National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

Exemplar for Internal Achievement Standard

Physical Education Level 3

This exemplar supports assessment against:

Achievement Standard 91499

Analyse a physical skill performed by self or others

An annotated exemplar is an extract of student evidence, with a commentary, to explain key aspects of the standard. It assists teachers to make assessment judgements at the grade boundaries.

New Zealand Qualifications Authority

To support internal assessment

	Grade Boundary: Low Excellence
1.	For Excellence, the student needs to critically analyse a physical skill performed by self or others. This involves drawing conclusions from the performance analysis about: • which parts of the skill have the greatest impact on performance • the factors that influence the person's ability to improve their performance of the skill. This student has drawn conclusions from the performance analysis about which parts of the skill have the greatest impact on performance. The conclusions link to the biomechanical principles used in the performance analysis (1). This student has attempted to draw conclusions about factors that influence the ability to improve the performance of the skill (2). For a more secure Excellence, the student would need to draw more detailed conclusions from the performance analysis about the factors that influence the person's ability to improve their performance of the skill.

Student 1: Low Excellence

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The swing is an executive movement made up of many sub movements, which combine and add together to give the overall ideal end result of the shot. Within both the overall executive movement and the sub movements there are many factors that have crucial influences on both movement and outcome of these. These factors may be biomechanical, environmental, emotional and physical. I believe the most important factor of the Golf swing itself is definitely biomechanics, as this is the basis or foundation for any efficiency and this is the prime way in which we can further or improve our swing. These biomechanical aspects require understanding, so that we can then manipulate them in practice and in real on course game...We must then break down the swing and ask ourselves to identify which line actually has the most impact on performance, and also improvement of efficiency of the swing.

Through the lines that we have been looking at as a class (structure, 3rd, 6th and 9th), it allows us to then take a step back and see if we can find any trends or evidence to help us answer reasonably and logically this question. The first is within research outside of golf, one website (www.golf-swing-magic.com/golf-downswing.html) states that, "The most important and critical area of the golf swing: The golf downswing. That with it we uncover the most common and at the same time most devastating flaws in golf. The peak of frustration is reached here because, no matter what has gone before it, this one move can make a greater difference in the result of the swing and the shot than any other." There is some truth to this statement in the fact that it can be the most frustrating line as this is what we naturally blame our shot's faults and weaknesses on. But In my own personal opinion I believe that we cannot pin point one crucial moment or aspect of importance within the swing that "can make a greater difference." Purely because golf as a sport is not about one movement or part of the body; instead it is the sequential combination of many parts of the body and many different movements put together. Some may argue that 6th line or impact is the most important part of the swing as it is the actual club to ball connection in which the main aim of the shot is technically complete. But what did it take to get to impact? What does it take to create accuracy at this impact? What comes after this impact that helps us finish out our movement? The answer is easy, each of those lines inter-relate to give the overall importance and impact of performance. We only need to take a look through the strengths and weaknesses stated previously in the slides to see the relationships between the stages of the lines and their impact on each other. A direct example of this is found in 6th line of the student's shot, his weakness of having cramped arm space and limited control, was due to a completely different weakness found on 3rd line. The cause was having inaccurate rotation of his core and trunk and also bad sequencing of force summation in that line 3 previously as stated.....This also adds to my point that these other lines in the follow through after 3rd and 6th line should have been able to be just as important to fix or even make an impact on these weaknesses.

1

… Going back to the point of biomechanics although, I do agree that this factor (excluding the actual lines of the swing), is extremely important and does have a major impact on both the executive, overall performance and the smaller more defined aspects of the swing.... The quantitative biomechanical data needs to be interpreted by the bio mechanist and translated into coaching points for golf professionals and coaches." I believe that this statement is fair, but much like the different lines in golf there cannot be only one biomechanical principle seen as being the most important. This is because each principle inter-relates... example of these principles inter-relating within the student's swing, is when his lever (the golf club) is in an effective position in relation to his body and this then positively effects his stability for the rest of his swing…… . But

1

we must ask the question; would all that focus on only one principle allow for overall improvement of the executive movement? Or would it hinder progress of those biomechanical principles that are less focused on? This again comes down to that question of which has the most impact on the swing, and the answer is simple, they are all inter-related and equally important and influential. If you took one of these principles out of the swing, e.g. stability then I know for a fact that the rest of the principles incorporated into the swing would be hindered and affected greatly.

