

This evidence has been adapted from a 2022 submission to reflect the 2023 Subject Outline changes. The investigation analysis and evaluation of the method now appears within the journal (Part A), with the 5 minute recorded pitch now devoted almost entirely to the evaluation of collaboration.

	Investigation, Analysis, and Evaluation	Knowledge and Application
A	<p>Critically deconstructs a problem and designs a logical, coherent, and detailed scientific investigation using a scientific method and/or engineering design process.</p> <p>Obtains, records, and represents data, using appropriate procedures, conventions and formats accurately and highly effectively.</p> <p>Systematically analyses and interprets data and evidence to formulate logical conclusions with detailed justification.</p> <p>Critically and logically evaluates procedures and their effect on data.</p> <p>Critically and perceptively evaluates the effectiveness of collaboration and its impact on results/outcomes.</p>	<p>Demonstrates deep and broad knowledge and understanding of a range of science inquiry skills and scientific concepts.</p> <p>Applies science inquiry skills and scientific concepts highly effectively in new and familiar contexts.</p> <p>Critically explores and understands in depth the interaction between science and society.</p> <p>Communicates knowledge and understanding of science concepts coherently, with highly effective use of appropriate terms, conventions, and representations.</p>
B	<p>Logically deconstructs a problem and designs a well-considered and clear scientific investigation using a scientific method and/or engineering design process.</p> <p>Obtains, records, and represents data, using appropriate procedures, conventions and formats mostly accurately and effectively.</p> <p>Logically analyses and interprets data and evidence to formulate suitable conclusions with reasonable justification.</p> <p>Logically evaluates procedures and their effect on data.</p> <p>Critically evaluates the effectiveness of collaboration and its impact on results/outcomes.</p>	<p>Demonstrates some depth and breadth of knowledge and understanding of a range of science inquiry skills and scientific concepts.</p> <p>Applies science inquiry skills and scientific concepts mostly effectively in new and familiar contexts.</p> <p>Logically explores and understands in some depth the interaction between science and society.</p> <p>Communicates knowledge and understanding of science concepts with mostly coherent and effective use of appropriate terms, conventions, and representations.</p>
C	<p>Deconstructs a problem and designs a considered and generally clear scientific investigation using a scientific method and/or engineering design process.</p> <p>Obtains, records, and represents data, using generally appropriate procedures, conventions and formats with some errors but generally accurately and effectively.</p> <p>Undertakes some analysis and interpretation of data and evidence to formulate generally appropriate conclusions with some justification.</p> <p>Evaluates procedures and some of their effect on data.</p> <p>Evaluates the effectiveness of collaboration and its impact on results/outcomes.</p>	<p>Demonstrates knowledge and understanding of a general range of science inquiry skills and scientific concepts.</p> <p>Applies science inquiry skills and scientific concepts generally effectively in new or familiar contexts.</p> <p>Explores and understands aspects of the interaction between science and society.</p> <p>Communicates knowledge and understanding of science concepts with generally effective use of appropriate terms, conventions, and representations.</p>
D	<p>Prepares a basic deconstruction of a problem and an outline of a scientific investigation using a scientific method and/or engineering design process.</p> <p>Obtains, records, and represents data, using procedures, conventions, and formats inconsistently, with occasional accuracy and effectiveness.</p> <p>Describes data and undertakes some basic interpretation to formulate a basic conclusion.</p> <p>Attempts to evaluate procedures or suggest an effect on data.</p> <p>Attempts to evaluate the effectiveness of collaboration and its impact on results/outcomes.</p>	<p>Demonstrates some basic knowledge and partial understanding of science inquiry skills and scientific concepts.</p> <p>Applies some science inquiry skills and scientific concepts in familiar contexts.</p> <p>Partially explores and recognises aspects of the interaction between science and society.</p> <p>Communicates basic scientific information, using some appropriate terms, conventions, and/or representations.</p>
E	<p>Attempts a simple deconstruction of a problem and a procedure for a scientific investigation using a scientific method and/or engineering design process.</p> <p>Attempts to use some procedures and record and represent some data, with limited accuracy or effectiveness.</p> <p>Attempts to describe results and/or interpret data to formulate a basic conclusion.</p> <p>Acknowledges that procedures affect data.</p> <p>Acknowledges the effectiveness of collaboration and its impact on results/outcomes.</p>	<p>Demonstrates limited recognition and awareness of science inquiry skills and/or scientific concepts.</p> <p>Attempts to apply science inquiry skills and/or scientific concepts in familiar contexts.</p> <p>Attempts to explore and identify an aspect of the interaction between science and society.</p> <p>Attempts to communicate information about science.</p>

Grade = B+

Stage 2 Scientific Studies – Assessment Type 2

Collaborative Inquiry (20%)

Introduction and Purpose of Task:

Your task is to collaborate with others to address an investigable question or to propose a solution to a problem, need or opportunity related to your program. Your group will deconstruct the question or problem and design a scientific investigation to test a hypothesis or prototype, for which the outcome is uncertain.

To deconstruct your question or problem, you may need to consider various aspects, including but not limited to:

- what effects there are,
- how to measure the dependent variable,
- equipment that could be used and any other variables.

After the experiment has been completed, you will need to analyse your data, evaluate the procedures and justify conclusions based on the data obtained. You will also need to consider the limitations of the experiment and consider ways of improving the outcome of your experiment.

Evidence for assessment is in the form of two individual submissions:

- a **personal journal** which records your progress and outcomes in your group work
- an **evaluation** where you evaluate the effectiveness of collaboration on your results / outcomes.

Part A: Collaborative Inquiry Design (Personal Journal)

You are to maintain, then submit a personal journal where you record work and critical thinking individually. The personal journal will demonstrate:

1. initial thinking and ideas as you deconstruct the problem + planning/designing a practical
2. evidence of your contribution to the project and supporting documentation on the application of their collaborative skills (this can include pictures and linked video/audio evidence by QR code)
3. representation(s) of the data collected by the group
4. preliminary analysis and interpretation of data
5. connections between results and relevant scientific concepts
6. an evaluation of the procedures and their effect on data
7. a conclusion with justification and the consideration of possible limitations

The personal journal may include, but is not limited to:

- Deconstruct template
- Design Annotated research template/ideas
- Methods trialled + outcomes
- reflection on progress/journal entries
- pictorial record of experiments
- analysis of data
- future planning + suggestions for improvements
- peer review (rate-your-mates)

The journal is limited to **12 A4 pages**, single sided, with a minimum font size of 10. Electronic submission is compulsory – if you want to hand write, the pages must be scanned for submission.

All oral submissions will be recorded for moderation purposes.

If you are submitting your evidence electronically, use the following naming protocol:

SACE registration number-2STU20-AT1-collaborative inquiry journal
SACE registration number-2STU20-AT1-collaborative inquiry evaluation

Assessment Design Criteria

Your journal and pitch will be assessed against the following Performance Standards

- Investigation, Analysis, and Evaluation: IAE 1, 2, 3, 4, 5
- Knowledge and Application: KA 4

Part B: Collaborative Inquiry Evaluation (Recorded presentation)

Students individually evaluate the collaborative inquiry, in the style of a recorded presentation.

This should include:

1. a description of what the inquiry was about
2. an evaluation of the effectiveness of collaboration and its impact on results/outcomes

Guidelines

The following guidelines may be useful in the preparation of the student's recorded presentation. Please note that these are guidelines only. Students are not required to address every dot point and may include other relevant aspects.

1. A description of what the inquiry was about

This includes:

- the inquiry title / or engineering design problem
- a brief statement giving an overview of the investigation process used and should be a maximum of **1 minute**.

2. Evaluation of effectiveness of collaboration (IAE5)

Some of the following pointers may be considered by students when preparing for the evaluation of the effectiveness of collaboration and its impact on results/outcomes in the Collaborative Inquiry. Choose TWO or THREE to focus on!

