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	
Principal Investigator: Lawrence WEE Loo Kang (Educational Technology Division) Co-Principal Investigator (if any): Jean Phua Yin Chiun (Educational Technology Division) Cleve Chia (Physical, Sports & Outdoor Education Branch, Student Development and Curriculum Division) Team members (if any): Chong Tze Wen (Singapore Examinations and Assessment Board, SEAB) Mohammad Faizal Zainal (SEAB) Ng Xue Ting (SEAB) Sylvia Tan (SEAB) Andy Luo (Dunman High) Collaborators (if any): Han Wei Yang (Catholic High School) Wong Zhiyong (Westwood Secondary School) Ng Yong Sheng(CHIJ St Theresa's Convent) Mentor Karen Lam (Master Specialist, Assessment Policy & Practice, Curriculum Policy Office)	Explanatory Notes Provide the names and designations of project team members.
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 (EJSS[1]) 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 6[2] 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 SLS[3] 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.	Briefly 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.

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

Table RDM1: Breakdown of students in different schools (anonymous) and their streams

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 questions[4] 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.

methods of data collection and analysis.

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

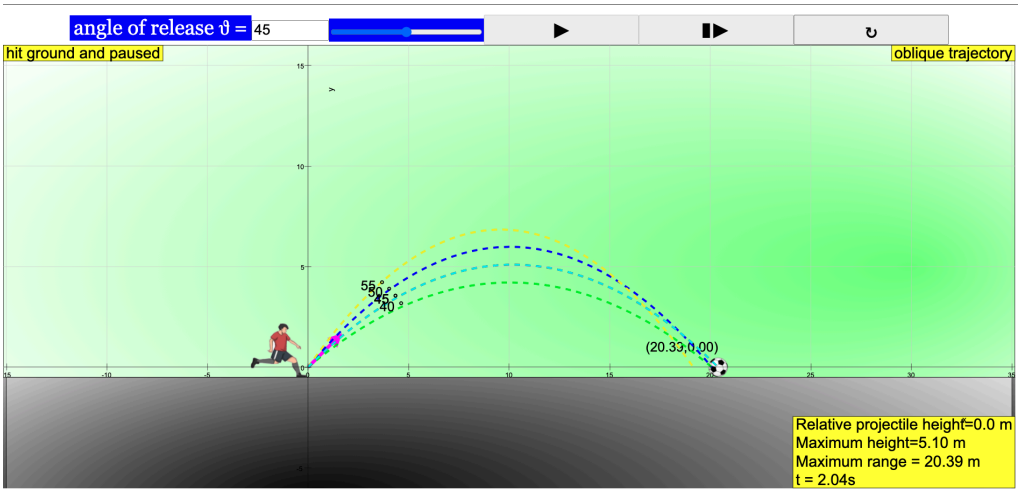


Figure S1: Simulation showing angle of projectile at 40, 45, 50, 55 degree paths, where angle 45 degree has the greatest range.

Question 1 is in Figure below.

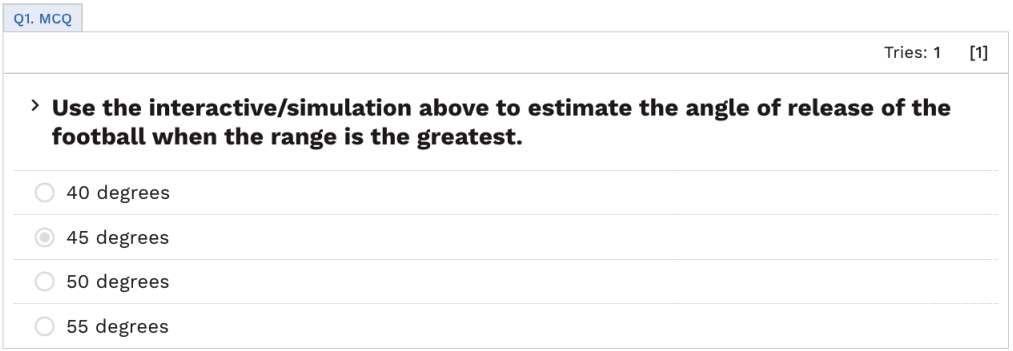


Figure Simulation 1:Question 1

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	*b (correct) 45 degrees*	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.

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

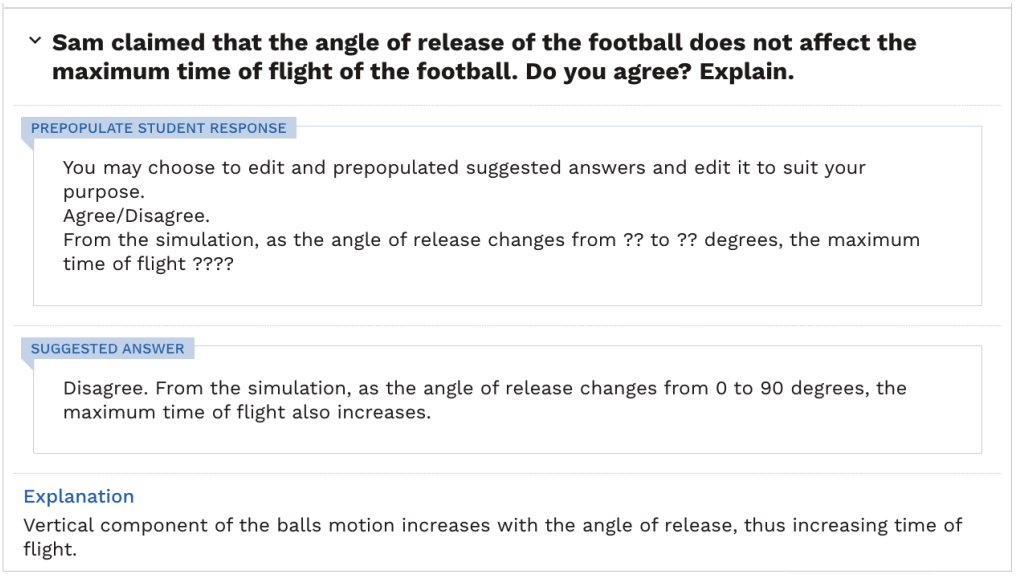


Figure Simulation 1:Question 2

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.

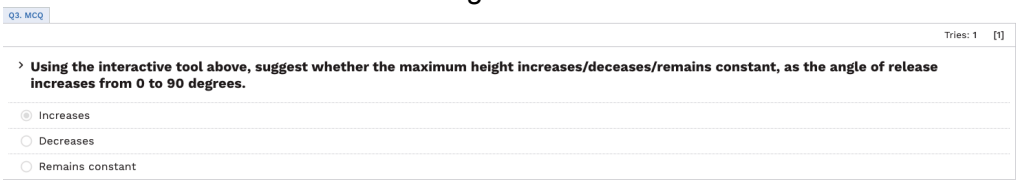


Figure Simulation 1:Question 3

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.