… The next all important question, is surrounded and seemingly answered by a cloud of different opinions, beliefs and skepticism… our modern day society technology is so far developed and there is such a massive importance placed upon the use and incorporation of it. So it is no surprise that in sport, modern and sophisticated technology has been mixed with our own physical human technology that which comes naturally. Within our school we are extremely lucky with the resources around us, which enable us to delve deeper into technological evaluation and critiquing of our chosen sport of golf. As with every great debate there come the pros and the cons of the use of technology, but right from the beginning of our own unit we definitely saw the pros and benefits. Take the golf academy itself for example, beautiful environment, resources and most importantly up to date software that allowed us to slow down our partners swing for evaluation.

The first use of technology was in the videoing of our first initial swing, thus giving us raw and real data to work …Technology allows for us to move a lot faster with every task that we do, it means we are not always relying on natural forms of sometimes inaccurate or un helpful feedback, but instead gives us a way of logic and science to look at it. Research on two key websites www.forbes.com/2009/03/25/high-tech-golf-technology-lifestyle-golftech.html and http://www.golftec.com/ shows beliefs in this great use of technology. Stating that, “Choose the right technology, and you can indeed lower your score, lengthen your career and simply have more fun.” also that “An objective analysis using video and motion measurement, have seen learning rates becoming dramatically accelerated with visual feedback that positively reinforces new swing habits”

2

…where the risks or cons come into play with technology. .. technology can only go so far, but the human mind and eye can go so far and beyond this task and actually bring in creativity and opinions into the task. We can bring emotion and direct feedback from the moment a task was carried out or a shot was hit, non-technological improvements can be instant and beneficial easily. Whereas we may forget to take in factors of emotion or even environment when dealing with technology, there may be no reasoning or special considerations made, all that can help is there in the math's and numbers of the technological data and feedback.

2

	Grade Boundary: High Merit
2.	For Merit, the student needs to analyse, in depth, a physical skill performed by self or others. This involves: • discussing how the biomechanical principles inter-relate to improve the performance of the skill • using this discussion to provide feedback and/or feed-forward to the performer with the intent of improving their performance of the skill. The student has discussed how biomechanical principles inter-relate to improve performance of the skill (1). The student has used this discussion to provide feedback (2) and/or feed-forward (3) to the performer with the intent of improving their performance of the skill. The student has drawn some conclusions from the performance analysis about what parts of the skill have the greatest impact on performance and why they are important (4). To reach Excellence, the student would need to draw conclusions from the performance analysis about: • other parts of the skill that have the greatest impact on performance • the factors that influence a person's ability to improve their performance.

Student 2: High Merit

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Torque is created when the force is applied. In the student's case this is the magnitude of the force generated by the use of her muscles and the acceleration of the body parts during the swing (f = m x a). The student ensured she has created long levers for herself by extended her elbow joint (tricep being the antagonist and the bicep being the agonist) to ensure the lever is at its maximum length. We know that the longer the lever (arms and club) the greater the speed of the club head will be at the point of contact with the ball. You can see from the student's performance that she is using the principles of torque, Newton's laws, and levers to effectively influence her performance. **1**

…projectile motion acts upon any object that is released into the air. Once in the air, the object has two forces acting upon it at release. These are horizontal and vertical. They determine the flight path and are affected by gravity, air resistance, angle of release, speed of release, height of release and spin (Pg. 3 of *sport biomechanics ppt.)* Speed of release is relevant in this part of the swing as the momentum lost by the golf club is equal to the momentum gained by the golf ball at impact. This means that the momentum that is being gained by the golf ball is equal to the momentum that is lost by the golf club. To ensure maximum momentum (Mo = m x v) is gathered to then transfer to the ball (name removed) has concentrated on also applying the principles of force summation. Larger body parts/muscles, which have the most inertia are used to begin the movement, through to smaller body parts/muscles last. The gluteals, hamstrings and quadriceps of the lower body are employed first, through to the muscles of the trunk (erector spinae, rhomboids, rectus abdominus) through to the arms (deltoids, biceps, triceps) and lasting the wrist (extensors and flexors). As the student's swing looks smooth you can tell she has used the muscles sequentially, with correct timing, ensuring the previous muscle group has contributed fully before the next muscle group begins. The student realised she could not change her mass, but she could change the amount of force generated by using her muscles effectively. This coupled with the arm swing (acceleration) affects the speed of release aspect of projectile motion. In this part of the golf swing, the factors that affect the projectiles (ball) flight path are speed of release, force summation and transfer of momentum. **2**

Strengths: The club head has made impact with the ball at a good speed of release to allow the ball to gain loft and gain good distance.