Communication within the group, such as:

- Communication during and between meetings
- Record keeping
- Positivity

Leadership and involvement, such as:

- Leadership model
- Inclusive
- Contribution to the outcome

Collaborative Processes, such as:

- Decision making
- Goal setting
- Action plan
- Task allocation
- Shared responsibilities
- Opportunity for 'way out' thinking
- Democratic
- Evidence based
- Risk taking
- Problem solving
- Check points
- Finalisation

Deadlines

- Setting milestones/targets
- Adjusting deadlines

Conflict resolution

- Interpersonal
- Project related

The evaluation of collaboration should be a maximum of **4-5 minutes**. You may choose to either:

- Have a recorded conversation with your teacher, or another student
- Film yourself presenting using your laptop or camera
- Screencast your voice + evidence using QuickTime (recommended)

<p>A crowded basketball court with other practising players will interfere with one's own practise and performance.</p>	<p>Presence of a watching crowd would pressure and distract player, impairing performance.</p>	<p>Weather conditions can affect feet stability (in cases of rain and windy weather), therefore decreasing efficiency in performance.</p>		<p>Low arm positioning post shot would result in a low-ball arc. It is recommended that the elbow is positioned slightly higher than eye-level post-shot. As this would determine that wrist was properly positioned under the ball & a higher ball arc would have been produced which could lead to successful shots depending on distance & practise.</p>		<p>Foot alignment is important in a free throw for balance and power. Feet shoulder-width apart can either be aligned square on (in line with one another) or at a slight diagonal (with one foot slightly in front of the other).</p>
<p>How pumped up the basketball is. The ball is less likely going to go through the hoop if it does not have the optimal amount of air pumped into it. As without the optimal amount of air the ball would have less bounce. The NBA recommends the air pressure in a basketball to be between 7.5 -8.5psi (per square inch of area).</p>		<p>Surface material of basketball court: Basketball courts that are polished and made of hardwood flooring are ideal as it would allow for grip (stability) and can prevent injuries. Surface quality of basketball court: An uneven court can result in injury and increases fatigue – playing on an uneven court consumes more energy.</p>		<p>It is optimal for the face & chest to face the direction of the basketball hoop; as then the shoulders are in line. This prevents injury from overexerting the back shoulder in addition to making it easier to shoot a shot.</p>		<p>Individuals with a proper diet and sleep schedule will have more energy and are less likely to be injured. A balanced diet would ensure that an individual has enough fuel and energy pre and post-game to aid with their performance, recovery and repair. Adequate sleep will also improve cardiovascular health, memory/skill consolidation and decrease illness among other benefits.</p>
<p>Certain basketball shoe designs are made to offer benefits that would aid an individual in their shooting performance. These benefits can include comfort, ankle support, bounce/elasticity and grip.</p>	<p>Environment</p>	<p>Body positioning</p>	<p>What factors affect shooting accuracy in basketball?</p>			<p>Upper body control and strength in the arms guides the direction/angle the ball is heading towards. Power is needed to have the ball travel the distance to the hoop (power is also generated from the legs in addition to arms). This is especially needed for far distance shots.</p>
<p>It is recommended that the shooting arm should only be moving up when releasing the ball as this would improve the height of the ball. Moving the shooting arm back before release to gather power would overexert the upper arm and lead to injury. It is encouraged to gain power from lowering, to lifting the shooting arm before releasing the ball (all in one motion).</p>	<p>Equipment</p>	<p>Technique</p>	<p>Power/strength</p>	<p>Physical Health</p>	<p>Individuals with higher range of motion (ROM) and flexibility are less likely to get injured and have less muscle tension. Less muscle tension would allow an individual to perform more efficiently.</p>	
<p>An effective shooting release involves the wrist & fingers flicking 180° towards the basketball hoop while simultaneously extending the shooting arm upwards at an angle (towards the hoop).</p>	<p>With an effective shooting release, the ball in motion would rotate and bounce off the basketball rim softer meaning there will be less bounce. Furthermore, the rotation would keep the ball travelling a consistent straight path to the hoop.</p>	<p>Core strength will ensure stability/balance when in position to shoot. It can be beneficial in shooting posture which would in turn improve shooting performance.</p>		<p>Leg stability and strength is important in basketball shooting. This is as strength is generated from the legs – from the slight squat position pre-shot.</p>		

IAE1: Broad and detailed deconstruction of a problem. Student has identified a variety of factors that could be investigated and then provided detailed information on those variables as applicable to the question.

Journal Entry 1 – Week 5, Term 2

Friday 3rd we had a long double lesson in which we were able to be given a larger amount of time to brainstorm more ideas. The teacher gave us an Excel spreadsheet with inquiry ideas and as a group we allocated ourselves to one of the inquiry ideas each and drew a quick brainstorm of ideas, after spending a lot of brainstorming we finally came together with all our ideas as a group and sat down and discussed how we can use the brainstormed ideas to guide us on what we want to do. The chosen ideas we brainstormed were how foods are used to make plastic, how to shoot a basketball and yoga muscular flexibility. The only with concern with decision making being or other team member not being to participate at the moment of time so to allow her to contribute with the group decision we communicated through social media and Microsoft Teams which allowed her to participate with the group decisions, the form of communication will continue to be our source of communication for the remainder of the design and deconstruct. After the discussion as a group we then decided on going with the basketball idea but modified it a lot to be "how does external noise affect shooting accuracy in basketball" this then included a psychological sense in our practical. During this lesson we were also able to allocate time on discussing what type of errors could occur during the experiment and how it was going to be tested. At the end of all the planning and preparation we identified more group norms we wanted to incorporate within our group which were attendance, communication which has already been able to be applied through social media, Microsoft Teams and in person. The final group norm being respect such as respecting what one of our members has been going through and is still able to contribute and offering her time to take part although going through personal issues.

IAE5: Evidence of group collaboration taking place. Students collaboratively decided on next steps and where to next. How to keep a member informed as they were not available. This evidence supports the evaluation of collaboration in the recorded presentation (part B)

Table 1: Deconstruct planning table

Considerations	Aspects of the Question: What factors influence free throw shooting accuracy in Basketball?				
	Physical Health	Body Positioning	Crowd presence & External Noise	Equipment	Power/strength
Options	<p>The effect of sleep on free throw shooting accuracy in basketball.</p> <p><i>IV:</i> less than 6hrs (hours) of sleep vs. sleep between 7-9hrs <i>DV:</i> free throw shooting accuracy</p>	<p>The effect of leg width positioning on free throw shooting accuracy in basketball.</p> <p><i>IV:</i> legs shoulder width apart vs. participant preferred leg width positioning vs. legs 1m (metre) apart. <i>DV:</i> free throw shooting accuracy</p>	<p>The effect of crowd presence and external noise on free throw shooting accuracy in basketball.</p> <p><i>IV:</i> no crowd with noise cancelling headphones; neutral crowd; positive crowd & negative <i>DV:</i> free throw shooting accuracy</p>	<p>The effect of shoe support and type on free throw shooting accuracy in basketball.</p> <p>Normal shoes vs Basketball shoes <i>IV:</i> leather lace up shoes vs. running shoes vs. basketball shoes. <i>DV:</i> free throw shooting accuracy</p>	<p>Group of participants with proper strength training comparing with the participants with no professional strength training</p> <p><i>IV:</i> Different strengths of training <i>DV:</i> free throw shooting accuracy</p>
Questions to research	Why is sleep important in sport performance.	Is shooting accuracy dependent on body positioning? What body positioning improves shooting accuracy? Does a player's body positioning affect the strength in their free throw shots?	Does crowd presence worsen or improve free throw shooting? How does external noise impact a player's shooting performance?	What shoes are appropriate for basketball?	Who has more of a better shooting accuracy, person who goes to the gym vs someone who doesn't gym? Does a person with plyometric training has a better shooting accuracy?
Possible Hypothesis:	Person with more sleep is efficient to shoot better goals compared with the one that has less sleep	Person who has the proper shooting body technique is more likely to shoot better than person with their own comfort body positioning	Comparing with the positive crowd, negative crowd and neutral crowd, it is predicted that participants would have a higher free throw accuracy if they are wearing noise cancelling headphones and have no crowd present.	Person with proper basketball shoes is likely to shoot better compared to the person without proper basketball shoes.	Person with more power/strength is to shoot better than person with less power/strength.
Possible Limitations /Ethical Concerns	Possible limitation and Ethical concern are that everyone has different sleep schedules which impact our results.	-Improper body positioning can potentially lead to injury. -may be difficult finding participants -participants may vary in height; which may mean that a further width stance would not impact their free throw shooting ability as it would a person of shorter height.	Limitations that can be identified is the weather conditions. If the weather conditions are wet and slipper someone may get hurt or injured throughout the trial.	Using different basketballs in different trials may affect the results. If a basketball hits the rim of the hoop, it can affect the air pressure in the basketball which differ in our results. Uniform is considered to be a limitation. With the school uniform from past experiences, it is known to be uncomfortable with the long white t-shirt or the girl's school dress.	Ethical concerns can be identified is from the body posture. If the body posture is not right and too much strength is given to one shoot there maybe be certain injuries. Long term injuries or short term- pulled a muscle, cramp. Part of the experiment is to see how power affects shooting accuracy, which allows us to monitor how proper strength training (which should be done over a period time so muscles can be developed).

