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A COMPARATIVE ANALYSIS OF BADMINTON GAME INSTRUCTIONS EFFECT OF NON-LINEAR PEDAGOGY AND LINEAR PEDAGOGY

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ABSTRACT

The recent implementation of TGfU pedagogy among Malaysian schools game curriculum challenging teachers who are comfortable with technical-skill driven Linear Pedagogy (LP). This conundrum led to this quasi experimental pre-post-test design study using n = 56 students aged 13±.23 years old investigated Non Linear Pedagogy (NP) and LP models using badminton curriculum in terms of tactical decision making, recovery movement to base, skill execution of drop shots and smash in badminton doubles game play. Findings, as for tactical decision making, recovery to base, drop shot and smash in doubles game play, *ANCOVA* and *ANOVA* statistics indicated significant improved performance via NP compared to LP. Conclusion, implementing NP in schools would further strengthen TGfU as teachers can adjust tactics, skill tasks to the performer's abilities and situated learning environment

Keywords: Linear pedagogy, Non-Linear pedagogy, badminton, skill execution, decision making

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1. INTRODUCTION

1.1. Introduction and problem background

Game-based pedagogical model of Teaching Games for Understanding (TGfU) and Constraint-Led Theory (CLT) from ecological perspective of motor learning approach gaining significant attentions lately among Physical Educationist, researchers and theory generator [7,25].TGfU a game-based approach through its pedagogical principles representation and exaggeration considered as a Non-linear Pedagogy (NP) approach [32]but in essence TGfU considerd student's centered tactical approach of learning games [24,26,28]. Whereas CLT proponents proposed that Non-Linear Pedagogy is a student centered skill learning rather tactical learning approach. In the lens of motor learning exponents sees that learning in Physical Education (PE) especially learning games and human learning as a non-linear process. As they see it skill execution is the centre of PE game learning couple with technical and social development. NP is a learner-centered to skill acquisition as the central tenants of teaching that uses task and environment design to develop skill acquisition. Students learns through exploration, practice play that both movement co-ordination solutions and decision making can be learnt and enhanced [5].

However, merging these two approaches: TGfU a tactical centered learning approach and CLT as a skill or technical centered learning approach under the roof of one holistic NP still premature in research or being practiced in game play especially in Malaysian PE game curriculum. One the other hand, the Malaysian PE curriculum lately moving towards standard based curriculum and introducing TGfU as their main game based instructional approach. Whereas the skilled-centered teacher's approach or linear pedagogy (LP) primarily, underpinning positivist epistemology of behavioral psychology and dwelled around behaviorist learning theory [38,41]seems be popular approach among PE teachers in Malaysia for a long time. Furthermore, based on some preliminary analysis's of Malaysian game curriculum such as badminton, soccer, hockey to name some in PE curriculum reflected in Standard Document of Curriculum and Assessment [15] the game curriculum was developed based on original TGfU model. Credit and kudos must be given to the Ministry of Education of Malaysia bravely introducing tactical learning model of TGfU replacing skill based LP

approach, however one has to be caution as the original TGfU model itself still need to strengthen in order to be relevant as holistic game-based model.

Prior to the emergence CLT, those undertook research via TGfU globally and Malaysia evolved around comparing TGfU model versus skill based model or technical model in terms of skill execution, tactical decision making and knowledge components across various types of small sided game play. Based on the numerous findings indicated that TGfU model seems to be a better learning model for game learning compared to skill-led technical model or LP approach [13]. The skill-led technical-based LP approach follows three stage of linear process of warming up activities, skill/technical activity/skill drills and a game-based activity and the end , this process limiting students chances to play in game play. The emphasis of this technical model is on acquiring technical skills for game play, while the cognitive skills essential for effective tactical decision making and participation in games are often undermined [9,43]. As a result, it is suggested that students fail to transfer the skill and knowledge, tactical decision making elements of game performance to game plays.

Metzler pointed out in 2005, versus research paradigm of comparing TGfU and skilled based technical model or LP approach ought to be ovaioded, however this notion appropriate for countries in Europe, USA, Canada, Australian and New Zealand very much into student centered game based approach [23]. However, this notion could be argued as some eastern countries still prepared teacher centered pedagogy or approach based on eastern tradition and customs. Meanwhile Metzler too suggested more in-depth research need to be undertaken in implementation of TGfU itself in education and coaching context as well [23]. In regards to Malaysian education context making comparisons between the tactical learning approach of TGfU the NP versus skill based technical model of LP approach is still a lively issue for debate, as the teachers who are accustomed to the “old fashioned” technical-skill based ways-of-doing are now starting to be challenged by innovation [27].

PE game curriculum designer apart from addressing versus paradigm issue, another issue of TGfU to be resolve. TGfU apparently need support of motor learning theories such as CLT especially in improving game configuration in terms of perfection of skill execution, fitness

components and adapting different game situations, different constraints and environments. Perhaps, curriculum designer should also consider the emergence of CLT to be merged in TGfU model. Furthermore one shouldn't omit the revise model of TGfU developed by Kirk and MacPhail demands the importance situational learning perspective cue-perception and skill development components in line with situational learning theory [16].

Badminton is the national sport of Malaysia and key game curriculum in PE. The Malaysian PE game curriculum endorsed the original TGfU model as main game approach in primary school curriculum from the year 2013 and secondary school by the year 2017 [14.15]. However, based on teachers lesson plan and their teaching approach via TGfU in conundrum as teachers inclination and mind set in favor towards teachers-centered skill approach of LP pedagogy. In contrary TGfU a student centered tactical approach NP yet being implemented correctly in schools. On the other hand, even though TGfU seems to be most sought game learning model but as it still lacks of strength in developing player's technical development especially dealing with low ability students. Therefore, partnerships with CLT a model inclined to technical development via task, environment and performer may strengthen the TGfU approach as more holistic Non-Linear Pedagogical (NP) game learning model.