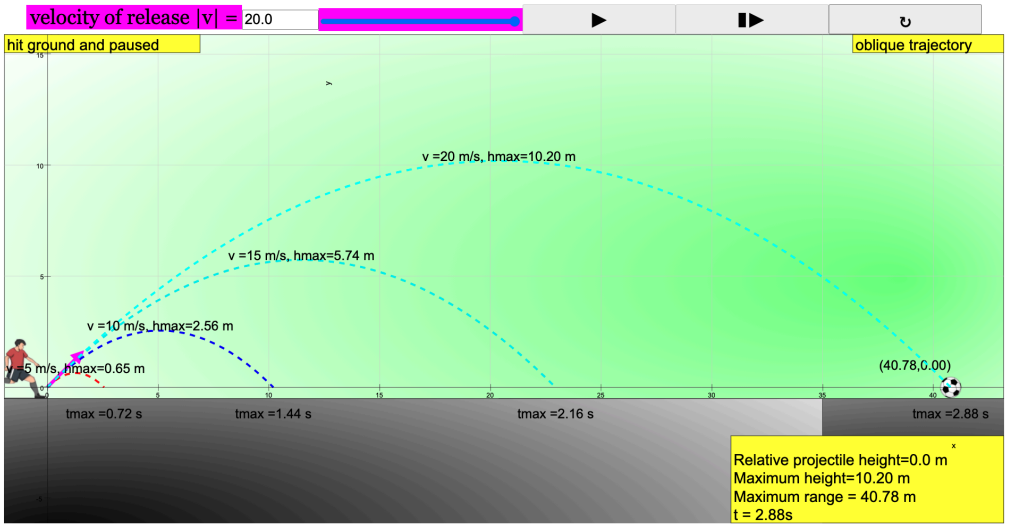


Figure S2: Simulation showing different initial velocity paths where velocity = 20 m/s result in the greatest range of 40.78 = 41 m.

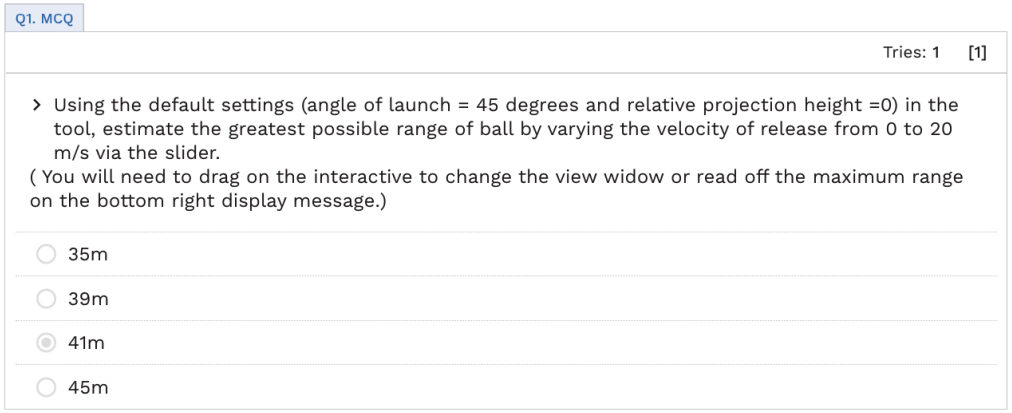


Figure Simulation 2:Question 1

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**

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.

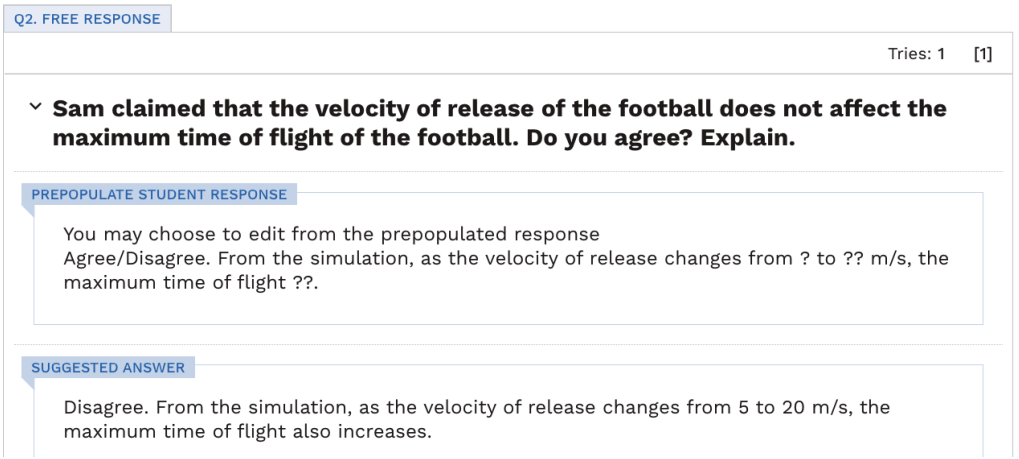


Figure Simulation 2:Question 2

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*	
school / marks	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.

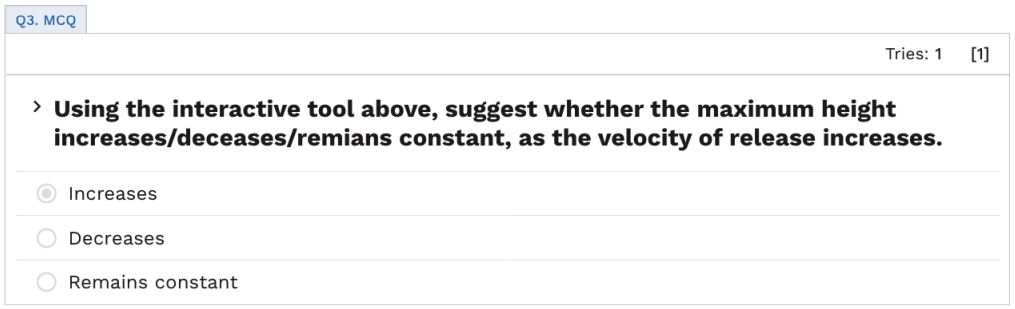


Figure Simulation 2:Question 3

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

School/ MCQ	*a (correct)*	b	c	Grand Total

	Increases			
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.

Figure Simulation 3:Question 1

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

School/MCQ	a	b	*c (correct) 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.

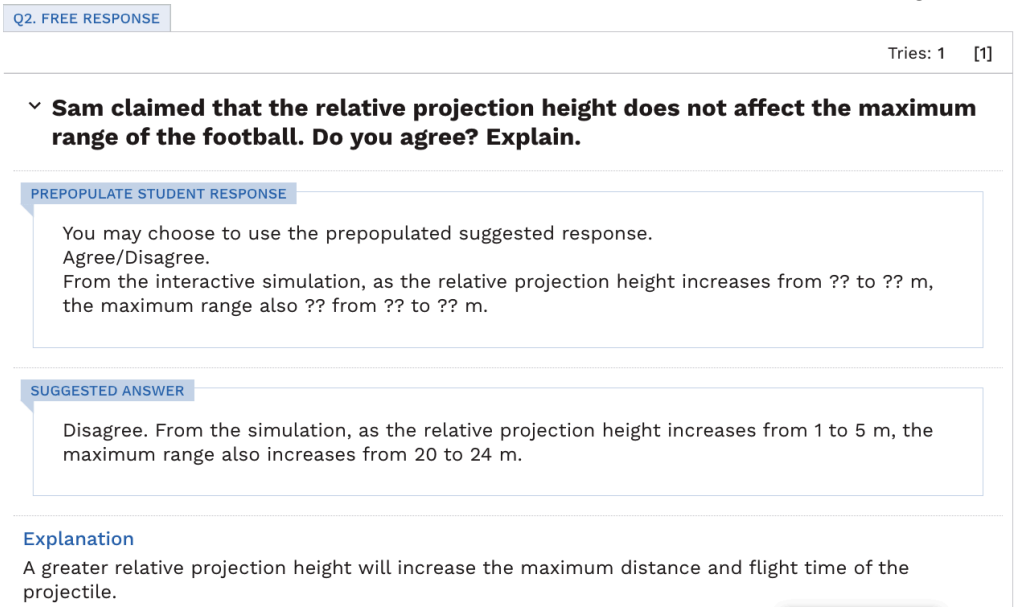


Figure Simulation 3:Question 2

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.