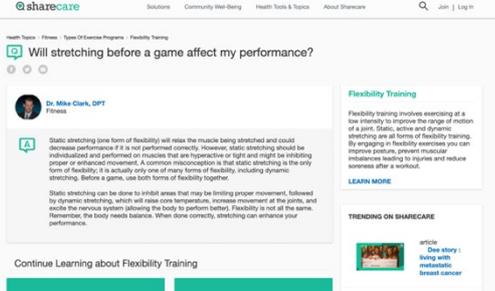
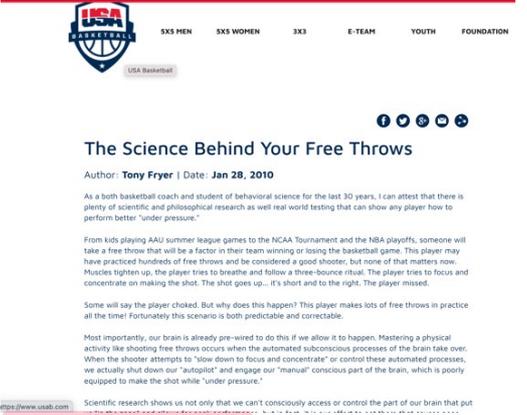
Justification:

The chosen independent variable is 'crowd presence and external noise' as during COVID-19 restrictions were applied in the sports community where fans were not allowed to attend the games. Which would mean that players would play without the distraction of crowd noise and presence as they would usually do pre-COVID-19. These chosen independent variables are representative to how the dependent variable can be impacted pre and during COVID-19. It was also chosen as this independent variable involves more sport psychology than the other independent variables.

IAE1: Logical deconstruction of the variables and questions to research. Detailed discussion and thoughts on benefits, limitations and ethical considerations presented. Limitations were varied and well considered.

Part A – ANNOTATED RESEARCH

Table 2: Annotated research

<p>You might think that skipping the warm-up when you work out isn't that serious. You only have so much time to get your work out in, so you think, "My warm-up was walking in here," and "I don't have enough time!"</p>  <p>Warming up is a significant component of your fitness routine, and skipping it could result in unpleasant and dangerous results. Muscle strains, muscle injury, and pain are just a few of them. In all honesty, a proper warm-up will actually advance your workout performance!</p> <p>Source 1: (Duncan, 2022)</p>	<p>This article is written by Ashley Duncan in 2018 who is a part of NIFS and is certified and degreed on fitness subjects going from workouts to nutrition. The information from this website explains why warming up is important for the body. Warming up prepares the body for activities that will be performed shortly after by increasing blood flow to the muscles. If the participants don't warm up, it will lead to their muscles being cold therefore not being able to stretch to their full potential, with a possible chance of pulling a muscle when performing specific actions.</p>
<p>What launch speed/how much force do I need when shooting?</p>  <p>What information revealed by Dr. John Fontanella in his book <i>The Physics of Basketball</i> shows that launch speed is determined by the amount of force you apply to get the ball to the goal. How much force is necessary is determined by your distance from the goal. For example, when shooting a 2-foot shot, you only need a launch speed of approximately 10 miles per hour. For a 3-point shot you need a launch speed of approximately 18 miles per hour. More force (speed) is necessary for longer shots to get the ball to the basket.</p> <p>Source 2: (The physics of free-throw shooting – Secrets of Shooting, 2022)</p>	<p>Coach Bob has over 20 years of basketball coaching experience. this article goes into depth on the mechanics to shoot a free throw. Distance and deviation are two physics factors that come into play when shooting a free throw. Two things determine distance: launch angle and launch speed. A 0-degree angle is when your arm is straight out and parallel to the floor. A 90-degree angle occurs when your arm is straight up and pointed to the ceiling. A 45-degree angle would be halfway between these two extremes. The appropriate launch angle for a slow-moving ball at the rim is determined by your distance from the goal and the release height of your shot.</p>
<p>Muscles Used in Shooting a Basketball</p>  <p>Source 3: (Muscles Used in Shooting a Basketball, 2022)</p>	<p>This article talks about the muscles that are being used while shooting. Basketball. The triceps are a group of large muscles on the backs of your upper arms. They have the anatomical purpose of extending the elbow. When your arm goes from a bent to a straight position during your shot, this action is seen. The shoulder muscles also play a factor because when you raise your arm to shoot, it activates the shoulder muscles. The exact muscles that are being used are the deltoids and the trapezius. The forearm muscles are also being activated when shooting because when the wrist is being flicked and the follow through with the shot.</p>
 <p>Source 4: (Clark, Undated)</p>	<p>This article discusses the importance of stretching before taking part in any shooting activities. The article indicates that stretching before shooting a basketball helps prevent injuries from occurring also allowing an individual to reach full potential when shooting the ball. It also states that flexibility increases the balance between muscles that allow you to have efficient movement and produce more force. This article is written by Dr Mike Clark, DPT chief executive of (NASM) the National Academy of Sports medicine. Therefore, the information gathered from this article will be used to assist on limiting any risks such as injuries that could happen during our practical and help on minimising factors that could have a negative impact the individuals shot accuracy.</p>
 <p>Source 5: (Fryer, 2010)</p>	<p>This article is written by tony, fryer who conducted work as a research biochemist in the department of biochemistry, at North Staffordshire Hospital NHS trust. Within this article it provides detailed analysis behind the science of free throws, providing in depth description on how someone's shooting form and accuracy is affected when put under pressure. also explaining the way your brain acts when put under pressure stating that the brain shuts down its auto pilot state and engages the manual state which has a higher chance of missing a free throw under pressure. This information collected from this article provides an understanding on how and why the different types of crowds might influence how someone's shooting accuracy may differ and get worse.</p> <p>KA4: The links between the relevant science and topic is detailed and communicated clearly, with effective use of terms and conventions.</p>

 <p>Source 6: (IBSA Basketball, Undated)</p>	<p>This source implies that the more strength and power a person has the be better they become at shooting, stating that the more weight training you do whilst also consistently working on your shooting the easier it will become to make shots from further out. Although, shooting a free throw isn't far from the rim it requires some sort of a of strength due to fact that you are unable to jump when shooting a free throw. Therefore, meaning you are not able to jump to get any extra momentum to generate enough power to reach the targeted distance which could be a result in bad shooting accuracy. This article/ program is written and run by former basketball professional Zelimir Stevanovic, who is highly educated on what factors make you a better shooter. This information could be reliable in looking at other factors that could influence how good or bad someone shot accuracy is.</p>
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Part B – DESIGN

Hypothesis:

Comparing with, the positive crowd, negative crowd and neutral crowd, it is predicted that participants would have a higher free throw accuracy if they are wearing noise cancelling headphones and have no crowd present.