Games like badminton, hockey, soccer, basketball players need to have a good command of game knowledge for quick movement to base, decision-making as to *"what to do"* and *"how to do" right skill execution* in game situation, speed and accuracy in executing skills at the right time in a game play [12,18,27,39]. Developing players' on these game configuration and specific game motor fitness are among many challenges faced by PE teachers through pedagogical approaches be it linear or non-linear methodology [4, 20, 37]. The TGfU model has non linear pedagogy elements seems to be popular game learning compare to linear model or known as skilled-based teaching or technical model [13]. However, the motor learning proponents argued that TGfU still lack of underpinning theory as NP, as they suggested TGfU to be merged with CLT [7,25] and they proposed partnership TGfU-CLT as more holistic NL game pedagogy.

Based on anecdotal evidence and observation of PE classes in Malaysia in particular badminton game play even though the curriculum stipulated TGfU as non linear tactical approach, but in reality game lesson such as badminton been conducted using a structural lesson or skill-based approach also known as technical model or the LP [7,37]. The LP lesson badminton lessons comprising of ; warming up activities, followed by skills teaching, small sided game play and finally with limbering down activities, coupled with an authoritarian teaching style of bottoms down exhibited by the teacher. Therefore the LP model considered too structured, with warming-up activities and skill drills being the main components and thus depriving students of substantive opportunities to participate in game play. The emphasis of this model is on acquiring technical skills for game play, while cognitive skills which are essential for effective decision making and participation are often ignored consequently, it is suggested that students fail to transfer the skills and knowledge, tactical decision-making elements of game performance to game plays [43].

Reaseach mainly using TGfU shows that this model has been effective in students learning hockey and basketball [18,27,31,42,43] in game especially for tactical decision making . In game play attributes like ball control, decision-making on tactical elements, and upgrading players game knowledge of declarative (rules and regulation of games) and procedural, known action knowledge in badminton and hockey indicated too significant improvement via TGfU [9,43,27], however for skill execution still further research needed to further confirm TGfU claim to be a suitable game based pedagogy. Perhaps merging TGfU and CLT as more holistic NP could enhance significant skill execution in game play. However, limited research has been undertaken globally and in Malaysia to investigated the effectiveness non-linear pedagogy (NP) with merging TGfU with of CLT [6,7,8] which emphasizes on decision making tactics and skill execution during game play [21]. In particular, limited research has been undertaken to investigate the merged model of TGfU with CLT as a holistic Non-Linear game pedagogy (NP) approach in Malaysian secondary school game based curriculum such badminton game especially, investigating the effect of tactical decision making when and where to send long or short shot,, recovery movement to base, skill execution of drop shot and smash and the process on how badminton learning takes place, interacting with environment, performance and task prepared by teacher. Therefore the purpose and objectives of this

research investigated the comparative effectiveness between Non Linear Pedagogy (NP) and Linear Pedagogy (LP) models in terms of tactical decision making when to apply of long or short shot, players recovery to movement to the base, skill execution of drop shot and smash in doubles badminton game play performance before and after intervention

1.2 Theortical framework and Literature review

The PE and motor learning field provides quite numbers of pedagogical theory and models serve as game-based curriculum guiding principle for teaching and learning as well as to upgrade game. Teachers often fail to understand the relevance of theory and models for their work or studies, be it practical teaching, hands-on-teaching and learning. However in teaching and learning coaching, pedagogical approaches such as Non-linear and Linear are based upon some sort underpinning theory. Here we discuss TGfU model contains many attributes of constructivism theory, and Constraints-led theory (CLT) a motor learning theory [30].

The TGfU model was first introduced at Loughborough University in late 1960s, in response to concerns that children were leaving school with: (a) little success due to the emphasis on performance; (b) knowing very little about game; (c) some supposed skills, but in fact possessing inflexible techniques and poor decision-making capacity; dependence on the coach/teacher; and (e) little development as thinking spectators and knowing administrators [3,24,29]. This approach is contrast to traditional linear approaches of skill drills or technical model, which focus on technical development before applying these techniques to game situation [13,19,27]. As noted Griffin and Paton [11] the TGfU model as in Figure 1, the original model presented by Bunker and Thorpe in the year 1982 is a step-by-step procedural model for students or players to become skill full games players. The model consists of six steps namely, step 1: understanding game form, step 2: game appreciation, step 3: tactical awareness, step 4 :making appropriate decision , what tactics to use and how to do it, step 5 :how to execute skill execution and finally step 6: upgrading game performance. While, the original TGfU model was value added with Tactical Game Model (TGM) advocates the invasion game framework of scoring, preventing scoring and restarting play by players on ball and players without ball [21,22].

