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Train in Virtual Court: Basketball Tactic Training via Virtual Reality

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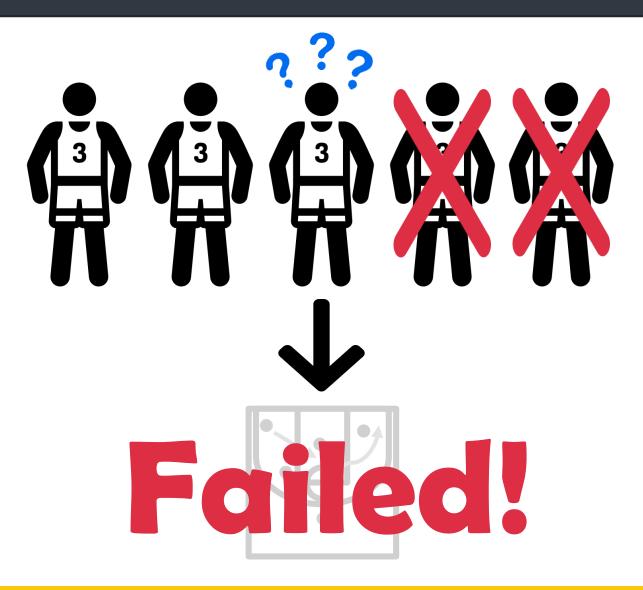National Cheng Kung University, Taiwan

Introduction

Tactic training is important for the training of a basketball team.

Conventional physic basketball
tactic board
(BTB)

Failed!

Pre-User Study

- Total **12** subjects (4 females and 8 males)

- Playing basketball **> 2** years (averagely 8 years)
- Semi-structured interview

Face-to-face interview

Q1 What obstacles did they encounter while being trained with a conventional physical basketball tactic board(BTB)?

Too many steps
Multiple player move at the same time

Without offensive position mark

Face-to-face interview

Q2 How many times of explanations do you need to understand the advanced-level tactic well?

2~3 times, 5~6 times lack of experience

Face-to-face interview

Q3 In your opinion, what kinds of presentation could help you be familiar with the tactics more easily?

Auxiliary video with guidance

Add defenders

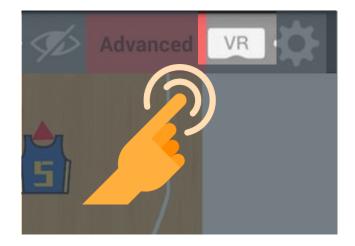Actual practice on the court with enough training players

System Framework

2D-BTB application

- Tactical path recording
- Orientation recording
- Strategy step recording
- Tactic saving
- Tactic loading
- Tactic recommendation
  - Dynamic Time Warping(DTW)
- Virtual Reality mode

Review on Trajectory Similarity Measures
(2015 ICICIS, Nehal Magdy, Mahmoud A.Sakr, Tamer Mostafa and Khaled El-Bahnasy)

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TCP transmission

Tactic trajectory

3D virtual content rendering

- Normal mode
- Learning mode
- Defender mode

- First person perspective
- Third person perspective

Made by Unreal Engine 4

Mode Design - Normal
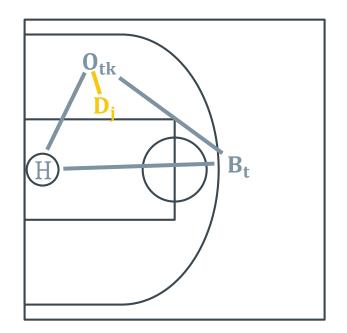
Mode Design - Learning