Justification:

The presence of a crowd would impair a player's performance as crowd pressure which would include the output of negative and/or positive comments will cause confusion and anxiety in a player's free throw ability. This would inhibit a player's ability to focus, cause issues in communication between coach and player and result in poor free throw accuracy ¹. Considering the concepts of social facilitation (where individuals perform better at a task with the presence of others but only if the task is well practised & simple) and social inhibition (where individuals perform worse at a task with the presence of others due to the task being complex, unfamiliar and unpractised) the participants of this experiment are more likely to have better free throw accuracy if they are not distracted by external noise and peer pressure as the participants vary in experience and skill level in shooting free throws .

IAE1: Hypothesis is generally clear, but the justification provided is detailed and provides links to scientific concepts. Variables are clear with a detailed justification. Factors kept constant are logical and well defined.

Variables

Independent: conditions crowd behaviour and presence (no crowd with noise cancelling headphones; neutral crowd; positive crowd and negative crowd).

Dependent: free throw shooting accuracy in basketball (%)

Justification:

The occurrence of COVID-19 and COVID restrictions required sports such as the NRL to play their games without an audience and instead with artificial crowd noise in the background ². The independent variables were chosen as it models and represents an occurrence in the professional sports community during COVID restrictions. The no crowd variable with noise cancelling headphones shows how participants would perform without the pressure of a crowd and reduced distraction of external noise. The neutral crowd variable will show how participants would perform with the added pressure of a crowd that does not interact with the players and the positive and negative crowd variables will produce data showing how well participants perform with negative and positive output from the crowd.

Table 3: Constant variables table

Factors held constant.	How will it be constant	Justification
The basketball used	An experiment conductor will provide the basketball throughout the four-day experiment.	Different basketballs have different texture and touch this would have an impact on their shot and the results as different players are used to different ball textures.

¹ Topendsports.com. 2008. *Effect of Crowd Noise on Sports Performance*. [online] Available at: <<https://www.topendsports.com/psychology/crowd-noise.htm>> [Accessed 24 June 2022].

² Hinds, R., 2020. *New rules, no crowd, fake noise — footy is back as the vision of Peter V'landys*. [online] Abc.net.au. Available at: <<https://www.abc.net.au/news/2020-05-29/rugby-league-returns-from-covid-19-shutdown/12298446>> [Accessed 30 June 2022].

Scientific Studies – Collaborative Inquiry Folio

Number of participants in each group	New participants will not be included, and current participants will not be excluded from the experiment to keep the number of participants even in each group. To prevent issues relating to participant absence, back-up participants will be notified and considered.	The number of participants in each of the groups will need to be kept the same so that the recordings are all the same and the final scores for each type of crowd will be consistent.
The participants involved in each trial are the same	Participants will be notified of the time and day the experiment is conducted to avoid having to use back-up participants and/or recruiting new participants on the day.	This will need to be kept constant so that there won't be a fluctuation in the results (for example, if a participant went 8/10 and they got replaced for the next experiment, and the new participant goes 2/10). That will then be considered as inefficient data.
The setting	The basketball court chosen is usually free and not occupied. To ensure the court's availability the timetable of P.E. classes that may be using the court will be checked day before the experiment is conducted.	The court that will be used will need to be kept the same so that the participants get used to the environment as there could be some errors that could occur if the setting is changed (e.g. the height of the rim might vary from court to court).
The type of basketball shot conducted	Participants will be performing free throw basketball shots throughout the experiment each time.	The type of shot will need to be taken from the same spot as everyone else so that everyone shoots from the same distance making it a fair test.
Amount of air pumped into the ball	Balls will be pumped up the day before the experiment is conducted. The same number of pumps will be used each time.	This variable will need to be kept constant so that if the shot isn't a swish* and bounce around the rim, it will have the same amount of bounce as the other shots. * a swish is when the ball enters the hoop without touching the basketball rim or backboard.
Age	Participants of ages 16-25 will be used in this experiment.	The age range will need to be kept the same so that there are no physical advantages or disadvantages.

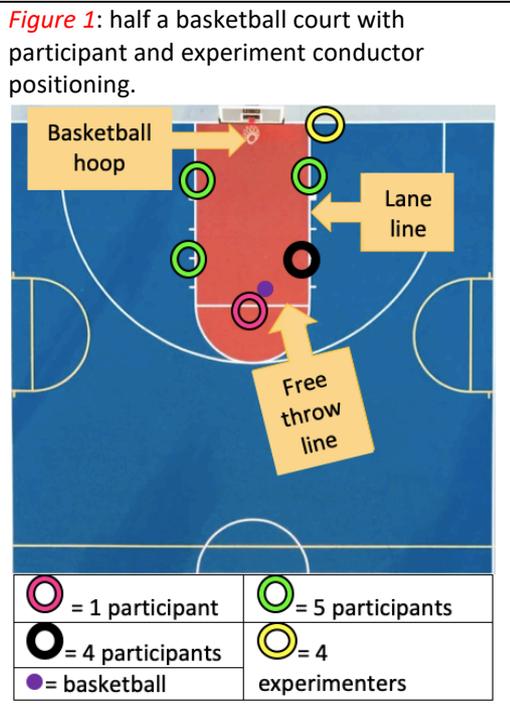
Table 4: Materials table

Materials	Justification
Basketball (x1)	-Basketball is needed for participants to shoot their free throws.
Whistle-optional (x2)	-A whistle help grab attention of the crowd & control when they start shooting their free throws.
Noise reducing headphones (x1)	-Noise cancellation headphones were used in one of our categories to reduce the distraction of external noise
Notebook & Pen (x1)	-A notebook and pen are needed to document the results and take note of any random & systematic errors.
Basketball hoop (x1)	-A basketball hoop is needed for participants to shoot their free throws.

Hazards	Precautions
Injury: pulling muscles, twisting ankles, getting hit by a ball.	-participants stretch before and after experiment; expectations on behaviour are briefed before experiment; participants stand at least 2 metres away from the basketball hoop to prevent getting hit by the ball.
Dehydration	-participants are recommended to bring a water bottle to each experiment trial
Wet weather conditions	-experiment days where the weather is forecasted to be unsuitable for testing will be postponed.
Health issues: Asthma	-participants bring their inhaler to all experiment trials

Method

1. Hand out information and consent forms to 20 selected participants and have the consent forms signed
2. Split the participants into 4 groups.
3. The first trial day is testing 'no crowd with noise-reducing earphones'.
4. Groups will be brought out one by one to reduce crowd presence and will be required to wear noise reducing headphones to reduce external noise from being a distraction.
5. Participants are briefed on the first trial and are led through a 5-minute warm before starting.
6. The participant going first will stand at the free throw line with the headphones on and the other participants will stand on the lane lines (view *Figure 1*).
7. Participants will shoot 10 consecutive shots when they are ready while the other participants wait at the opposite side of the basketball court for their turn.
8. Experiment conductors record each participant's results.
9. When the entire group is done bring out the next group and repeat step 6-7 until results for all groups are obtained.
10. The second trial conducted the next day is testing a 'neutral crowd'.
11. Participants from all groups are present, briefed on this second trial and led through a 5-minute warmup before starting.
12. The crowd is expected to not talk while the participants are shooting, only to watch.
13. Participants shoot 10 consecutive shots each.
14. Results are collected, and the second trial concludes.
15. Third trial conducted the day after tests a 'positive crowd'.
16. Participants from all groups are present briefed on this third trial and led through a 5-minute warmup before starting.
17. Participant shooting will be at the free throw line with a basketball, waiting participants are expected to watch, cheer and provide positive comments to the participant shooting.
18. Participants shoot 10 consecutive shots each.
19. Results are collected, and the third trial concludes.
20. The fourth trial conducted the day that after tests a 'negative crowd'.
21. Participants from all groups are present and are briefed on this fourth trial and are led through a 5-minute warmup before starting.
22. Participant shooting will be at the free throw line with a basketball, waiting participants are expected to watch, boo and provide (appropriate) negative comments to the participant shooting.
23. Participants shoot 10 consecutive shots each.
24. Results are collected, and the fourth trial concludes.