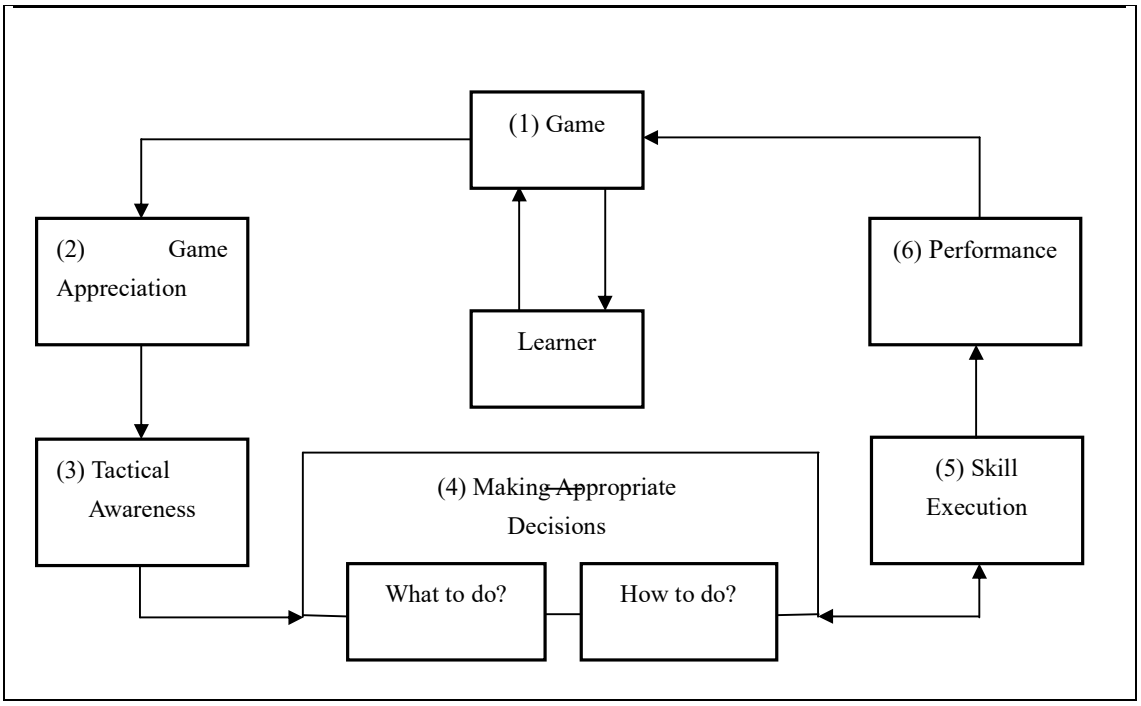

Fig.1. TGfU original model, adapted with permission Thorpe (2017)

Motor learning theory generator advocates the importance of CLT theory for acquisition of movement skills and game play knowledge. As the motor learning proponents argue that the constraints–led framework can help physical educators to built their teaching and learning instruction using task, performer and environmental constraints to explain on how learner acquire movement skills and decision making behaviours. Actually constraints-led approach is developed based on ecological psychology and dynamical system. The constraints–led theory as Figure 2, is divide into three categories : performer, environments and task as these factors interacting that shape students behaviours as created by Newell to as to provide a framework for understanding how movement patterns emerge during task performance [30].

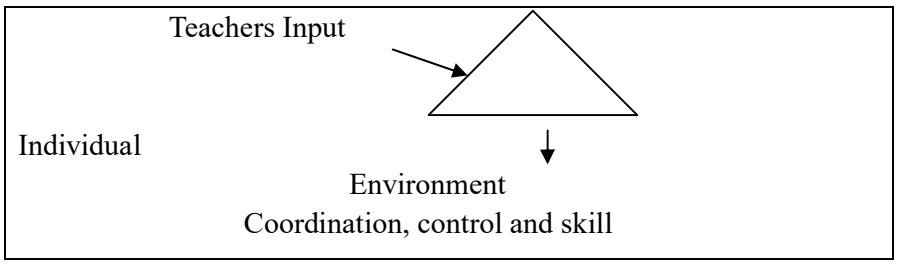

Fig.2. Constraints–led theory (Newell, 1986)

As in figure 2, performer represents functional characteristics of learners and factors related to their physical, physiological, cognitive and emotional. Whereby learners morphology, fitness level, technical abilities and psychological factors like anxiety and motivation may shape the way individuals approach a movement task [30,35].

The players as individual learners may use to solve movement problems in especially in doubles game play . The solutions which emerge from the activities of different learners has important implications for how pedagogy expert structure the learning tasks for acquiring movement skills as well as game play. These unique performer characteristics can be view as resources for each individual that channel the way in which each learner solves particular task problems or characteristics that can lead to individual-specific adaptations. It is clear that movement solutions will vary as each individual strives to satisfy the unique constraints on him/her. Variability in movement patterning can play a functional role as each individual seeks to achieve a task goal in his/her own way [30,35]. Another constraints, Environmental *constraints* refer to physical factors such as the surroundings of learners including gravity, altitude and the information available in learning contexts, such as amount of light or level of noise in a gymnasium or sports field. Other important physical environmental constraints include the parks, backyards, empty spaces and alleyways that provide the backdrop for early sport experiences of many active children. The importance of these environments should not be under-estimated in the development of expertise in sport as they provide a non-threatening environment where children can learn to play sports without the pressure of adult interference. A second important category of environmental constraints includes social factors like peer groups, social and cultural expectations. Such factors are of particular relevance for young learners whereby motor learning is often strongly influenced by group expectations, trends and fashions, and the presence of critical group members such as the teacher or class-mates. Availability of parental support, access to high quality teaching and adequate facilities are powerful environmental constraints on movement skill acquisition recognized by physical educators [30,35].

Finally, *task constraints* are perhaps the most important constraints for physical educators because of their significance in learning. They include the goal of the specific task, rules of the activity and the implements or equipment used during the learning experience. The

proficiency with which physical educators can manipulate task constraints like modifying equipment available to learners, or the size of playing areas, setting relevant task goals in games or enforcing specific rules for performance can shape the emergence of learners behaviours in physical education. The task of modifying equipment and playing area in net and wall game similar to TGfU approach whereby teachers often change the dimensions of courts or pitches as practice environments to encourage emergence of particular movement solutions desirable for learners to acquire. In badminton, for example, if children have no understanding of the important game principle of hitting to space, teachers often create a long and narrow adapted court compared to a wide and shallow court. The perceived information from the task constraints (long narrow courts), together with the intention of the performer, will accentuate the overall variations in length of shots (i.e., long and short). This manipulation of task constraints could lead to the performer hitting overhead clear and drop shots or underarm lifts in an attempt to win a rally by exploiting the space in front of or behind the opponent [30,35]. However, to effectively implement constraints led theory in game approach requires teachers to possess a mastery of knowledge and experience in specific sports, games, and physical activities to lead learners towards discovering functional coordination patterns and decision making behaviours. Furthermore according to Renshaw *et al*. (2010), small and important changes to learning environments, leading to large scale changes in movement patterns during motor learning [30]

