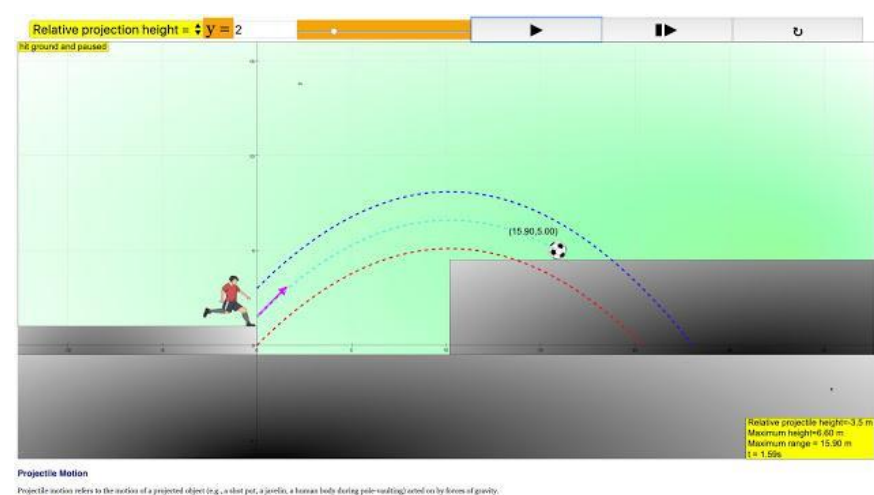


Figure A2: Simulation 2 shows the different relative projection height projectile motion model⁸

Describe any deliverables which can be used by school practitioners or MOE HQ officers (e.g., teaching packages, lesson plan, survey instruments or policy brief). Include any extension or further research developed based on the project.

⁷ <https://iwant2study.org/ospsg/index.php/935-angle-of-release-projectile-motion-model>

⁸ <https://iwant2study.org/ospsg/index.php/936-relative-projection-height>

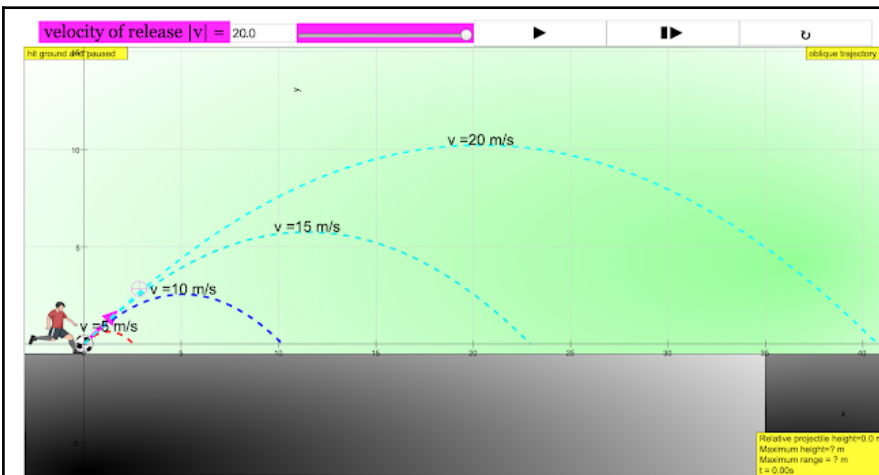


Figure A3: Simulation 3 shows velocity of release = 10,15,20 m/s projectile motion model⁹