IAE1: Designed a well considered investigation. Scientific method is clear and consistent throughout. Some variation within regarding perception, however, overall would be easy to replicate.

Materials table is clear although some discussion on total numbers required for the investigation would be helpful

Journal Entry 2 – Week 6, Term 2

During this lesson we were able to identify some random and systematic errors that may have occurred during this experiment. Therefore after identifying some of the errors that could occur during the experiment, we decided to figure out some control ideas to try and keep the practical consistent which can be seen on table 3. We were also able to complete the method on how the practical was going to be commenced so that we were able to begin doing the practical and collect results. Before beginning the experiment, we had set out a date to commence a trial, so we had an idea what it was going to look like. During this lesson we also begun allocating people to their groups on which people would be in what groups when taking their shots.

IAE5: Evidence of group collaboration during the progress of the assessment. Student identified different requirements and stated group involvement. This should be discussed in the evaluation (part B).

Part C Reflection

Strengths and weakness:

Ethical guidelines:

Throughout this experiment, multiple group norms and ethical guidelines were put in place in order to encourage productiveness. throughout the experiment it was clear that the entire group was able to compile with the group norms considering this one of the strengths of the group. The ethical guidelines were set due to it being a mandatory element of the entire practical. This was highly important for our practical due to us conducting a practical that required a high number of participants meaning we required consent from participants to be a part of the practical also giving them the right to drop out of the experiment whenever they wanted to. To confirm the consent of the participants they were required to sign a consent form that stated during the time of the practical they were able to participate see (appendix 4). To try and comfort the participants on what they were signing for a quick explanation of what it was and what we were trying to achieve by doing this was given. participants were also informed that they were going to be allocated to different groups before participating due to any comfit that could occur as a result of the groups. Participants were also informed on how their names will not be used when evaluating results due to people being uncomfortable with sharing their results.

Experimental design:

A strength of this practical was how we were able to set up to try and limit any preventable errors, for example the experiment was spaced out between 4 different days of trials for each type of audience. This was done to prevent the practice affect from occurring during this practical. Which would have advantaged he trial that was conducted last. This was a weakness within the initial design of the practical. Although this experiment was conducted over a space of 4 days and not one to prevent the practice effect. It was still possible for the practice effect to occur over the 4 days so to reverse this we conducted a 2nd practical with the different trials in a different order, so that we were able to see if the practice effect was affecting the results.

Sample size:

To begin testing on which type of environment was best when shooting free throws, we had a sample size of 20 participants for each trial. According to (Ganti, 2022) This sample size is considered a weakness within our practical. To increase the reliability of the data the minimum sample size when involving participants was 30. This is because having more people doing the experiment gives more data when removing outliers which are people who could be a lot more experienced than others resulting in there results sometimes being a lot better than other participants. A weakness of this sample size is that it only contained one specific age group which were people between the ages of 16-18 which represents a small population as they could have been less experienced and reacted differently to the different type of crowds which is considered a weakness on the sample. However, a strength that was evident when organising the experiment was that the male to female ratio of participants was somewhat equal which represents a larger population than if we were to only have male participants.

Prior shooting practice:

When conducting the experiment, we didn't put into consideration that some of the participants could have had practice shots prior the experiment depending on the time the experiment was done at. For example, some of the trails were held after recess and lunch meaning some of the participants had played basketball prior taking their shots, which would then mean that they would have already had more practice than most of the other participants which could have protentionally allowed them to score higher than other people. A difficulty that we encountered as soon as we begun conducting the practical was that most of the participants wanted to take practice shots which were not allowed as it would create errors within the practical.

Environment and movement:

Our group was able to realise early into the practical that the environment in which the experiment was conducted in would influence the results as it may have interfered with the practical. For instance, it was clear that the environment and weather was out of our control so when conducting the experiment multiple people would complain that the sun or the wind was interfering with their shooting ability. Which was one of our weaknesses in a preparation towards the practical, this could have been solved by organising a time to use an indoor gym with a controlled environment which could have potentially resulted in better results to evaluate on.

Journal Entry 3 – Week 10, Term 2

At this time, we had finished collecting all the results for the experiment. However, when having conversations as a group, we realised that the order in which the experiment was conducted may have influenced the results due to the amount of practice. So, then agreed to continue with the investigation; however, the order of the different crowds will be reversed, and new participants will be used. That way, we will be able to have clear evidence of whether the order had an effect or not. This also will set us back 1-2 weeks to complete the entire experiment, so, to investigate within the due date, we had to make a strict timetable.

Ref: A1194913

KA4: Coherent communication with effective use of terms and relevant conventions.

IAE1: Discussion of participant consent and implications of this consent. Reflection on improvements to design method and weaknesses experienced.

Strengths and weaknesses were broad and discussed in depth.

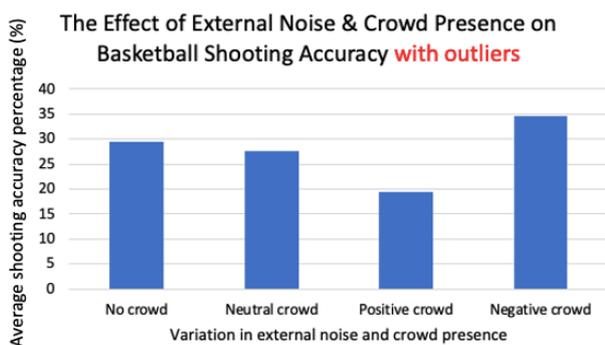
IAE5: Group discussion resulted in observations of error and impacts of this on the experiment. Collaborative decision made for improvement.

Part C Results

Results Table 1: **Experiment 1** table displaying the results in order of (No Crowd, Neutral Crowd, Positive Crowd and Negative Crowd) on shooting percentage on the free throw line, calculations of the percentages, standard deviation, with and without outliers

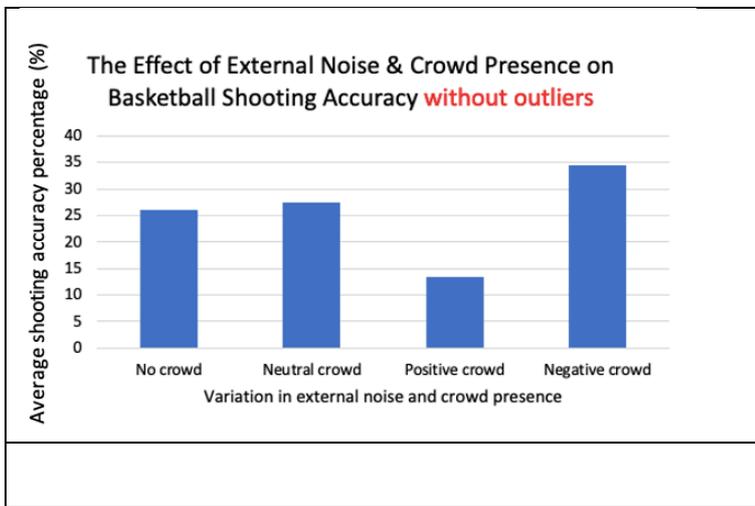
The effect of crowd presence and external noise on free throw shooting in basketball				
Participants (trials)	No Crowd	Neutral Crowd	Positive Crowd	Negative Crowd
A.G.S.	20%	20%	0%	30%
J.L.	0%	30%	20%	40%
A.D.G.	50%	30%	10%	20%
B.P.	30%	40%	20%	70%
L.R.	30%	10%	40%	40%
D.N.	30%	40%	0%	40%
N.K.	50%	30%	20%	20%
J.B.	40%	40%	30%	50%
B.N.	50%	60%	10%	30%
J.S.	20%	30%	0%	20%
J.N.	0%	0%	20%	40%
I.S.	50%	20%	10%	30%
N.J.	30%	10%	20%	60%
M.M.	20%	20%	20%	50%
L.B.	70%	50%	60%	70%
S.K.	0%	20%	10%	10%
M.D.	20%	20%	20%	10%
A.H.	30%	0%	10%	0%
S.B.	40%	50%	60%	40%
A.L.	10%	30%	10%	20%
Total Average with outliers	29.5%	27.5%	19.5%	34.5%
Total Average without outliers	26%	27.5%	13.5%	34.5%
Standard Deviation with outliers	18.567	15.772	16.576	18.835
Standard Deviation without outliers	16.493	15.772	10.138	18.835