Blomqvist, Luhtanen and Laakso [1] investigated the effects of two forms of instruction, "traditional' and 'traditional plus strategy" instruction (strategy-oriented) on students' knowledge, game understanding, skill execution and game performance. Their research utilized teacher-training students (n=30), who were divided into treatment groups: strategy-oriented (n=11) and traditional (n=10), and a control group (n=9). Both treatment groups received 20 lessons of 'traditional' badminton instruction and played singles badminton for 8 lessons. In addition, the strategy-oriented group received video-based strategy input. Furthermore, the strategy-oriented group received video-based strategy instructions for 8 lessons. Pre-and post-tests were administered for badminton knowledge, game understanding, skill and game performance. The strategy orientated and traditional group improved their badminton knowledge (based on 36 items on a badminton knowledge

test) whereas the control group showed no improvement. As for the skill test the traditional group was able to significantly improve in the skill of serving. On the other hand for game play performance, in terms of dependent variables, the percentages of successful shots (hit within the boundaries of play), forceful shots (hit into target area) and cooperative shots (hit straight to the opponents-non tactical) indicated no significant mean effect. Earlier study by Blomqvist, Luhtanen, and Laakso [2] examined the effect of TGfU on game understanding and game performance between young expert and novice players in badminton. The dependent variable included skill components(serve, clear, drop) whereas game performance was measured by the total amount and average length of shots, total distance travelled and game understanding based on responses to games shown on a video recording. Findings indicated the young expert players were significantly better than the novice players in terms of long serve and clear, performing longer shots, backhand shots, and physically they travelled significantly longer distances around the court, and they also demonstrated better understanding of tactics. Analysis from above research findings using the linear pedagogy (LP) or the skill-based technical instruction in schools indicated this method improved players' general skills and fitness level in games like badminton, soccer, hockey but players failed to transfer the skill into a real game situation. Whereas research findings using a tactical model or TGfU indicated players were able to make appropriate game decisions as well as in improving their declarative and procedural game knowledge. In contrast findings also indicated that they also lacked skill execution in game situations. A part from game play findings, physical fitness and morphology do play important role in whatever pedagogical model employed in games teaching and learning situations [2].

This notion supported with the findings by (Phomsoupha & Laffaye, 2015) indicated the badminton learners or players should be tall, lean with an ecto-mesomorphic body type suited to the high physiological demands of a match. Indeed, The intermittent actions during a game are demanding on both the aerobic and anaerobic systems: 60-70% on the aerobic system and about 30% on the anaerobic system, with greater demand on the alactic metabolism with respect to the lactic anaerobic metabolism. The shuttlecock has an typical trajectory and the players perform specific movements such as lunging and jumping, and powerful strokes using a specific pattern of movement. Badminton players should be visually fit, picking up accurate

visual information in a short time [33]

In another study by Lee, Chow, Komar, Tan, and Button [17] that explore the effectiveness of a Nonlinear Pedagogy approach for learning a sports skill students with among n=24, 10-year-old females in a 4-week intervention involving either a Nonlinear Pedagogy (NP) (i.e., manipulation of task constraints including equipment and rules) or a Linear Pedagogy (LP) (i.e., prescriptive, repetitive drills) approach to learn a tennis forehand stroke. Both groups NP and LP showed improvements in performance accuracy scores over time, the Nonlinear Pedagogy group displayed a greater number of movement clusters at post-test indicating the presence of degeneracy. The results suggest that degeneracy is effective for learning a sports skill facilitated by a Nonlinear Pedagogy approach. Their findings also indicated the NP approach was able to cater for individual learning differences Indeed, the NP approach prepares the individual with a variety of movement solutions to cope with a dynamic sporting environment that NP is effective and is an instructional approach worth pursuing [17]. Olvares, Villora, Lopez and Araujo [32] conducted study using two pedagogical principles of Game-based approaches, representation and exaggeration which considered as Nonlinear Pedagogy among U10 soccer players in term of tactical decision making and skill execution in small sided game play (SSGs). Findings indicated no significant difference observed among these two pedagogical principles approaches in SSGs in term of decision making and skill execution (ball control, passing, dribbling and get free movement) and both SSSGs games could provide similar degeneracy processes to the players for the capability to achieve different outcome in varying contexts. Therefore research is needed, from ecological points of view, to determine how we should use SSSGs in Game-based approaches or Non Linear Pedagogy 32].

Nathan [25] the pricipal researchers, in his earlier research examined, the effects that a revised model of TGfU (Kirk & MacPhail) merged Constraint-led theory (CLT) compared to Skill Drill Technical (SDT) a technical model had on learning movement skills in Badminton, including returning to base, decision making and skill execution whilst performing in a doubles game play. The study also explored teachers' perceptions of navigating between the two models.The participants comprised 32 school badminton players aged 15.5 ± 1.0 years, were randomly selected and assigned equally into groups of TGfU and SDT. Two experienced

physical education teachers wrote their thoughts as the students enjoy game play via TGfU. Findings indicated for movement to the base in doubles game play indicated significant improvement using TGfU, on the other other hand no significant difference between TGfU and SDT for decision-making (contact,drop shot, smash, clear and drive) and skill execution (skill execution (contact,drop shot, smash, clear and drive) in doubles game play. The author suggest further research findings ought to be circulated among teachers in Malaysia and similar Asian counties [25].

1.3 METHODOLOGY

The main methodology that proposed in this research was balanced group pre and post-test quasi experimental design as proposed by Gray & Airsan [10], to determine the effectiveness between Non Linear Pedagogy (NP) and Linear Pedagogy (LP) models in terms of tactical decision making when and where to apply long or short shot, recovery movement to the base, skill execution of drop shot and smash in doubles badminton game play performance before and after intervention. The intervention of NP and LP models lasted for five weeks and two weeks were allocated for pre and post-tests.

Participants

The samples proposed in this study consists of n = 56 students (16 female and 40 male students) from three physical education class (13±.23 years old) from three different schools across three different states in Malaysia namely Selangor, Perak and Penang. The sample were assigned equally into groups of NP model, n = 28 and LP model, n = 28. The number of sample of each group sound in power of sampling as it determine.80 effect size based on Cohen's formula.