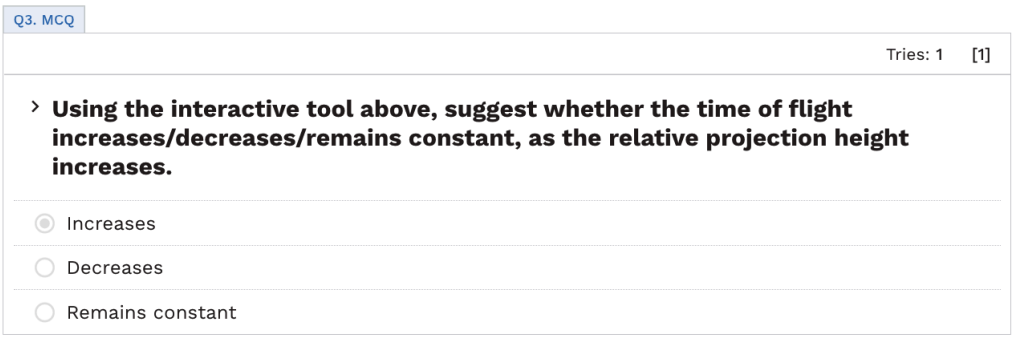


Figure Simulation 3:Question 3

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

School/MCQ	*a (correct) Increases*	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.

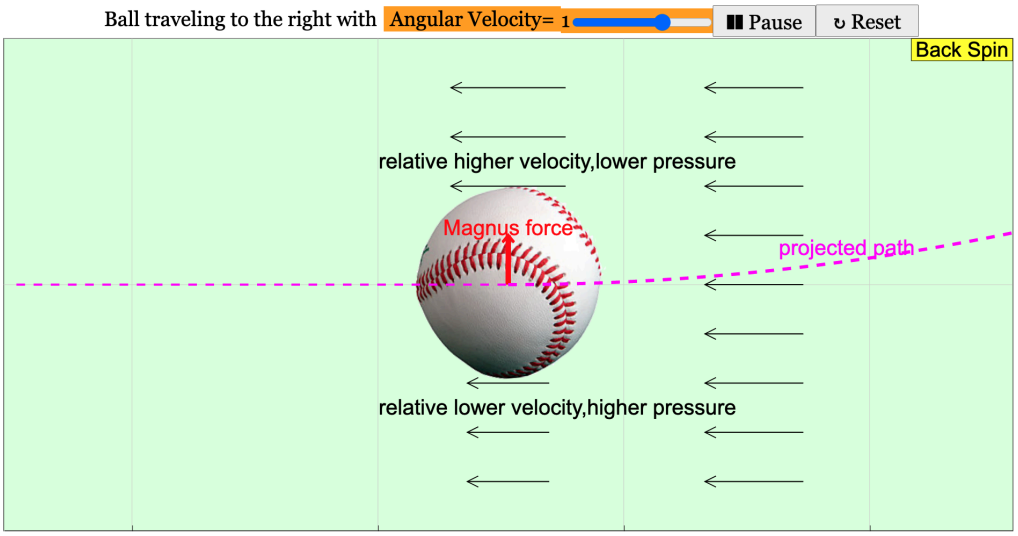


Figure S4: Simulation showing a baseball travelling to the right with an angular velocity (anti-clockwise) = 1 that results in a Magnus force upwards for a back-spin for an upwards projected path that likely will result in a further horizontal distance travelled.

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

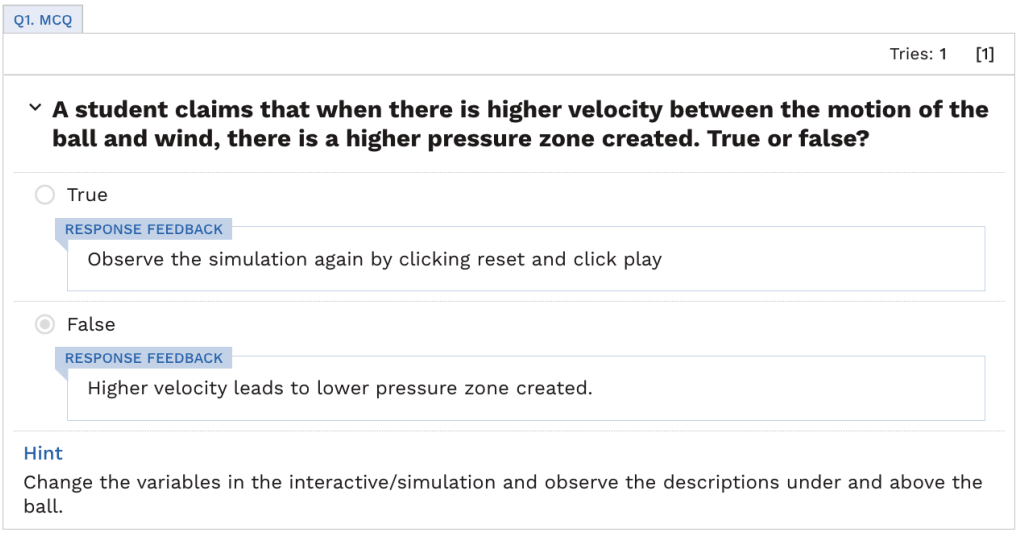


Figure Simulation 4:Question 1

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.

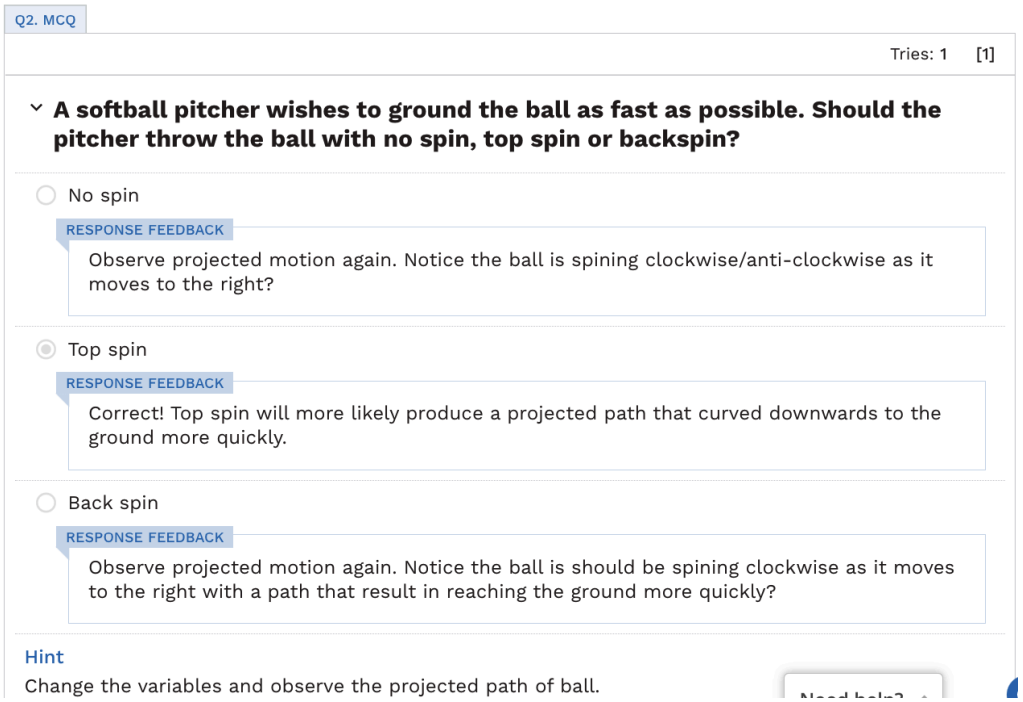


Figure Simulation 4:Question 2

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

School/MCQ	a (No spin)	*b (Top spin)*	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.