Graph 1: Average basketball shooting accuracy with outliers in Experiment 1



Graph 2: Average basketball shooting accuracy without outliers in Experiment 1

The column graph demonstrates the results seen on the table in graphical form, visually displaying the percentage of shot average of each participant for each of the independent variables including outliers. It shows that negative crowd was the best environment for shooting free throws with a shooting percentage of 34.5%. the worst shooting free throw environment according to the results acquired was positive crowd which had a percentage of 19.5%. the results obtained through this practical show that no crowd and neutral crowd had similar results. No crowd 29.5% and neutral crowd 27.5%.



IAE2: Mostly accurate presentation of data with some format issues. Title of table should discuss the fact that they are recording accuracy of free throw and the "%" should be included as units at the top of the table. Outliers and SD are appropriate and provide accuracy.

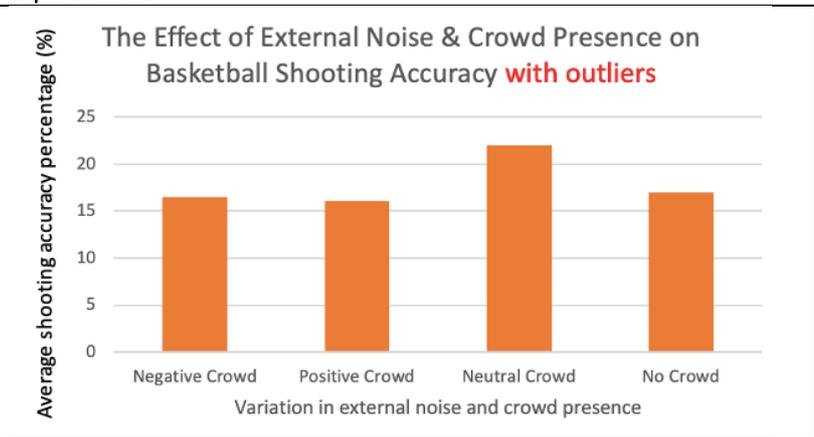
Graphical representation is accurate and appropriate. Units and titles are consistent and clear.

In the next column graph visually displaying the percentage of shot average of each participant for each of the independent variables without outliers. It comprehends that with outliers that negative crowded had the highest average shooting percentage (34.5%). It also shows that without the outliers that when there was a positive crowd people performed the worst shooting at a percentage of 19.5%. it also shows that the results for no crowded and neutral crowded were the most similar results throughout the entire experiment. Neutral crowded showing 27.5% shooting accuracy and no crowded 26% shooting accuracy.

Results Table 2: Experiment 2 in order of Negative Crowd, Positive Crowd, Neutral Crowd and No Crowd

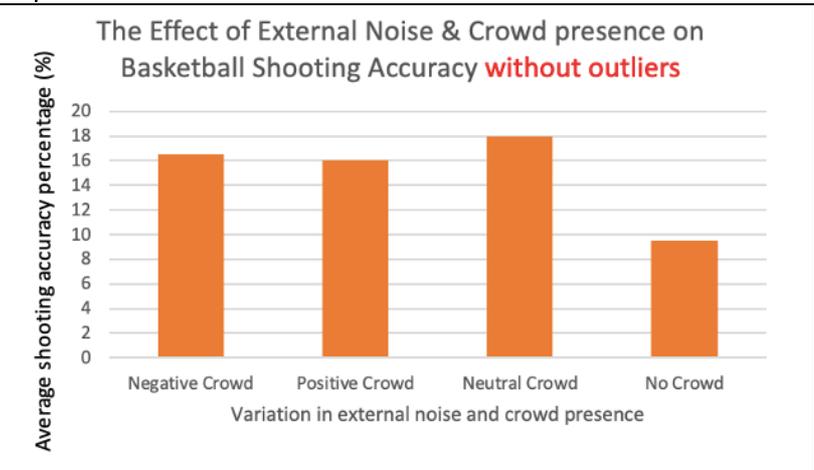
The effect of crowd presence and external noise on free throw shooting in basketball				
Participants	Negative Crowd	Positive Crowd	Neutral Crowd	No Crowd
M.S.	20%	40%	10%	70%
N.W.	10%	0%	40%	10%
M.E.	30%	20%	10%	30%
A.T.	30%	40%	50%	10%
T.P.	30%	40%	50%	0%
K.G.	0%	0%	10%	10%
A.C.	10%	10%	0%	10%
N.A.	0%	10%	0%	0%
I.E.	20%	0%	10%	10%
F.S.	10%	10%	0%	0%
C.K.	10%	10%	10%	10%
L.H.	10%	0%	0%	20%
C.D.	0%	0%	0%	0%
S.A.	40%	30%	50%	0%
J.L.	20%	30%	80%	80%
S.L.	0%	0%	20%	10%
A.A.	20%	0%	20%	0%
H.K.	20%	20%	50%	40%
M.A.	10%	30%	0%	20%
W.M.	40%	30%	30%	10%
Total Average with outliers	16.5%	16%	22%	17%
Total Average without outliers	16.5%	16%	18%	9.5%
Standard Deviation with outliers	12.359	14.967	22.935	21.932
Standard Deviation without outliers	12.359	14.967	19.165	10.787

Graph 3: Average basketball shooting accuracy with outliers in Experiment 2



The graph reads that with outliers included natural crowd performed the best with 22% from the free throw line. Following with no crowd averaging 17%. The independent variable the participants performed worst with was positive crowd with a shooting average of 16%. Just above that was negative crowd with an average of 16.5%.

Graph 4: Average basketball shooting accuracy without outliers in Experiment 2



The graphs show that the best environment to shoot free throws out of the four was natural crowd (18%), which was followed by negative crowd (16.5%). Followed by positive crowd which had an average of 16% and the worst environment according to the results no crowd (9.5%)

Part C Discussion

According to the results obtained by the first practical in the order of No Crowd, Neutral Crowd, Positive Crowd and Negative Crowd, it is clearly evident that people shooting when there was a negative environment were able to shoot the best as can be seen on table 1 that they had a free throw percentage of 34%. As people were able to shoot the best in a negative environment, the hypothesis stated 'it is predicted that participants would have a higher free throw accuracy if they are wearing noise cancelling headphones and have no crowd present' was not supported. Various research including research done by (USA Basketball, 2010) shows that practice on your own with no external noise and nothing present encourages better performances when shooting free throws. This is because of the fact that if a person is good at shooting free throws and have got a lot of practice before the brain is now prewired to be good at shooting free throws.

IAE3: Logical analysis of data with reference to support/ not support hypothesis. Justification with links to existing research effectively incorporated to support the analysis and discussion.