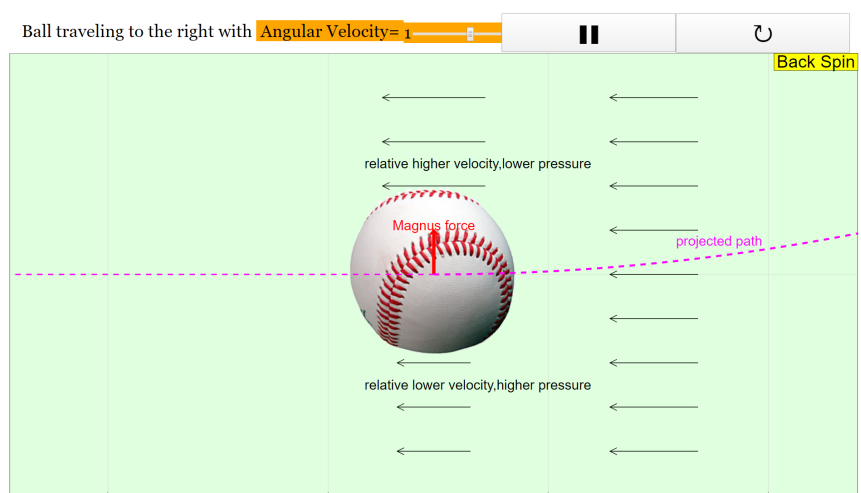


Figure A4: Simulation 4 shows a baseball travelling to the right with Magnus' force for sports and science¹⁰

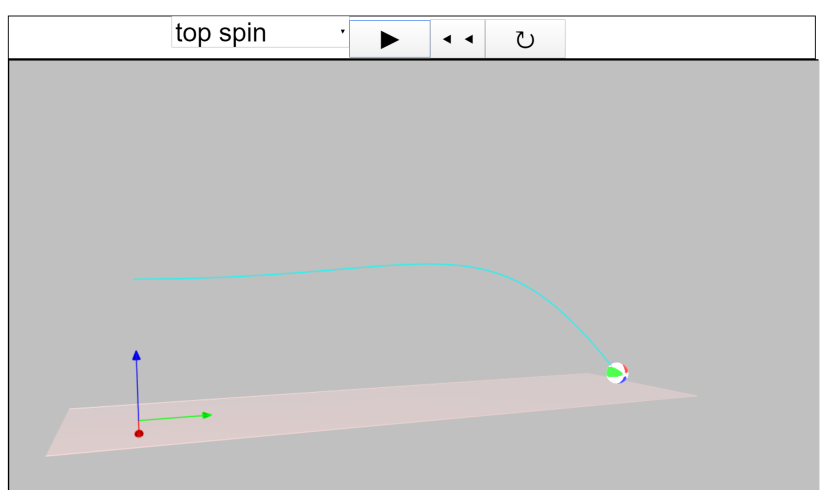


Figure A5: Simulation 5 shows a beach ball in a 3D view with a top spin travelling to the right for sports¹¹

⁹ <https://iwant2study.org/ospsg/index.php/937-velocity-of-release>

¹⁰ <https://iwant2study.org/ospsg/index.php/942-magnus-force-for-sports-and-science>

¹¹ <https://iwant2study.org/ospsg/index.php/943-beach-ball-physics-for-sports>

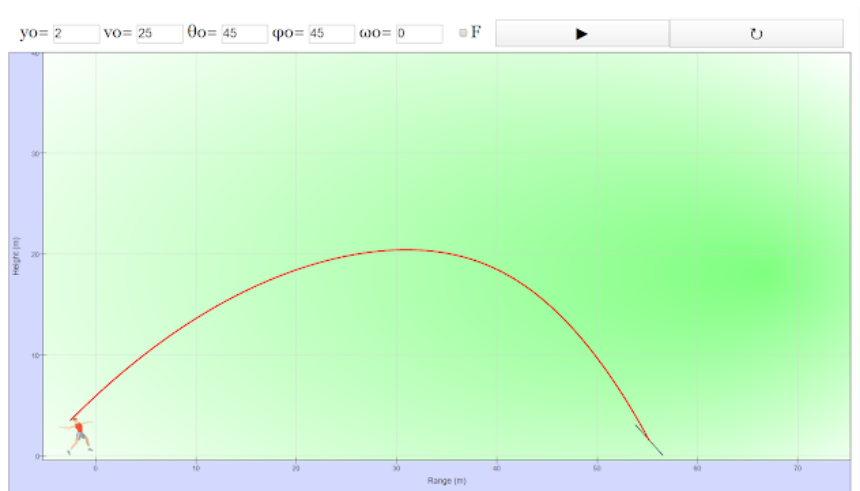


Figure A6: Simulation 6 shows a man throwing a javelin to the right for flight dynamics¹²

The e-SBA package is on SLS Community Gallery free for teachers to copy, modify or assign to their students for e-SBA or just normal teaching and learning, a point the team wanted to ensure.