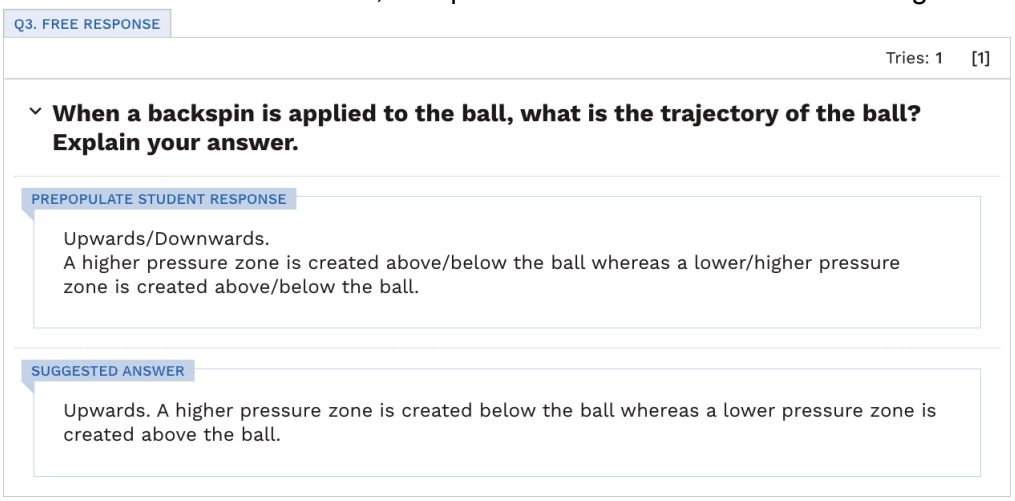


Figure Simulation 4:Question 3

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

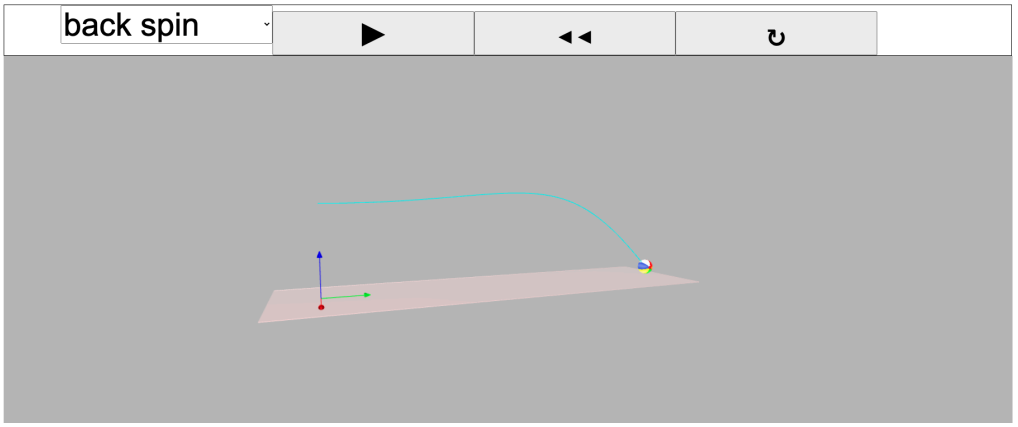


Figure S5: Simulation in 3D showing a beach ball travelling to the right with back spin that results in a Magnus force upwards for an upwards projected path that result in a further horizontal distance travelled.

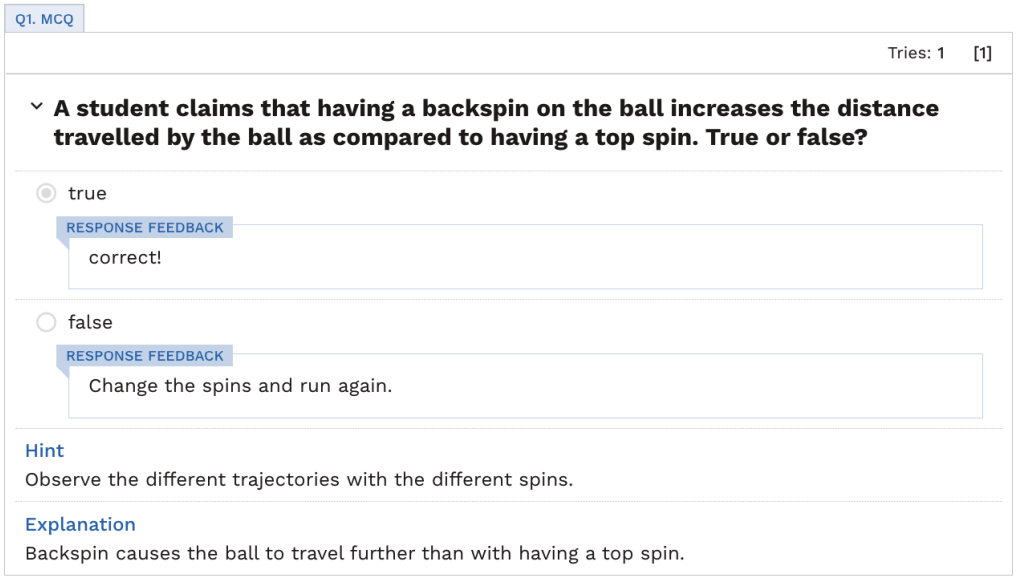


Figure Simulation 5:Question 1

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

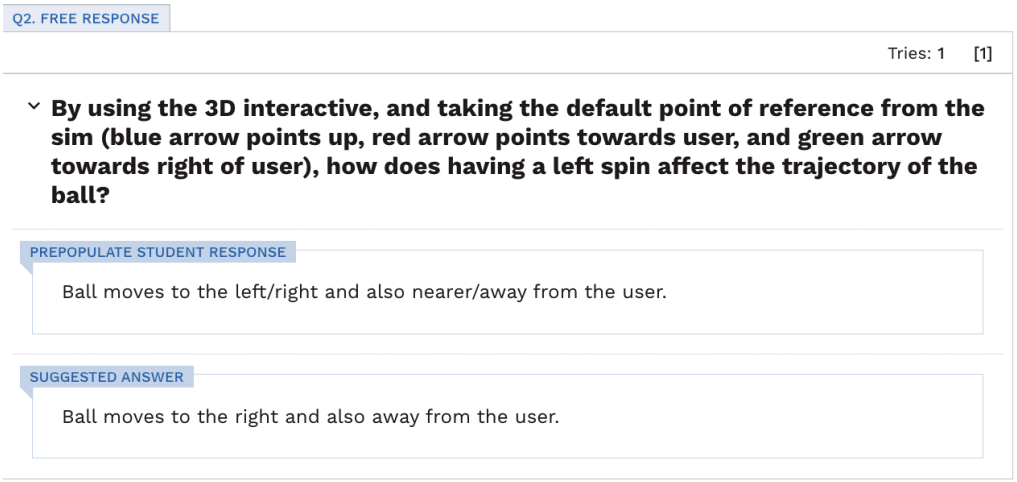


Figure Simulation 5:Question 2

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

Q3. MCQ

Tries: 1 [1]

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.