Mastering a physical activity such as shooting free throughs regularly happens when the automated subconscious takes over (Nowakowski & Brown, 2022). So that you are taking shots without thinking too much about your technique. However, when a crowd is put in place and an individual starts slowing down to think about how they will shoot they actually shut down the automated subconscious and now engage in a manual conscious which is not highly equipped to shot whilst under pressure(Breakthrough basketball , 2018). However, according to the results obtained after completing this experiment the first time this was not achieved, this may have been due to extraneous variables such as practice effect or also situation factors such as the weather and environment.

Reasonable conclusions drawn with logical justification.

Random errors may have occurred when conducting the trial (negative crowd) due to the high standard deviation compared to the other independent variables which was 18.835. this also indicates that the data collected when doing this trail had the most scatter, therefore this indicates that the results obtained for this independent variable was less precise. Table 1 also shows that the test that had the second highest average shooting percentage which was no crowd (29.5%) also had a high standard deviation with outliers, however when outliers were removed it was clear that the average shooting percentage had decreased to (26%).

IAE5: Connections made between outliers and potential errors, links also made to standard deviation.

Which indicates that the results had multiple of outliers in the upper bound which resulted in the results decreasing when removed. Which could have been due to the level of shooting ability of the different participants.

In graph 1 the graph displays that with the outlier's negative crowd had the highest shooting percentage which was 34%, following up with no crowd which had the second highest shooting percentage of 29.5%. neutral crowd had the third highest shooting percentage of 27.5% and the worst shooting percentage was seen when doing the positive crowd test which had a shooting percentage of 19.5%. however, in graph to its evident that when outliers were removed the order of which trail performed the highest shooting percentage had changed. The new order then changed to neutral crowd being second and no crowd being third. A second experiment was conducted due to the likeliness of the practice affect occurring during the experiment due to the order of which independent variable was conducted on what day. The thought of conducting a second practical with different people was brought up also because of a visible trend seen when evaluating the experiment. The trend was that as the experiment went on the shot averages with no outliers got higher and higher except the positive crowd which could have been due to the occurrence or a random error.

IAE3: Trends linked to data are logical and clear. Patterns which removed potential outliers explained and expanded upon.

According to the results collected from the second experiment in the order of Negative Crowd, Positive Crowd, Neutral Crowd and No Crowd shows that without outliers, when people were shooting with a neutral crowd it resulted in the best shooting average from the free throw line with a shooting percentage of 18%. And looking at the trend of the result which look mostly randomised with no visual trend that can be seen by looking at the graph which mean that the practice effect wasn't the cause of the trends in the seen in the results. The second best performing was the negative crowd experiment and the worst being no crowd which was the complete opposite of what was predicted in the hypothesis.

IAE3: Logical conclusion based on the impacts of data points and observations. This was also supported by the inclusion and justification of existing research.

Evaluation

One random error that occurred was the weather conditions at it was uncontrolled due to the experiment being conducted in an outdoor setting. An example of the of this error effecting the results can be seen in (appendix 1) which shows a list of observations made on the day and what was happening during the second experiment. It shows that on the day in where the natural crowd test was conducted had the best weather conditions except of for the fact the people complained about cold fingers, whereas the other days had the sun interfering with their shot and also the strong winds. This is evident and supported with the results as neutral crowd performed the best when doing the second experiment. Cold weather makes it harder for players to shoot due to it making them feel stiffer than usual, which would affect their coordination and flexibility (Farrugia, 2022) this would affect the precision of the results.

IAE4: Logical identification and implication of errors on data discussed in detail. Errors observed were supported by research which was referenced. Links between errors and precision and accuracy discussed.

Another random error that occurred which may have fluctuated the results was that before people took their shots they were shooting with the ball before calculating their results which may had resulted in them shooting better when taking their calculated shots. This error is unable to be confirmed with proof as it was not noted which player took practice shoots. However, I was able to find out from the participants themselves that two participants who took part in the first experiment played basketball moments before taking part in the experiment which was participant L.B and participant B.N which may have been the result in why they were one of the best shooters during the experiment.

A systematic error that may have occurred throughout this experiment that is not able to be confirmed or verified is whether the rim the participants were shooting in could have been off measure not being the accurate width size and not being straight due to people hanging off it which was not tested throughout this practical. The effect of this could be that if the rim was smaller than regular size it would make it a lot difficult for participants to make their shots (Wedlake , 2015) which would affect the accuracy of the results.

Another systematic error with the basketball hoop was that it was not the regular NBA hoop height which is 10 feet tall, and it was clear that the hoop that was being used for this experiment was not up to measure with accurate measurements so this may have affected the shooting accuracy of the participants. Making it easier for participants to end up with a higher shooting percentage with the lowered rim which would influence how accurate the results were.

Another systematic error that may have occurred throughout this practical was that the ball that was being used for the experiment may have been flat which is another factor that would have caused bad shooting, because we did not check how pumped up the ball was,

we are unable to verify whether this error occurred or not. The occurrence of a over pumped ball would result in the ball become to bouncy and would be hard to make a shot due to the ball bouncing to far it was to hit the rim, which would then mean you would be relying on luck for the ball to bounce in (Cremona, 2011), therefore affecting the accuracy of the results.

Peer review

Member 1 (A, H)	Never	sometimes	usually,	Often	Always
Participated in discussions and present during all lessons					A
Completed tasks by due dates					A
Listened to everyone’s contributions					A
Supported and helped other members				O	
Thought Critically and solved problems logically					A
Conducted experiment while considering safety and ethical guidelines				O	
Overall Reflection 8/10					

Member 1 tasks completed: Deconstruct mind map/brainstorm, design and gathering participants for second practical

This member was allocated to create a mind map table out of the ideas we had come up with in which she was able to complete in a timely manner which was also detailed and easy to understand. This member was very dedicated to completing her tasks on time and making sure the experiment was done according to plan. In the planning stage of this practical this member was able to come up with multiple suggestions and recommendations. This member had strong communication with the group as they were active majority of the time on all communication platforms which can visually be seen in appendix 2 and 3. This member strong dedication on completing every task supported the group in getting started and finishing this practical.

IAE5: The student recognised the need for communication, planning and commitment as part of the success of a team. Reflection of the team members participation was detailed and appropriate.

Member 2 (J, L)	Never	sometimes	usually,	Often	Always
Participated in discussions and present during all lessons					A
Completed tasks by due dates				O	
Listened to everyone’s contributions					A
Supported and helped other members				O	
Thought Critically and solved problems logically				O	
Conducted experiment while considering safety and ethical guidelines					A
Overall Reflection 7/10					

Member 2 tasks completed: annotated research and method

This member of the group complied with most of the group norms when it was time to produce work and ideas for the group. he was also able to voice some of their ideas when we were in the planning stage of this collaborative which was very beneficial to the group when it was time to come up with a final idea of what was going to be done. This member of the group completed all the tasks they were required to do however although it was a little bit late it didn’t affect anything to do with our final outcome. This member was here in majority of our lessons supporting and completing their work to a high standard. this member also took it into their own hands to provide some equipment that was required to commence and complete this experiment.