The Survey instrument is also on Google form, and please contact the PI for a copy to repurpose and use.

Reflection

What are your key learning points from the project?

The findings suggest simulations when well-designed are suitable tools for e-SBA as the percentage of correct varies from 29% to 98% and students are not disadvantaged compared to the usual pen-paper SBA.

	Incorrect	Partial correct	Correct
Sim1 , Q1	20%		80%
Sim1 , Q2	12%	26%	62%
Sim1 , Q3	18%		82%
Sim2 , Q1	20%		80%
Sim2 , Q2	8%	20%	71%
Sim2 , Q3	24%		76%
Sim3 , Q1	14%		86%
Sim3 , Q2	7%	14%	80%
Sim3 , Q3	8%		92%

¹² <https://iwant2study.org/ospsg/index.php/938-javelin-flight-dynamics>

Sim4 , Q1	53%		37%
Sim4 , Q2	27%		63%
Sim4 , Q3	12%	18%	69%
Sim5 , Q1	8%		92%
Sim5 , Q2	12%	45%	43%
Sim5 , Q3	2%		98% (highest)
Sim6 , Q1	27%	44%	29% (lowest)
Sim6 , Q2	12%	45%	43%
Sim6 , Q3	2%		98%(highest)
Sim6 , Q4	12%	45%	43%
Sim6 , Q5	2%		98%(highest)

Table R1: Summary of all questions grouped under columns incorrect, partial correct and correct. Note the correct range from 29% to 98%

Survey questions	Disagree	Neutral	Agree	Key Learning points / Reflection
1a) these (e-SBA) electronic School Based Assessment-interactive to improve students' learning experiences even during tests.	13%	32%	55%	The simulation been time dependent is closer to real life motion, thus is easier to understand.
2a) these School Based Assessment items are rich assessment item types compared to traditional text and picture assessment items. For example, was the soccer ball being able to be simulated based on your selection of a variable say speed or angle of launch, and was better able to show the concept than a static picture?	3%	29%	68%	The simulation able to adjust a variable and be able to visualize what is needed, is clearer than static picture.
3a) These School Based Assessment items are rich assessment item types compared to text and video based assessment items. For example, was the soccer ball being able to be simulated based on your selection of a variable say speed or angle of launch, and was better able to show the concept than a	5%	40%	55%	The simulation can vary any variable which better supports sense making, while video can only show one particular aspect of the motion. On the hand, video can explain better than simulation

video of one particular case?				because simulation needs to make meaning yourself.
4a) I would recommend to my teachers to design and use such interactive in future school based assessment types for more interesting assessment.	11%	18%	71%	Simulation are more engaging and interesting than traditional picture, thus students would recommend to their teachers to use simulation.
5a) I would recommend to their teachers to design and use such interactive in future school based assessment for more realistic assessment in the context of exercise and sport science.	8%	18%	74%	Teachers should use simulation as after students explore the variables themselves in the simulation, students can understand better.

Table R2: Summary of survey questions into columns Disagree(Strongly Disagree and Disagree), Neutral, and Agree (Agree and Strongly Agree) and the respective qualitative responses as key learning points.

<u>Were there any circumstances which aided or impeded the progress of the research?</u> Covid-19 has prevented our trainer to fly in from Spain to Singapore to support our project in 2020. The project has kept the funds in 2021 and hopes to utilize the funds when Covid-19 effects has normalized and allows face to face collaboration in 2021 and 2022 if supported.	If YES, give details of problems and explain the steps that the project team took to overcome them.
<u>Other comments/feedback.</u> NIL	

Final Statement of Accounts

Items	M	E / F	M / C	T / M	Total
Total Approved Grant (1)	31,360.50	0	0	22,000.00	53,360.50
Total Actual Expenditure (2)	24,047.98	0	0	0	24,047.98
Total Outstanding Commitments (3)	0.00	0	0	0	0.00
Total Grant Balance (1)-(2)-(3)	7,312.52	0.00	0.00	22,000.00	29,312.52
Utilisation Rate [(2)+(3)]/(1)	77%			0%	45%

Note: **M** denotes manpower;
E/F denotes new equipment/facilities;
M/C denotes materials/consumables;
T/M denotes training costs/other miscellaneous costs