Weaknesses: The shot does not go straight. This is where the application of biomechanics has not worked in the student's favour. Because she concentrating on gathering maximal momentum to aid speed of release/impact the accuracy of the shot has been effected. **2**

She needs to adjust her body position and lever length. Firstly she needs to move her grounded feet further forward so that the ball is within her BOS. This then will make her more stable as she does not have to move her LOG so far out of her BOS. **3**

To get maximum force applied onto the ball, this performer needs to straighten her arms out to make the lever length longer than it originally was (through extension at the elbow via contraction of the agonist – tricep and relaxing of the antagonist – bicep). She also needs to make sure this arm length does not change in the process of the swing otherwise it will affect the velocity of the club which then affects the accuracy of the shot. **3**

Newton's 1st law is also applied here as the golf ball will remain at rest until another force has acted upon it. The amount of momentum and force behind the golf club will determine the acceleration and speed that the ball will travel at.

…come to the conclusion that the aspect holding the greatest impact on performance for my student from their performance analysis is the preparation phase. The preparation phase is extremely important in beginning to master the golf swing as it involves setting up the stability and balance, the levers and the control of the club. … The stability and balance considers both base of support and centre of gravity which prevent the player from overbalancing and toppling over when trying to get good rotation to increase momentum and force, which will need to be generated on the downswing through to impact. This is important as force behind the ball is important to get distance and speed behind the ball.

4

Levers are important in the golf swing also as they are what creates the power at impact and torque which is the turning force. Torque is required for a successful golf swing as it is the maximum rotation that is gained within the swing and the power that is gained by the rotation. But as mentioned before, I believe that levers are the most important part of the golf swing as it is what produces torque, rotation and power. All of these are what a golf swing requires to get maximum distance and a controlled golf swing with good rotation. However, to be able to use levers successfully, good stability and balance is required, to prevent over balancing. These two biomechanical principles are the foundations of the golf swing as they make it possible for other biomechanical principles to be used. This is why I believe that preparation phase is so important as it is the set up at which all of the important components are considered and are intertwined within the set up.

However projectile motion is also very important as it determines the flight path of the ball and this is important as the flight path is what determines the score that the player will get. Projectile motion is considered at impact because the angle and speed of release at impact affects the projectile (the ball) and its motion. The impact of the ball begins the process in which gravity and air resistance begins to act on the ball and its speed. These biomechanical principles within these two parts of the skill, I consider the most important biomechanical principles in a golf swing.

	Grade Boundary: Low Merit
3.	For Merit, the student needs to analyse, in depth, a physical skill performed by self or others. This involves: • discussing how the biomechanical principles inter-relate to improve the performance of the skill • using this discussion to provide feedback and/or feed-forward to the performer with the intent of improving their performance of the skill. The student has explained the parts of a physical skill using biomechanical principles (1). The student has briefly discussed how biomechanical principles inter-relate to improve performance of the skill (2). The student uses the performance analysis and biomechanical principles to provide feedback (3) and/or feed-forward (4) to the performer with the intent of improving performance. For a more secure Merit, the student would need to provide more detailed discussion on how the biomechanical principles inter-relate to improve the performance of the skill.