As for instrument, the study adapted Game Play Observation Assessment Instrument: Net/Wall Games developed by Mitchell *et al*. [21,22] was utilise to measure quantitatively game play components of effectiveness between Non Linear Pedagogy (NP) and Linear Pedagogy (LP) models in terms of skill execution, drop shot and smash, tactical decision making when to apply of long or short shot, players recovery movement to the base in doubles game play performance before and after intervention. The adapted instrument was piloted for reliability and validity, furthermore supported and permission was granted Prof. Mitchell of

Kent State University. The conceptual framework of this study dwelled by synthesis of underpinning theories, models, literature review and anecdotal findings in Malaysian school curriculum research and practice. Herewith enclosed the following conceptual framework for this study as illustrated in Figure 3.3, whereby the NP and LP serves as pedagogical interventions whereas skill execution in terms tactical decision making when and where to apply of long or short shot, players recovery to movement to base, skill execution of drop shot and smash in doubles game play dependent variables

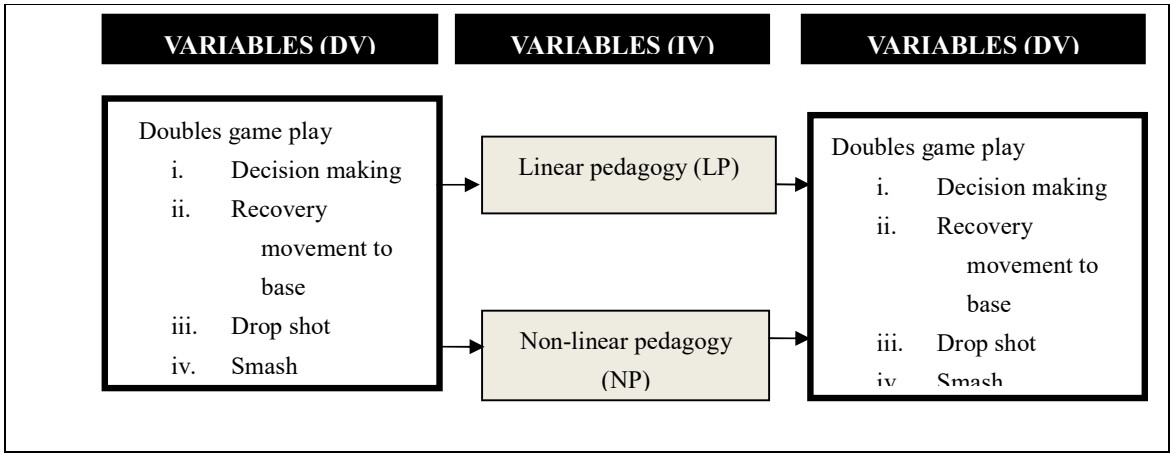

Fig.3. Conceptual framework of the study

Intervention procedures

In order to maintain the fidelity in implementation of these NP and LP pedagogical models for five weeks of intervention, the following steps were taken. A simultaneous briefing session was conducted on how to implement these two different models, by the principal researcher. The two teachers were given modules and checklist on implementing two pedagogical models. A pre training stint was conducted by researcher on implementation of these training intervention and method on carrying out all the required test of measures. A preliminary interview was conducted by the principal researcher to make sure these teachers conducted the learning and teaching units accordingly The contents of both instructional models boils around tactical and skill components of badminton game play particularly in doubles game play. However for the NP model were given more emphases on scoring strategy, tactical problem solving involves creating space on opponents side of net, winning the point, attacking as a pair using students approach. While in defence strategy, tactics involved

defending space on the own side of the net, defending against an attack, and defending as pair was utilised. On the other hand skills implementation was dominant in LP model and basic tactics were included at end of each lesson by the teacher. Both these models will utilise similar skills execution such as overhead clear (forehand and backhand skills) and underhand clear shots (forehand and backhand skills), low and high service, lob, drop shot, smash as well as returning to base.

The Non-Linear Pedagogy (NP) and LP intervention

In NP the following elements adopted from TGfU model is a tactical approach on 'what to do' and 'how to do' – game problem solving based on guided discovery, through guided questioning techniques. Activities in badminton game play will be organize based on mini game situations and by adjusting and constraints in the playing area, 1 v1, 2 vs 2 or 1 vs 2 in badminton game play situations [3,21,35]. The principal researcher will prepare the task or lesson activities with different constraints, based on specific rules, environment, modifying equipment available to the learners, playing areas size, and setting up goals and objectives in each lesson to upgrade players' performance as suggested by constraints-led theory. In order to expose students with constraints and difficulties of applying tactics of creating space for attack, closing space for defence strategy the researchers and teachers will create a long and narrow adapted court compared to a wide and shallow court. The perceived information from the task constraints (long narrow courts), this will enable the players to make tactical decision whether to execute, long and short shot. Adjusting and manipulating the area of badminton to wide and shallow courts as a task constraints could lead to the badminton players/students challenge the in solving of badminton tactical decision making and skill executing [35]. The NP lessons plan developed evolving around the following elements of: solving tactical problem, executing footwork movements and badminton skills scoring (offense) and preventing scoring strategy in badminton game play situations. Various game play situations were created based tasks, constraints and the players as performer. Furthermore, apart from TGfU and Constraints-led theory [30] the NP badminton lesson been supported by tactics and game strategy framework suggested by Mitchell *et al.* [21] and as well as been formatted in accordance with Malaysian standard based curriculum of KSSM (KPM) [15]. In scoring

strategy, tactical problem solving involves creating space on opponents side of net, winning the point, attacking as a pair utilizing skills such as overhead clear by using forehand and backhand skills and overhead clear shots using forehand and backhand skills or underarm clear using forehand and backhand skills, low service, high service, lob, drop shot, smash as well as returning to base. While preventing scoring (defence) tactics involved defending space on own side of the net, defending against an attack, defending as pair and skills involve forehand, backhand employing underhand and overhead strokes of clear and footwork movement, returning to the base.

The linear pedagogy (LP) based on the common practice in Malaysia, whereby physical education teachers predominantly use technical model approach: whereby teacher-centred technical activities of skill demonstration, skill drills activities given importance and only towards the end of the lesson, students were given chance to play small sided game play, whereas game tactics and strategy were given less importance. Skill drills activities based on technical model stages of development as proposed by Rink [36,37] supported in badminton instructional research (French, Werner, Rink & Taylor, 1996). In this badminton study the linear pedagogy (LP) is developed and adopted based technical model of instruction (teaching and learning) proposed by Rink [36] . This framework akin what being practiced in Malaysian (KBSM, Physical Education) curriculum [14]. The technical model proposed by Rink [36] outlined four stages in skill development and tactical development, with giving attention to skill first and then tactical. Stage one (1) the ability to control the object (example: hold racket, control shuttlecock and roll and tap in balls, stage two (2) execution skills in combination (example, forehand, backhand service, lob, drop shot, smash and clear in badminton), stage three (3) basic offensive and defensive strategy (example: open and close space) and stage four (4) modified games with changes in rules, boundaries, players or playing full game.