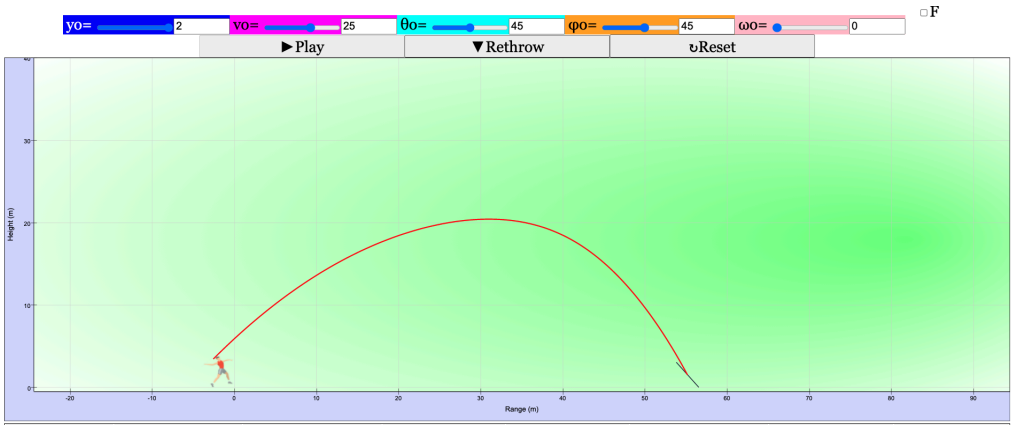
Figure Simulation 5:Question 3

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



Run #	launch height yo	Initial Velocity vo	Initial Theta θo	Initial Phi φo	Angular velocity ωo	Range	Time
1	2.0	25.0	45	45	0.0	56.521	4.15

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.

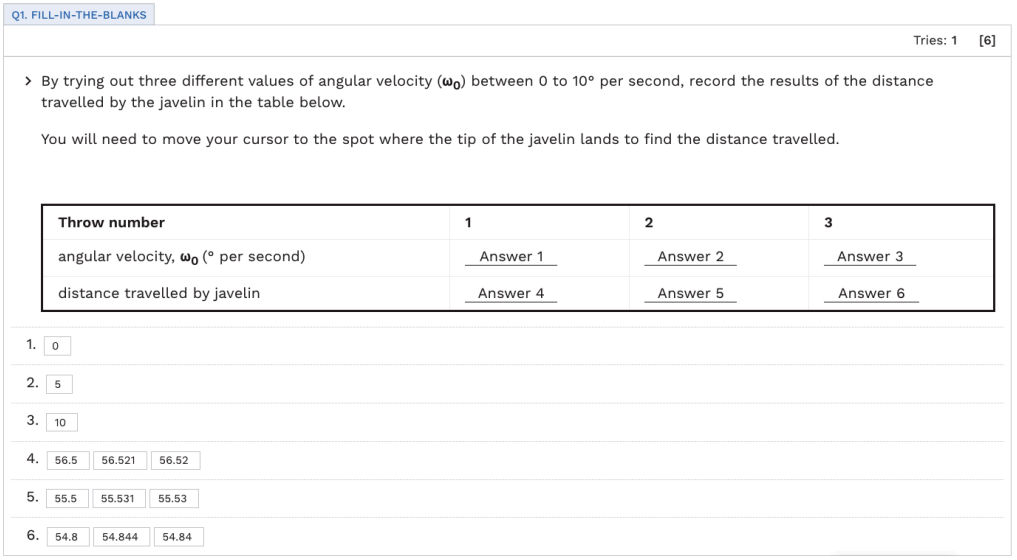


Figure Simulation 6:Question 1

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

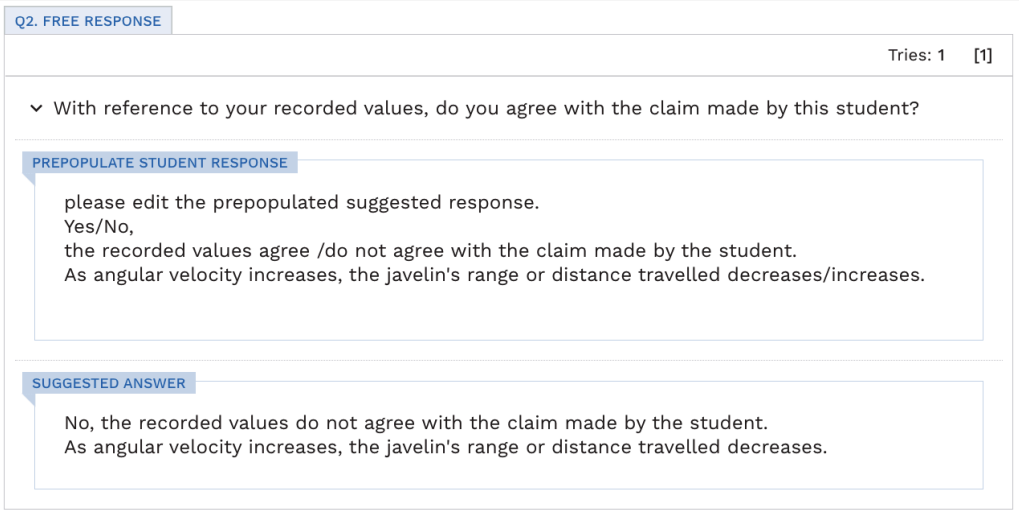


Figure Simulation 6:Question 2

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

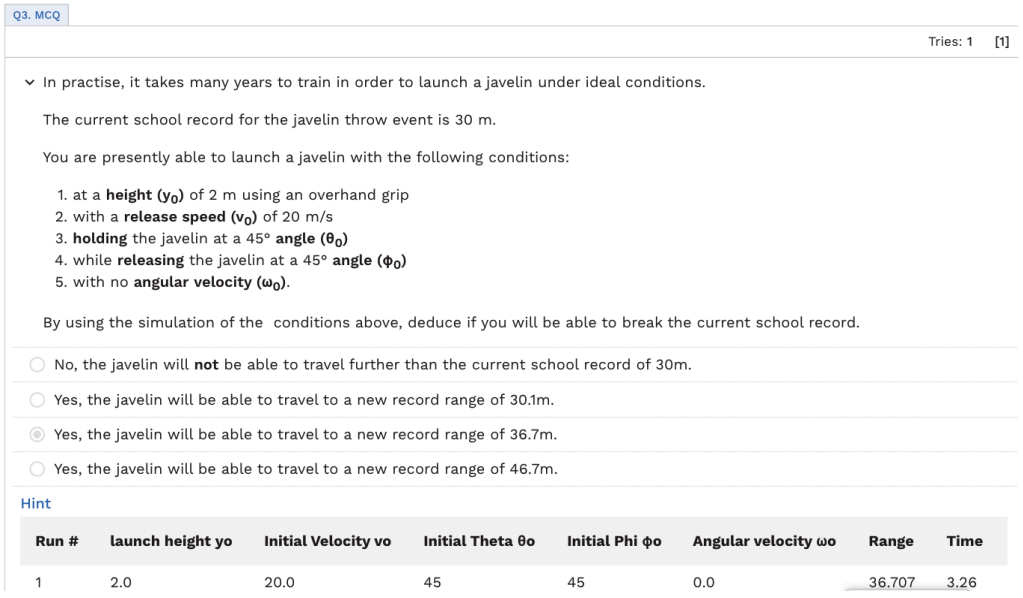


Figure Simulation 6:Question 3

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

School/MCQ	a	b	*c (correct) 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