Student 3: Low Merit

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In the preparation phase…the joint angle at his knees is too high therefore he needs to decrease this angle by about 20 degrees which will effectively lower his centre of gravity. By moving the joint from a position of extension to being more flexed this will influence his stability and base of support. The centre of gravity is the point at which all parts of the body are in balance or the point at which gravity acts through or about due to his knees being too straight (extension) the top half of his back has rolled over and does not remain in one long straight line. He has had to do this so the club aligns with the ball. However by doing this he has moved his line of gravity forward toward the edge of this base of support making him less stable. I feel he would be much more comfortable if he popped at the knees. This will all contribute to a better base of support, centre of gravity, and maintain his weight evenly throughout the body assisting to the line of gravity. Overall aiding his balance and overall performance producing an efficient and accurate golf swing. This is because we need a stable base through which to …

1

On contact, some momentum is transferred to the ball and it begins its flight path (becomes a projectile following a parabolic path). Any object that is released into the air becomes a projectile and has a number of factors that will predetermine and affect its flight path. All projectiles have two forces at the point of release, horizontal and vertical. These forces determine the flight path and time depending how they are affected by variables such as gravity, air resistance, angle of release, speed of release, height of release and spin…increased speed of impact will give greater distance…this is why for the tee shot and fairway drives we use longer clubs. By using a longer club we have lengthened the lever. The club head now has a greater arc to travel and can generate more speed. At the point of contact with the ball we will now have reached maximal speed of release which by way of a combination of lever length, and speed of release, will mean the ball will travel further… In the photos we see the student's body bowing and he is playing the shot more like a cricket shot, this may mean he is trying to 'help the ball up' by lifting the ball with the club, his arms are bent and he has not held a 'Y' shape at connection. This causing him to get under the ball too much, and causing a slice or back spin on the ball. This limiting its distance travelled due to height gained and back spin or slice (air resistance). To help us with the angle of release we also use a tee. This helps us to get under the ball (without bending our arms) to create a 45 degree angle of release. This is the ideal angle of release for maximum horizontal and vertical distances when the take off and landing points are equal, as they are in golf.

…the range of motion generating large forces on contact with the ball. The extension at the joint and swinging of the arms forward contributes to muscles being at optimum stretch allowing for optimum force. This will also allow the greatest possible range of motion through which body parts can move to allow for greater forces to be generated (I have explained the principle of force summation in detail later on in this analysis). If the student's arms for example are not fully extended as we see here in this photo, then he is not allowing his arms to go through the full range of motion and therefore not getting optimum force upon contact with the ball…by increasing the length of your arm and club combined (your third class lever) you are going to get greater speed at impact because the lever is longer. This is because by increasing the club length you are going to have greater acceleration at the extremity/end of the club. You will therefore hit the ball further. We can see here again has extremely bent arms and hunched at the shoulders, at contact he is not reaching his full potential, full range of motion and full extension of the arms and body (force

3

summation). Because he is not getting the best acceleration or club speed when making contact with the ball he is not producing the optimum momentum or force he could possibly apply to the golf ball. Inhibiting him from transferring this force summation to the ball, which in turn reduces the distance the golf ball will travel.

The feed forward I would offer here to improve the student's execution would be to again look at his posture/stance, relaxing through the torso, arms, shoulders (trapezius, deltoid) and back (rhomboids). This will give him more range of motion and allow freedom to fully stretch (extension) out to attain a longer lever

4

…we see the student has generated momentum, force summation, from the ground through to the feet then the gastrocnemius, bicep femorus (hamstrings) gluteus maximus, rhomboids, external deltoid to name a few muscle groups. The force summation begins at the feet and transfers through the body. The crucial part is getting (timing and sequencing of the right muscle groups/body segments, stretch and range of motion) it all right. The student's force summation is still impacted from his set up and the tension in his shoulders. ..

3

The greater the force that can be applied to the ball the greater the acceleration of the ball will be. By using correct force summation timing, sequencing, body segments, stretch and range of motion, large forces can be generated that will be passed on to the ball e.g. anterior deltoid through to bicep through to forearm, allowing (name removed) to play to his optimum potential.

2

	Grade Boundary: High Achieved
4.	For Achieved, the student needs to analyse a physical skill performed by self or others. This involves: • breaking the performance of the physical skill down into component parts • explaining the parts using biomechanical principles • using the performance analysis and biomechanical principles to provide feedback and/or feed-forward to the performer with the intent of improving their performance of the skill. The student has explained the parts of a physical skill using biomechanical principles (1). The student has used the performance analysis and biomechanical principles to provide feedback (2) and/or feed-forward (3) to the performer with the intent of improving their swing in golf. The student has attempted to discuss how the biomechanical principles inter-relate- to improve performance of the skill (4). To reach Merit, the student would need to discuss in more detail how the biomechanical principles inter-relate to improve the performance of the skill.