Data collection and data analyses

Data were collected at various stage of research. The pre-test data were collected at 1st week of actual research and then the post-test data were collected 7th week of research, whereas week 2nd -6th the period NP and LP intervention that took place. Data were collected in terms of tactical decision making (students make appropriate choices of when to place a long or short shot), recovery movement to base, drop shot and smash in badminton doubles game

play with (1) marks for appropriate and (0) marks for inappropriate action. The collected data were analysed in term of descriptive and inferential statistics of *ANOVA, ANCOVA* via SPSS software version 21, based on research hypothesis. Based on Kolmogorov-Smirnov and Shapiro –Wilk test for normaility, findings for almost all the dependent variables results indicated the *p* value more than .05, therefore normality assured for almost all the dependent variables in this study

2. RESULTS

Pre-test findings indicated there was difference between NP pedagogical model and LP effective in tactical decision making whether to send long or short shot in doubles game play performance before intervention $F(1,54)=5.840$, $p= .019$, $p<0.05$. As Table 1 deceipts Mean, SD and SE before intervention. ANCOVA was performed because there was significant difference between these models at pre-test for decision making in term of when to apply of long and short shot in doubles game play performance, using pre-test score as covariate. The results of ANCOVA confirmed and indicated there was significant difference between these two modes $F(1,54) =16.454$, $p=.001$, $p<0.05$, $\eta^2=.234$ in term of decision making when to apply long and short shot in doubles game play performance . The results of ANCOVA in term of analyses of covariance summary for decision making in term when to apply of long and short shot in doubles game play performance reflected in Table 2 and whereas Table 3 indicated estimated marginal means for decision making in term when to apply of long and short shot in doubles game play performance

Table 1. Deceipts Mean, SD and SE tactical decsion making before intervention

Pedagogy	N	Mean	SD	SE
LP	28	4.00	2.494	.471
NP	28	2.64	1.615	.305

Table 2. Analyses of covriance summary for tactical decision making

Source	Sum of Squares	df	Mean Square	F	Sig.
Group	36.161	1	36.161	16.454	.000

**p<0.05

Table 3. Estimated marginal means for tactical decision making

Group	Mean	Std. Error	95% Confidence Interval Lower Bound	Upper Bound
Linear pedagogi	1.025[a]	.281	.460	1.589
Non-Linear pedagogi	2.868[a]	.281	2.304	3.432

Pre-test findings indicated there was no significant difference between NP pedagogical model and LP, in players recovery movement to the base in doubles game play performances before intervention, $F(1,54)=3.743$, $p= .060$, $p>0.05$. As Table 4 deceipts Mean, SD and SE recovery to base. Based on ANOVA result, Findings indicated there was significant difference in effectiveness between NP (2.50± .923) and LP model (.93± 1.35) in players recovery movement to base in doubles game play performances after intervention with $F(1,54) = 25.624$, $p=.001$, $p<0.05$, $\eta^2=.322$. The following Table 5 illustrates Mean, SD and SE for recovery to movement to base in doubles game play. Meanwhile Figure 4 illustrates Mean and SD for recovery to base after intervention

Table 4. Deceipts Mean, SD and SE recovery to base before intervention

Pedagogy	*N*	*Mean*	*SD*	*SE*
LP	28	2.04	1.201	.227
NP	28	1.50	.839	.159

Table 5. Deceipts Mean, SD and SE for recovery to movement to base

Pedagogy	*N*	*Mean*	*SD*	*SE*
LP	28	.93	1.359	.257
NP	28	2.50	.923	.174

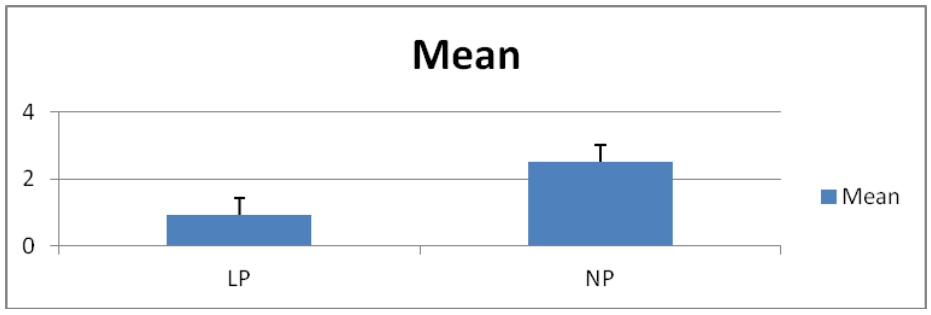

Fig.4. Deceipts Mean and SD for recovery to movement to base after intervention

Findings indicated there was no significant difference between NP pedagogical model and

LP effective in skill execution in term of drop shot in doubles game play performance before intervention, $F(1,54)=1.707$, $p=.97$, $p>0.05$. The following Mean, SD and SE are illustrated in Table 6. Post-test findings indicated there was significant difference between NP pedagogical model (2.78±.630) and LP (.86±.1.00) effective in skill execution in term drop shot in doubles game play performance after intervention, $F(1,54)=73.72$, $p=.001$, $p<0.05$, $\eta^2=.577$. Mean, SD and SE are illustrated in Table 7. On the other hand Figure 5, deceipts Mean and SD for drop shot