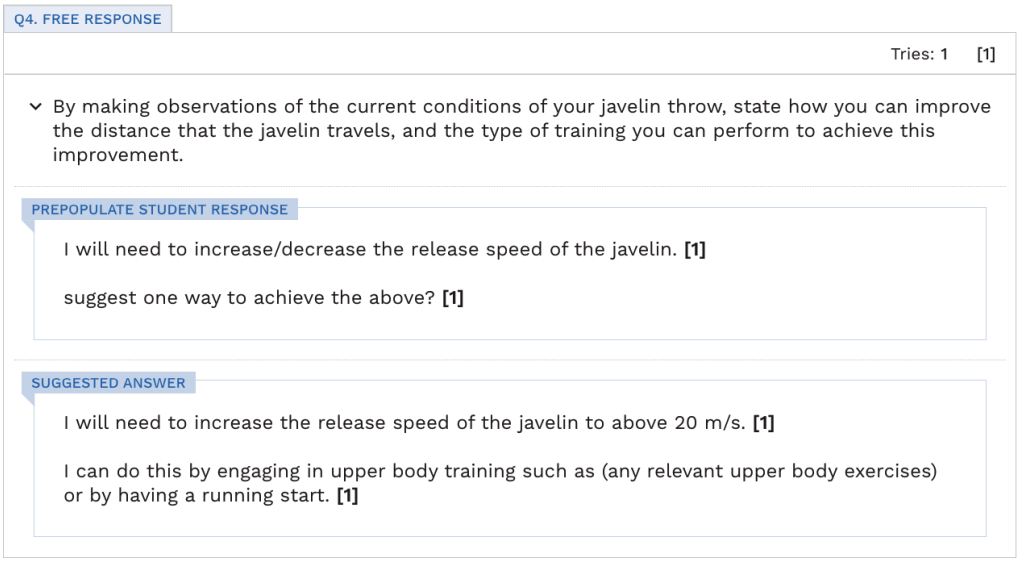


Figure Simulation 6:Question 4

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

School /Marks	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

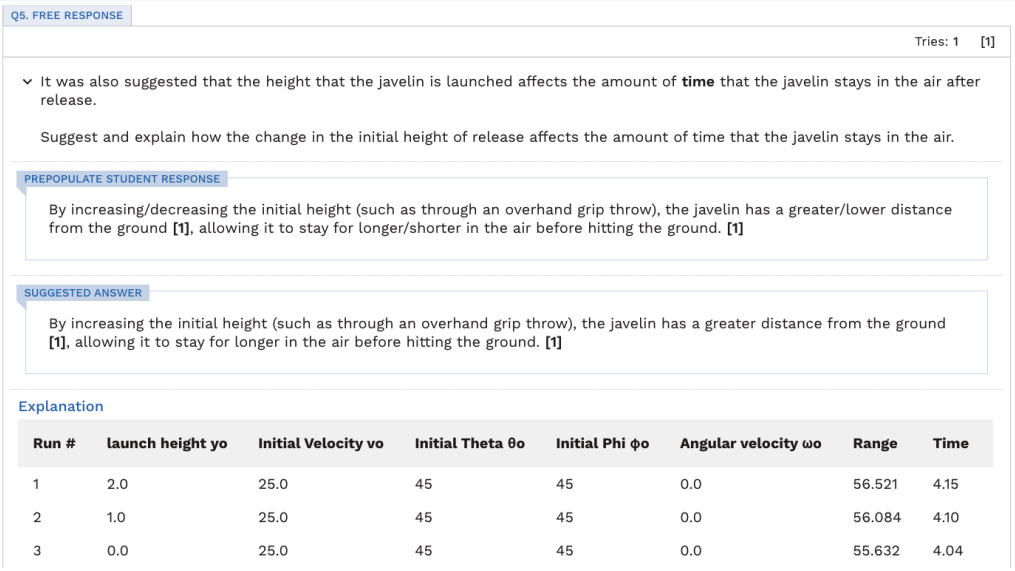


Figure Simulation 6:Question 5

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.

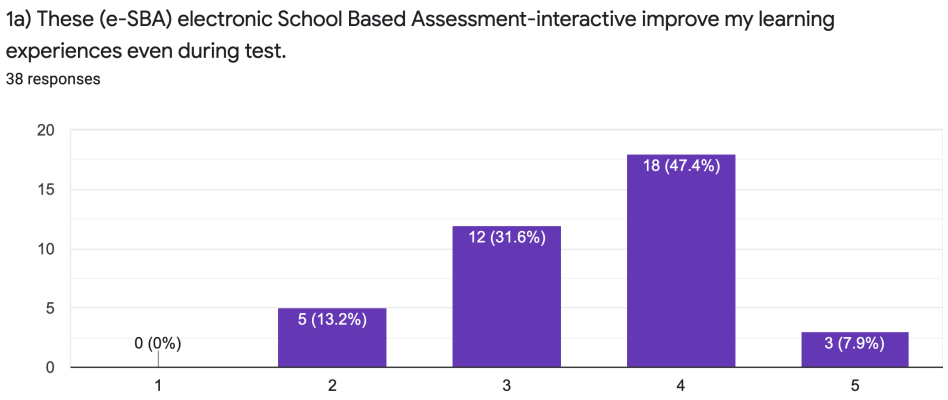


Figure S1: Google survey showing 1-Disagree to 5-Strongly agree to the

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."

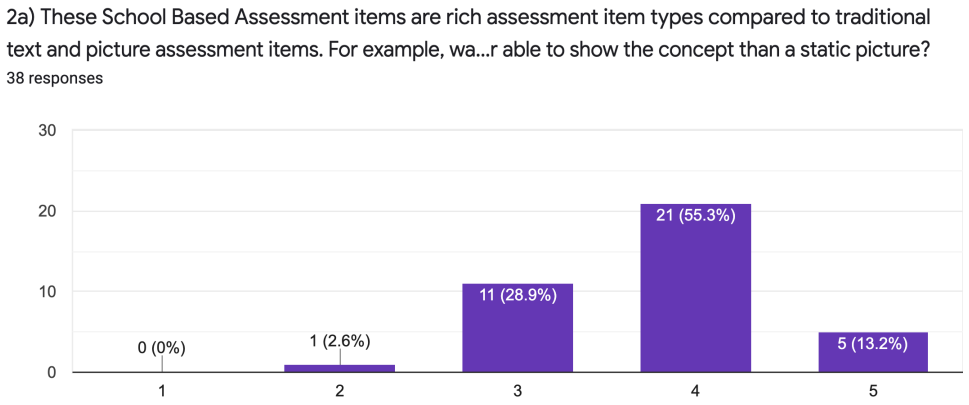


Figure S2: Google survey showing 1-Disagree to 5-Strongly agree to the question 2a)

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."