Student 4: High Achieved

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Because of student's height it would be beneficial for him to get a longer club (if possible) this would not only lead to a more comfortable body position, but the extra club length would mean he had a longer lever. Generally speaking a longer lever will result in greater speed and hence resulting in the ball travelling a greater distance. This is because the club will travel over a longer distance (arc), with the club head having more time to gain speed. By the time the club head makes contact with the ball it has generated maximal speed to then make the ball go further. This means he can get more torque through the club (force multiplied by distance) and thus transfer more energy through the ball, meaning the ball would go further for the same amount of effort put in. **4**

…the momentum for the shot is transferred through the legs and hips, the larger muscles (gluteals, hamstrings and quadriceps) through to the smaller ones in the arms and wrists (biceps, triceps, wrist extensors and flexors) as dictated by force summation. Maximum force will be generated by each body part/muscle group contributing to its full potential before the next muscle group then contributes. This is known as sequential summation of forces. **1**

By having his body slouched the student is limiting himself to the amount of momentum he can transfer to the ball as the line his body follows will be unnatural and not correct in terms of the optimal golf swing.
…by contacting the ground the student has also reduced the amount of energy that he can transfer to the ball, as it is being lost in the ground. Because momentum is defined as mass multiplied by velocity by hitting the ground before contacting the ball the student has greatly reduced the amount of momentum he is able to pass on to the ball, this in turn will mean the ball does not travel as far

…needs to work on in relation to force summation is more related to his finishing off of the stroke. By finishing the stroke properly the student should find he is able to transfer more of the momentum he gains through the forward swing into the ball as, by continuing the stroke into the 'follow through' more momentum is conserved through the motion. Because more velocity is maintained at the moment the ball is contacted this will mean the ball will go further. The easiest way to achieve this is to continue the motion right through to the finish position, as shown in the ideal. This will result in a much more efficient shot and will probably mean the ball goes straighter. **4** **3**

…evident fault is the swing. They do not use muscles in the correct sequence *therefore by applying the theory of sequential summation of forces, are* limiting the force that can be generated into the hit. The largest muscles must be used first through to the smaller muscles. This means my performer needs to rotate at the trunk, using leg (quadriceps and hamstrings), hip (gluteals and hip flexors) and trunk muscles (abdominals and erector spinae) to generate the initial force… **2**

…because they do not shift their weight and rotate most of the power is only coming from the smaller muscle in the arms (biceps and triceps), thus minimising distance gained toward the target (team member). They are concentrating on swinging down quickly with the arms rather than focusing on power initially being generated from core muscles

…needs to rotate hips, uncoil chest, rotate shoulders, then arms move in an arc through to finally smaller movements of the wrist… **3**

	Grade Boundary: Low Achieved
5.	For Achieved, the student needs to analyse a physical skill performed by self or others. This involves: • breaking the performance of the physical skill down into component parts • explaining the parts using biomechanical principles • using the performance analysis and biomechanical principles to provide feedback and/or feed-forward to the performer with the intent of improving their performance of the skill. The student has briefly explained the parts of a physical skill using a range of biomechanical principles (1). The student has used the performance analysis and biomechanical principles to provide feedback (2) and/or feed-forward (3) to the performer with the intent of improving their performance. For a more secure Achieved, the student would need to: • explain in more detail and accuracy the parts of a physical skill using biomechanical principles • use performance analysis and biomechanical principles to provide more detailed feedback and/or feed-forward to the performer with the intent of improving their performance. For example, the student could address why biomechanical principles are important for improving performance.

Student 5: Low Achieved

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The student's legs are too wide compared to where his shoulders are so his base of support is too wide. His body is not stacked correctly the result of this is means he is not vertically aligned. His back foot is also slightly opened

The student's base of support is too wide and doesn't line up with his shoulders this means he can not get as much rotation through the hips as possible and he will only be using his shoulders to attack the ball. With the student's knees not being popped there is more resistance to his forces of rotation as the student is transferring his weight from his neutral stance up into the backswing, so his transfer of energy will be decreased and will also restrict the rotation through the hips. The reason the student wants to have his feet wider apart is he is not comfortable with the relatively narrow base of support required in golf.