Table 6. Deceipts Mean, SD and SE drop shot before intervention

Pedagogy	*N*	*Mean*	*SD*	*SE*
LP	28	1.07	1.676	.317
NP	28	.57	1.136	.215

Table 7. Deceipts Mean, SD and SE drop shot

Pedagogy	*N*	*Mean*	*SD*	*SE*
LP	28	.86	1.008	.190
NP	28	2.79	.630	.119

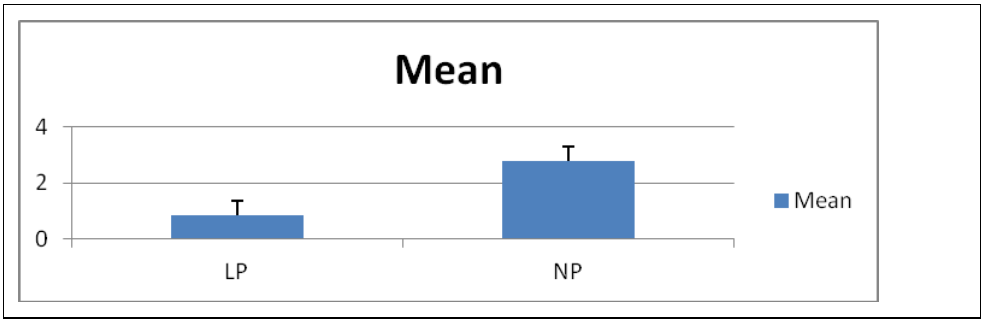

Fig.5. Deceipts Mean, SD and SE drop shot

Findings indicated there was no significant difference between NP pedagogical model and LP effective in skill execution of smash in doubles game play performance before intervention, $F(1,54)=.913$, $p=.344$, $p>0.05$. Mean SD and SE are illustrated in Table 8. Post-test findings indicated there was significant difference in effectiveness between NP (2,43±.790) and LP (1.21±,686) models in skill execution of term smash in badminton doubles game play performance after intervention with , $F(1,54)=37.69$, $p=.001$, $p<0.05$, $\eta^2=.830$. Mean, SD and SE for smash are illustrated in Table 9. While Figure 6 illustrated Mean and SD for smash

Table 8. Deceipts Mean,SD and SE smash before interventions

Pedagogy	*N*	*Mean*	*SD*	*SE*
LP	28	.50	1.232	.233
NP	28	1.00	2.480	.469

Table 9. Deceipts Mean, SD and SE smash after interventions

Pedagogy	*N*	*Mean*	*SD*	*SE*
LP	28	1.21	.686	.130
NP	28	2.43	.790	.149

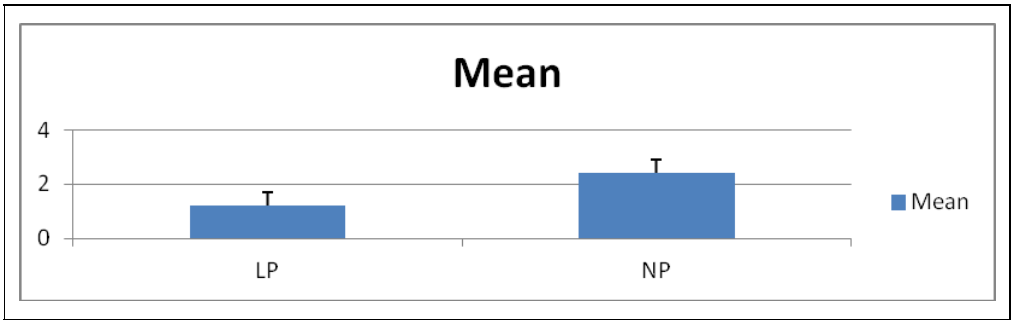

Fig.6. Deceipts Mean and SD for smash

3. DISCUSSION

The results of ANCOVA confirmed and indicated significant difference between these two models and NP indicated significant improve performance compared LP, $F(1,54) = 16.454$, $p = .00$, $p < 0.05$ in term of decision making in term when to apply of long and short shot in doubles game play. The findings similar with findings by Blomqvist *et al*. [1.2], as they examined the effect of TGfU via strategy group compared to traditional approach. Their findings indicated that the young expert players were significantly better than the novice young players as their groups demonstrated better understanding of tactics. This findings in contra with findings by Nathan [25] indicated no significant difference between TGfU and SDT for decision-making (contact,drop shot, smash, clear and drive) in doubles game play. Similar contra results recorded by Olvares *et al*. [32]conducted study using two pedagogical principles of Game-based approaches, representation and exaggeration which considered as Nonlinear Pedagogy among U10 soccer players in term of tactical decision making and skill execution in small sided game play (SSGs). Findings indicated no significant difference observed among these two pedagogical principles approaches in SSGs in term of decision

making (ball control, passing, dribbling and get free movement) and both groups using SSGs (small sided games). This present study of NP as better model for decision making supports the findings of Lee *et al*. [17] that explore the effectiveness of a Nonlinear Pedagogy approach for learning a sports skill students with among n=24, 10-year-old females in a 4-week intervention. Their study investigated the Nonlinear Pedagogy (NP) (i.e., manipulation of task constraints including equipment and rules) or a Linear Pedagogy (LP) (i.e., prescriptive, repetitive drills) approach to learn a tennis forehand stroke. Both groups NP and LP showed improvements in performance accuracy scores over time, the Nonlinear Pedagogy group displayed a greater number of movement clusters at post-test indicating the presence of degeneracy. Therefore the present findings confirm tactical model such TGfU along CLT as the components NP pedagogical model played vital role in enhancing players tactical decision making when and where to send the long or short shot in badminton doubles game play to snatch points from the opponents.

As for players recovery to base, findings revelaed significant difference in effectiveness between NP (2.50± .923) and LP model (.93± 1.35) in players recovery movement to the base in badminton doubles game play performances after intervention with $F(1,54) = 25.624$, $p=.001$, $p<0.05$. The present findings is in line with the findings of Lee *et al*. (2014) as they explored the effectiveness of a Nonlinear Pedagogy approach for learning a sports skill using $n=24$, 10 year-old female students in a 4-week intervention involving a Nonlinear Pedagogy (NP) (i.e., manipulation of task constraints including equipment and rules) or a Linear Pedagogy (LP) (i.e., prescriptive, repetitive drills) approach to learn a tennis forehand stroke. Both groups NP and LP showed improvements in performance accuracy scores over time, however the Nonlinear Pedagogy group displayed a greater number of movement clusters at post-test indicating the presence of degeneracy. In another study supports the present study, as Nathan (2016) revealed similar finding of recovey to base in badminton game play improved significantly via revised TGfU model (Kirk & MacPhail), [16] merged with Constraint-led theory (CLT) that was compared to Skill Drill Technical (SDT) a technical model. Kudos to NP model as the present study able to improve players recovery movement to base in doubles game play performances. As the NP dwells along

many small sided game plays, challenging the players in term of court area, task constraints, eventually enabling the players to improve their footwork by improving movement to base.