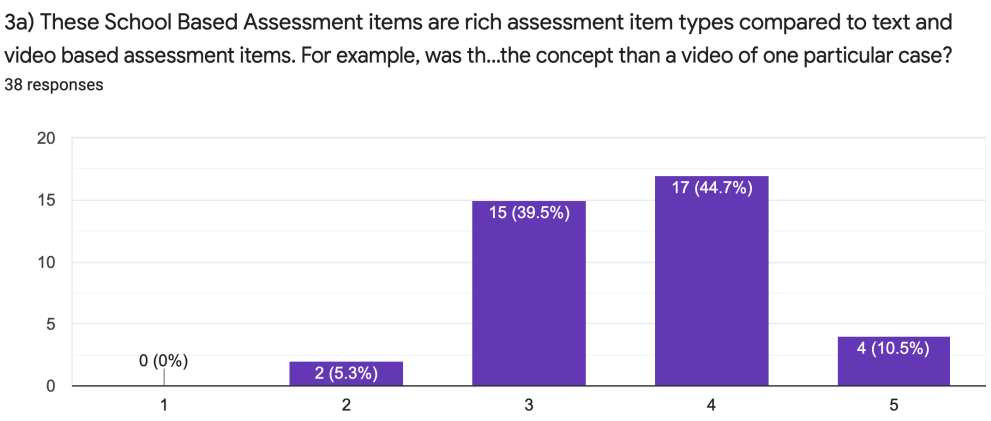


Figure S3: Google survey showing 1-Disagree to 5-Strongly agree to the question 3a)

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."

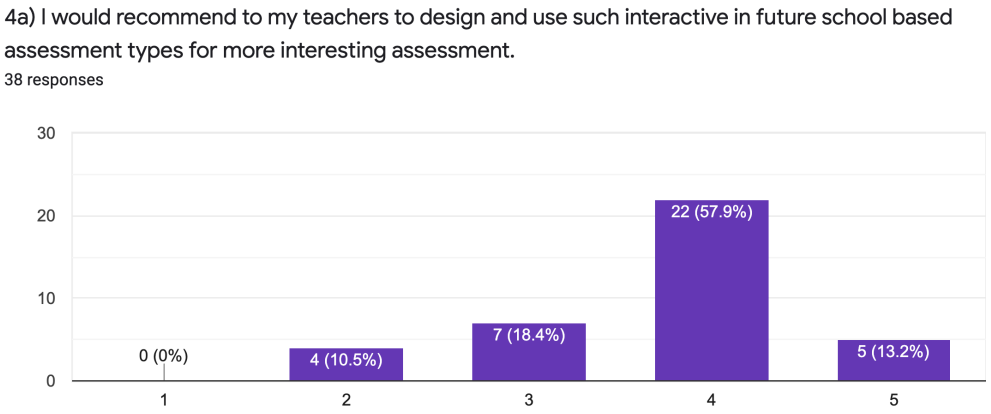


Figure S4: Google survey showing 1-Disagree to 5-Strongly agree to the question 4a)

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."

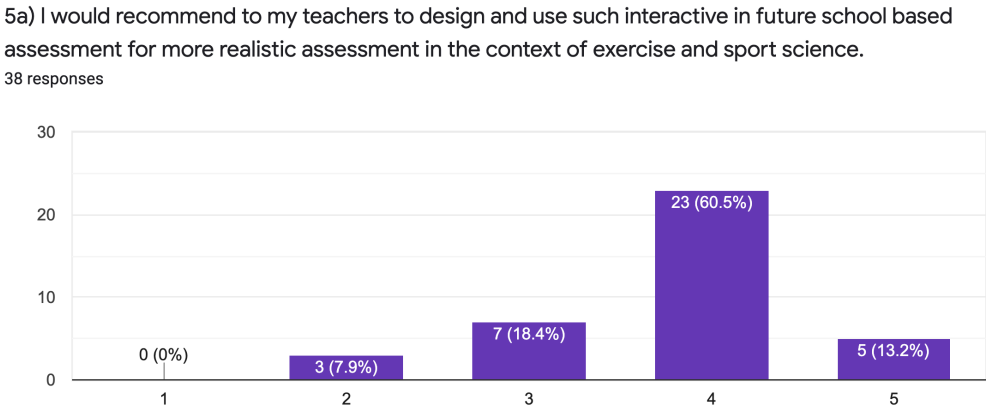


Figure S5: Google survey showing 1-Disagree to 5-Strongly agree to the question 5a)

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 link[5] a summary of the findings for unclassified information public dissemination.

An SLS lesson is published in the Community Gallery[6] to the benefit of the teacher community to edit and re-publish variant lessons using our SSTRF artefacts.

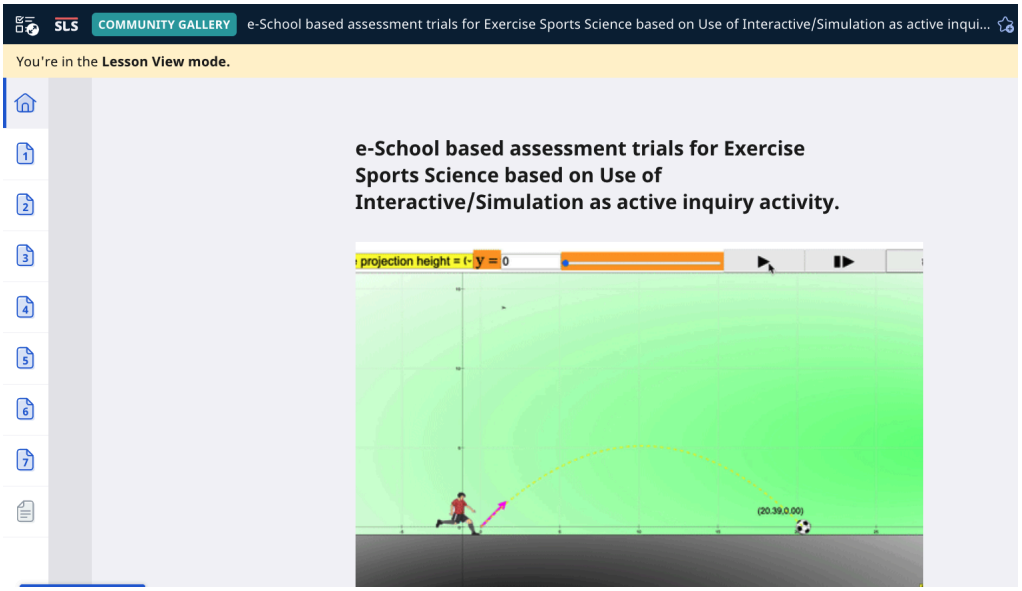
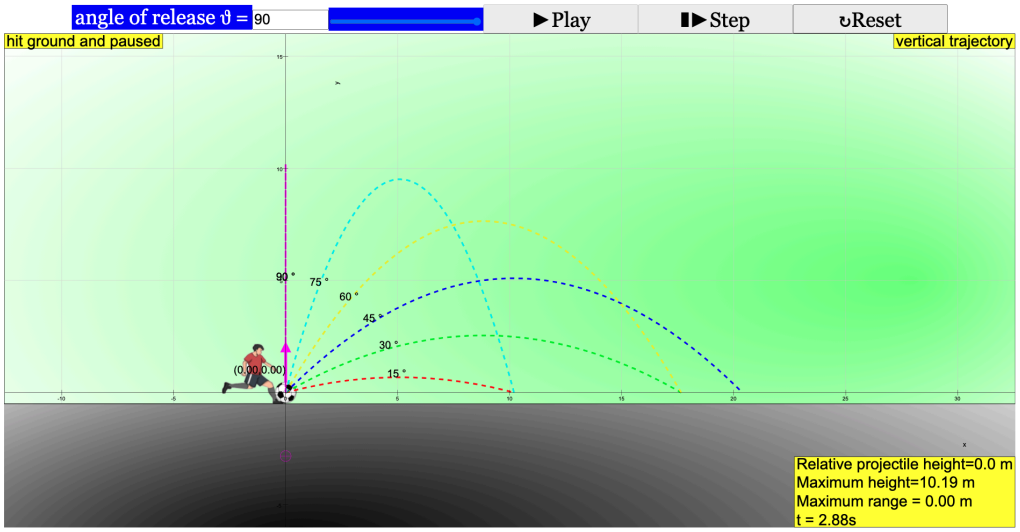