Member 3 (V, H)	Never	sometimes	usually,	Often	Always
Participated in discussions and present during all lessons					A
Completed tasks by due dates					
Listened to everyone’s contributions					A
Supported and helped other members				O	
Thought Critically and solved problems logically					A
Conducted experiment while considering safety and ethical guidelines					A
Overall Reflection 8/10					

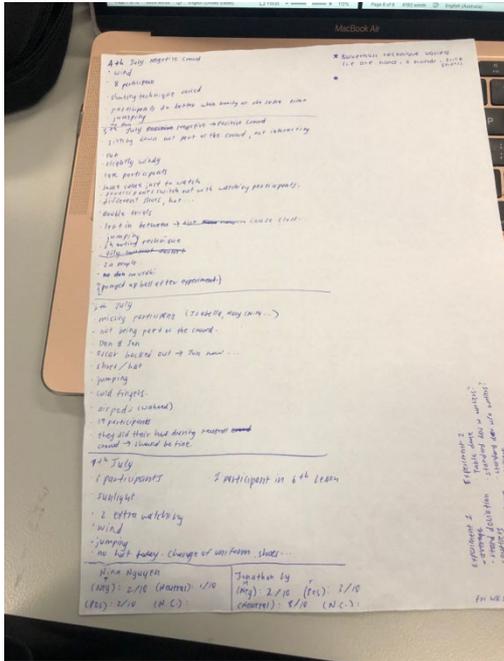
Member 3 task competed: deconstruct panning table, design

This member was not available for the brainstorming part of the design however when they were able to take part and participate this member worked very well with voicing ideas on what should and shouldn’t be done. Motivating the group to be very productive although this member recommended, we did tasks a lot faster which was hard at first, but due to this the

group was able to do a second practical to verify the results gathered from the previous one when analysing Our results. , this member complied with majority of the group norms however she had missed a couple lessons but was also to use our communication platforms

Appendices

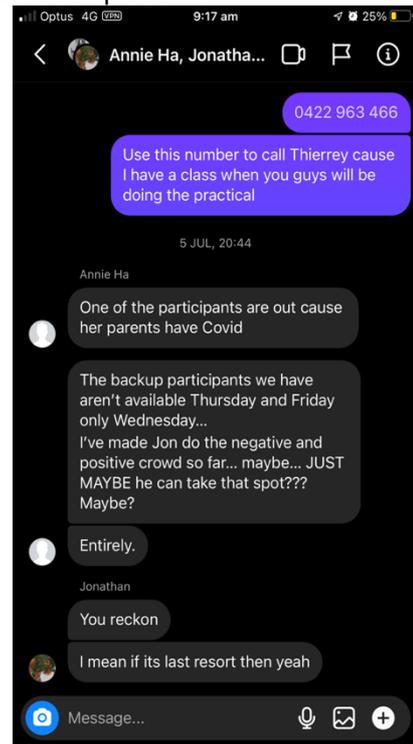
vely.



Appendix 1

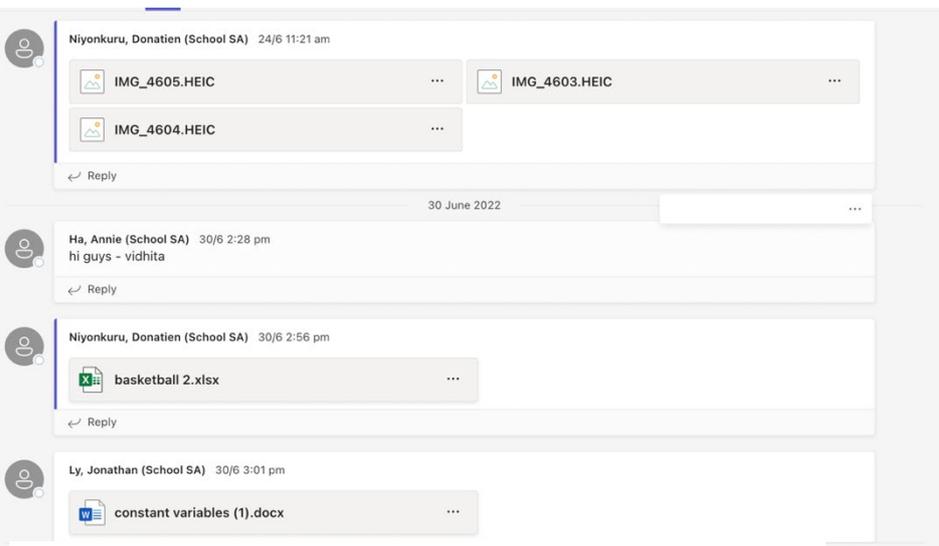
During this experiment we used a piece of paper to note down anything that may have affected the participants shooting accuracy on that day. This then made it easier to identify any random or systematic errors that would've disadvantaged the participants.

IAE5: Some of this information is featured in the evaluation in the recorded presentation and when commented on, would contribute to achievement in this task. However, evidence in the Appendices cannot be included in the assessment.



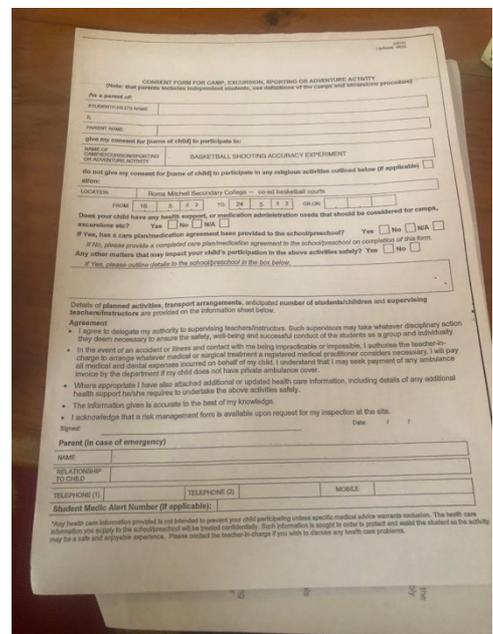
Appendix 2

this was our second form of communication used to inform participants what our plans were. This was also a lot faster at reaching group members because people are more on their phones at home



Appendix 3

this is an image showing how our group communicated which was done communicating via Microsoft teams. Microsoft teams was one of the most important sources of communication as it allowed us to share and distribute our different ideas, in order to resolve any conflict or confusion. It was also used to update any missing participants who weren't present on the day.



Appendix 4

This image shows the consent forms used to allow them to get permission from parents and teachers to leave class to participate within our experiment. This was required to make our experiment ethical.

References

Topendsports.com. 2008. *Effect of Crowd Noise on Sports Performance*. [online] Available at: <<https://www.topendsports.com/psychology/crowd-noise.htm>> [Accessed 24 June 2022].

Hinds, R., 2020. *New rules, no crowd, fake noise — footy is back as the vision of Peter V'landys*. [online] Abc.net.au. Available at: <<https://www.abc.net.au/news/2020-05-29/rugby-league-returns-from-covid-19-shutdown/12298446>> [Accessed 30 June 2022].

reyer, t., 2010. *The Science Behind Your Free Throws*. [online] Usab.com. Available at: <<https://www.usab.com/youth/news/2010/01/the-science-behind-your-free-throws.aspx>> [Accessed 12 August 2022]

Farrugia, S. (2022) *Tips for playing basketball in Cold Weather*, *Field Insider*. Available at: <https://fieldinsider.com/tips-for-playing-basketball-in-cold-weather/> (Accessed: October 22, 2022).

Wedlake, A. (2015) *Basketball Rim size cut in half for all levels*, *Basketball Manitoba*. Available at: <https://www.basketballmanitoba.ca/2015/03/basketball-rim-size-cut-in-half-for-all.html> (Accessed: October 22, 2022).

Cremona, J. (2011) *The effect of air pressure on the accuracy of a basketball shot*, *prezi.com*. Available at: <https://prezi.com/pvb3p8qpdhth/the-effect-of-air-pressure-on-the-accuracy-of-a-basketball-shot/> (Accessed: October 22, 2022).

Nowakowski, A. and Brown, K. (2022) *Understanding the science behind a successful free throw*, *WUWM 89.7 FM - Milwaukee's NPR*. WUWM. Available at: <https://www.wuwm.com/2022-02-08/understanding-the-science-behind-a-successful-free-throw> (Accessed: October 22, 2022).

Breakthrough basketball (2018) *How to overcome shooting slumps*, *Welcome to BREAKTHROUGH BASKETBALL*. Available at: <https://www.breakthroughbasketball.com/fundamentals/shooting/overcome-shooting-slumps.html> (Accessed: October 22, 2022).

Fontanella, J. (2017) *The physics of free-throw shooting*, *Secrets of Shooting*. Available at: <https://secretsofshooting.com/physics-based-basketball-shooting/> (Accessed: October 22, 2022).