On the other hand for skill execution of drop shorts and smash significant differences observed in the effectiveness between NP and LP models in skill execution in term drop shot in badminton doubles game play performance after interventions. NP pedagogical model effectively recorded (2.78±.630) compared to LP (.86±.1.00) drop shot skill execution after intervention, $F(1,54)=73.72$ $p=.001$, $p<0.05$. As for smash, too indicated significant improvement recorded by NP pedagogical model (2.43±.790 compared to LP (1.21±,686) in badminton doubles game play performance after intervention, $F(1,54)=37.69$, $p=.001$, $p<0.05$. The present findings or marked improvement in drop shot and smash skill using NP similar with findings by Blomqvist *et al.* [2] as their study examined the effect of TGfU on badminton game play too. Findings indicated the young expert players were significantly performed better than the novice players in terms of long serve and clear, performing longer shots, backhand shots, and physically they travelled significantly longer distances around the court, and they also demonstrated better understanding of tactics. The present findings support the study by Lee *et al*. [17] that explored the effectiveness of a Nonlinear Pedagogy approach for learning a sports skill students with among n=24, 10-year-old females in a 4-week intervention involving either a Nonlinear Pedagogy (NP) (i.e., manipulation of task constraints including equipment and rules) or a Linear Pedagogy (LP) (i.e., prescriptive, repetitive drills) approach to learn a tennis forehand stroke. In their study both groups NP and LP showed improvements in performance accuracy scores over time, however the Nonlinear Pedagogy group displayed a greater number of movement clusters at post-test indicating the presence of degeneracy

The present findings in term of drop shot and smash significantly improved compared to earlier study by Nathan [25] indicated no significant difference between TGfU and SDT for skill execution (contact,drop shot, smash, clear and drive) in badminton doubles game play. The present findings in contra by earlier study by Olvares [32] investigated two pedagogical principles of Game-based approaches, representation and exaggeration which considered as Nonlinear Pedagogy among U10 soccer players in term of skill execution (ball control, passing, dribbling and get free movement) and both SSSGs games, as findings

indicated no significant difference.The present findings the effectiveness of NP in drop shot and smash results similar with findings by Palaniappan [34]there was a significant difference between the instructional models of TGfU, SET and technical on the post test score for passing, scoring and decision making ability and enjoyment in 4 versus 4 handball game play among Malaysian school students

4. CONCLUSION

In conclusion it was found that the effect of NP model is more significant prominent compared to other models such LP in influencing badminton doubles game configuration. The components of TGfU model such as small sided game play, tactical-skill led approach and elements of task, constraints' and performer of CLT theory played the key role upgrading game play performances in terms of tactical decision making, skill execution drop and smash shot as well as players movement to the base in badminton doubles game play.The results findings of this study revealed NP able to improve students game play outcome performance in terms of tactical decision making, recovery movement to base, skill execution drop shot and smash. Non Linear (NP) should consider as another alternative pedagogical approach a part from TGfU stands alone in Malaysian schools. The findings on NP generally indicated a better model for game play outcome performance, therefore this model based on the present findings suitable to support product curriculum or the Tyler Model [44]. On the other in the context of process curriculum [40], to test the effectives NP in the learning process model and how teacher's negotiate this model, we recommend future research need to be carried out.

As mentioned in the problem statement, the Malaysian schools advocating TGfU as game-based pedagogical model for primary schools since 2013 and secondary school starting from the year 2017, based teachers lesson plan, textbooks, DSKP form one curriculum document analysis (KPM),[15]. Based on these documents analysis and anecdotal teaching observation, the implementation of TGfU in Malaysia schools geared towards student-centered skill-based aand tactical as key underpinning element proposed in TGfU model has been neglected. Therefore the principle tactical element behind TGfU curriculum model has been overlooked the Malaysian PE curriculum designer.

Therefore, it suggested that TGfU still a game-based pedagogy as planned the Ministry of Education Malaysia can be implemented as planned, however more emphases should be given the tactical aspect of TGfU, the vital tenant of TGfU. On the other hand if the Education Ministry and PE curriculum designer feels skill development should precede tactical elements in game play, we suggest NP as another alternative for game based teaching.Based on this present research we recommend that Non Linear pedagogy (NP), whereby NP developed as an eclectic model (merged between TGfU and CLT) would serve more holistic game-based learning for Malaysia students, as the present preliminary research results indicated the NP performance significantly better compared to LP for tactical decision making, recovery movement to base and skill execution for drop shot and smash in badminton game play. However more extensive research has to be done to claim the importance of NP. Why should NP considered a better pedagogical model, one has to understand the underpinning of model and theories as well as content NP dwelled in this research

The present study investigated the effect of these two pedagogical models in badminton game play badminton outcome. The results of this study revealed the need for more information concerning implementation Non Linear (NP) and TGfU in Malaysian schools and teachers negotiating NP and TGfU in schools environment. We recommend further studies to investigate the learning process involved between these two models using Qualitative Observational Analysis Instruments by Roberts & Fairclough [38]. Among learning process that can be evaluated such as student activity modes, lesson contexts and teacher interactions during game classes. This study investigated the effectiveness between Non Linear Pedagogy (NP) and Linear Pedagogy (LP) models in term of product curriculum such skill execution in terms of tactical decision making in term when to apply short or long shot, players recovery to movement to base, skill execution of drop shot and smash in doubles game play performance before and after intervention. The study indicated the NP seems to be overall effective as pedagogical model (instructional model) especially for tactical decision making whether to send long or short shot, movement to base, drop shot and skill execution doubles game play. However, to confirm the authencity of NP pedagogical as useful pedagogical for game play further study has to be undertaken other categories game play apart from net/wall game.

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