1

The student has not popped his knees so he is more upright and unbalanced so his swing through will have less acceleration therefore he will be hitting the ball with less force and the ball will travel with less distance and accuracy. The student being unbalanced will also affect his precision and consistency… His left foot has come of the ground and this has decreased his balance which decreases his ability to apply maximum force to the ball

The student has raised his back foot off the ground the effect of this is he will lose his balance and therefore he is unable to exert maximum force as he strikes the ball. With the student having his left arm bent this shortens his lever length and also effects the angle of his wrist (fulcrum), this causes the student to reduce torque forces that can be produced in the down swing of his shot. When the arms are at full extension we have increased length of the lever, so the speed of the club head and then the transfer of energy on impact to the ball could be more. This is because a longer lever has a longer distance to travel over which momentum can be gathered. This momentum at point of impact could result in the drive going further.

The student has rolled his wrists and opened the club face which effects the direction and velocity of the ball (commonly known as slicing the ball). The student has the angle of the club very steep so the angle of release of the ball will be quite flat so the ball will not travel as far as possible.

The student shoulders haven't fully rotated this means he is not creating as much torque forces as possible, he hasn't followed the whole way through which reduces the full transfer of energy created from the rotation of the down swing… The student needs to rotate the whole way through the shot so that he can create more torque forces because he hasn't followed the whole way through this reduces the full transfer of energy created from the rotation of the down swing.

3

The student appears to be rolling onto his front foot so he doesn't seem balanced which could be another reason he hasn't been able to rotate the whole way through.

If the student can follow the whole way through then he will be able to apply more force to the ball and this will mean more distance travelled by the ball ... the student has his base of support too wide this results in him not being able to get as much rotation through the hips, this will cause him to not be able to generate as much power in his shot so when he transfers that energy onto the ball it wont be going as far as it could possibly go. So if the student narrows his base of support the end result could mean a shot that makes the ball travel further

2

3

	Grade Boundary: High Not Achieved
6.	For Achieved, the student needs to analyse a physical skill performed by self or others. This involves: • breaking the performance of the physical skill down into component parts • explaining the parts using biomechanical principles • using the performance analysis and biomechanical principles to provide feedback and/or feed-forward to the performer with the intent of improving their performance of the skill. The student has briefly explained the parts of a physical skill using some biomechanical principles (1). The student has used the performance analysis and biomechanical principles to provide some feed-forward with the intent of improving the skill (2). To reach Achieved, the student would need to explain in more detail the parts of a physical skill using biomechanical principles.

Student 6: High Not Achieved

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Golf drive
Structure/Set up of the golf shot

Strengths (Feedback)

With the student having a wide base of support this will enable him to be very balanced, this will make his centre of gravity more stable so when he takes a shot he will have a strong base before torque comes into play. The student is holding the club correctly and the club head is sitting directly behind the ball and he appears to have his weight on his left side, so he will be able to transfer force from the left side to the right through the rotation of his hips and shoulders and accurately strike the ball

1

Weaknesses (Feed forward)

and if the student moves his feet closer together then he will be able to get more rotation through his hips and still be balanced enough to execute the shot. The student should pop his knees some more so that when he moves into his backswing he can accelerate faster and this will enable (the student to create more force then apply this onto the ball.

2

3rd Line / Downswing phase

Strengths (Feedback)

The student has shifted his weight onto his right leg so when there is a change in direction (backswing to downswing) he will be able to accelerate the club quickly, because force is equal to mass x acceleration, by increasing his acceleration he is also increasing the force he exerts on the golf ball . As the force on the golf ball is increased its distance travelled is maximised. For the student to apply maximum force to the golf ball he has to use a full range of motion to get this maximum acceleration which he is doing well

Weaknesses (Feed forward)

When the student is at his 3rd line he needs to straighten/extend out his left elbow this will mean that he can create a longer lever. The student should try and keep his front foot on the ground so that he is more balanced and then he can accelerate faster towards the ball resulting in more force applied to the ball and more force means the ball will travel further

2

Again both of the student's arms are bent, if he straightened them he could create a longer lever and generate more force to, so his ball could have the potential to travel a longer distance. The student's back foot has started to come off the ground when he is making contact with the ball so he is not perfectly balanced so he can't apply all that force he has generated to the ball