Figure D1: A community gallery lesson of the SSTRF project

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 science*[7]  *Figure A2: Simulation 2 shows the different relative projection height projectile motion model*[8]	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

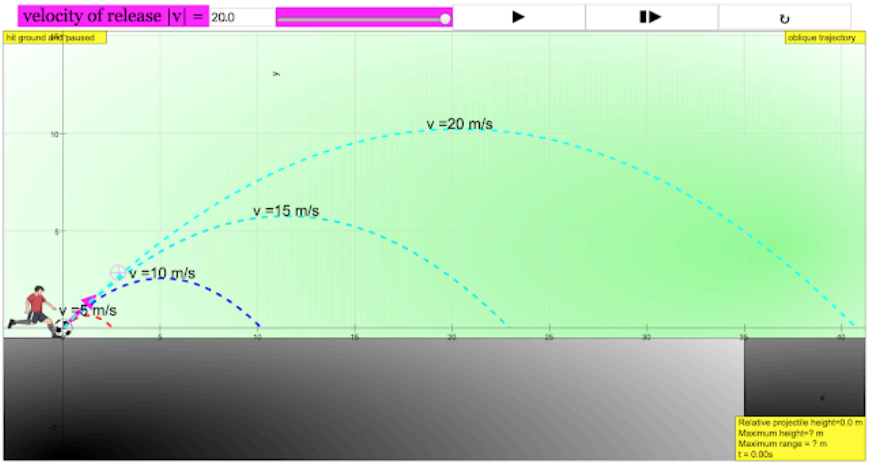


Figure A3: Simulation 3 shows velocity of release = 10,15,20 m/s projectile motion model[9]

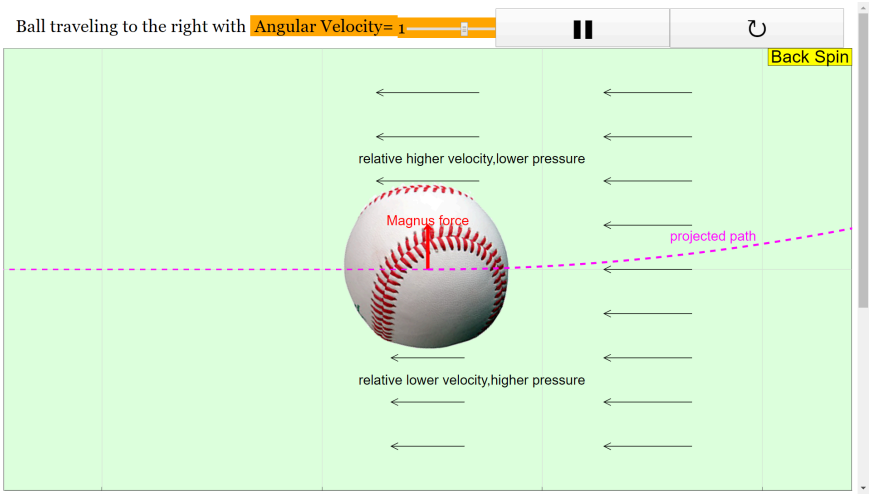


Figure A4: Simulation 4 shows a baseball travelling to the right with Magnus' force for sports and science[10]

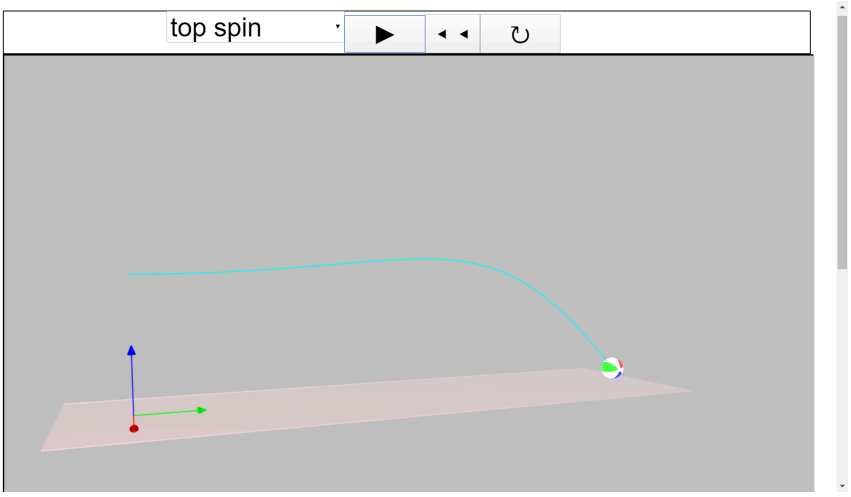


Figure A5: Simulation 5 shows a beach ball in a 3D view with a top spin travelling to the right for sports[11]

[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

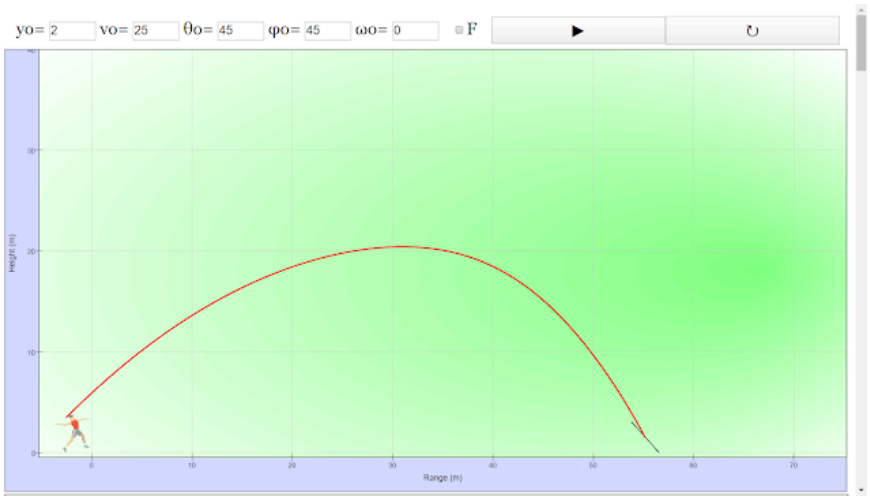


Figure A6: Simulation 6 shows a man throwing a javelin to the right for flight dynamics[12]

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.

Were there any circumstances which aided or impeded the progress of the research? 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.
Other comments/feedback. 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