Mode Design - Defender

Mode Design - Defender

$$u_{tk} = \gamma_o O_{tk} + \gamma_b B_t + \gamma_h H$$

$$\gamma_o + \gamma_b + \gamma_h = 1$$

H : hoop
O_{tk} : offensive player
B_t : ball
D_j : defensive player

$$0.62 O_{tk} + 0.11 B_t + 0.27 H$$

Characterizing the Spatial Structure of Defensive Skill in Professional Basketball
(Franks, Alexander, et al. "Characterizing the spatial structure of defensive skill in professional basketball." *The Annals of Applied Statistics* 9.1 (2015): 94-121.)
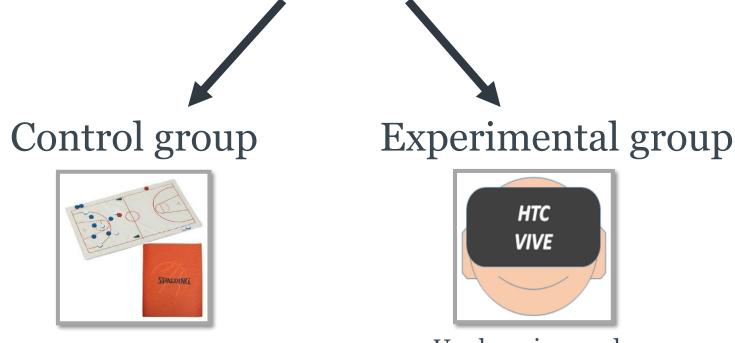
Perspective Design

Third person perspective   First person perspective

Experiment

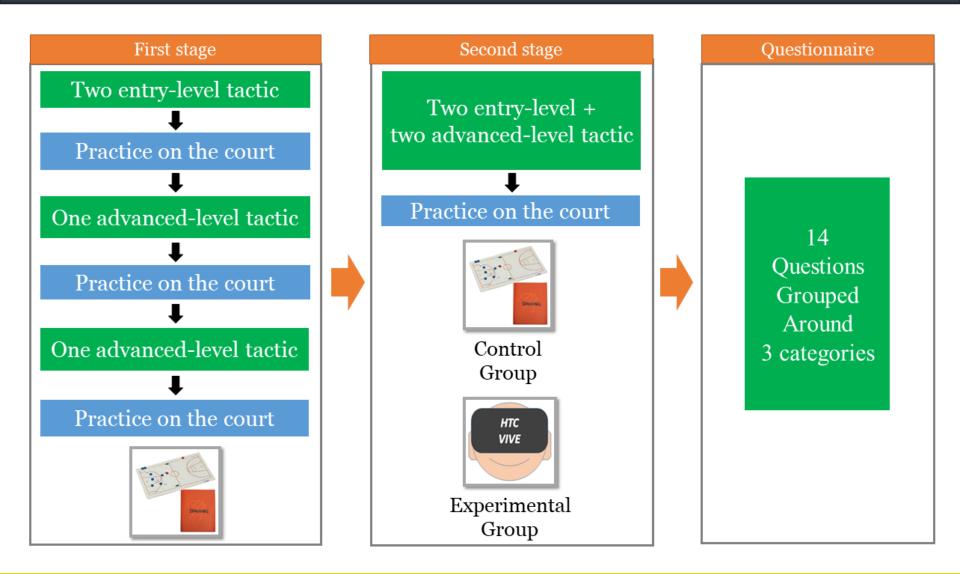## 60 subjects

(41 males and 19 females aged from 18 to 32)

Control group

Experimental group

Use learning mode

Control Group

Measurements	Term	Frequency	Percentage
Gender	Male	25	83.3%
	Female	5	16.6%
Age	Under 20	10	33.3%
	21-25	17	56.6%
	25-30	2	6.6%
	Beyond 30	1	3.3%
Age of basketball	Under 3	5	16.6%
	3-6	2	6.6%
	6-10	16	53.3%
	Beyond 10	7	23.3%
Offense Position	PG	7	23.3%
	SF、SG	8	26.6%
	PF、C	10	33.3%
	PG、SF、SG	4	13.3%
	SG、PF	0	0%
	None	0	0%
	All	1	3.3%

Experimental Group

Measurements	Term	Frequency	Percentage
Gender	Male	16	53.3%
	Female	14	46.6%
Age	Under 20	9	30%
	21-25	18	60%
	25-30	3	10%
	Beyond 30	0	0%
Age of basketball	Under 3	5	16.6%
	3-6	11	36.6%
	6-10	10	33.3%
	Beyond 10	4	13.3%
Offense Position	PG	6	20.6%
	SF、SG	9	31.0%
	PF、C	9	31.0%
	PG、SF、SG	3	10.3%
	SG、PF	1	3.4%
	None	0	0%
	All	1	3.4%

Experiment-Flow Chart

First stage

Two entry-level tactic

↓

Practice on the court

↓

One advanced-level tactic

↓

Practice on the court

↓

One advanced-level tactic

↓

Practice on the court

Second stage

Two entry-level + two advanced-level tactic

↓

Practice on the court

Control Group

Experimental Group

Questionnaire

14 Questions Grouped Around 3 categories

Experiment-Setup

- Evaluation
  - Hesitation time
- The court
  - GoPro Hero3 on a helmet
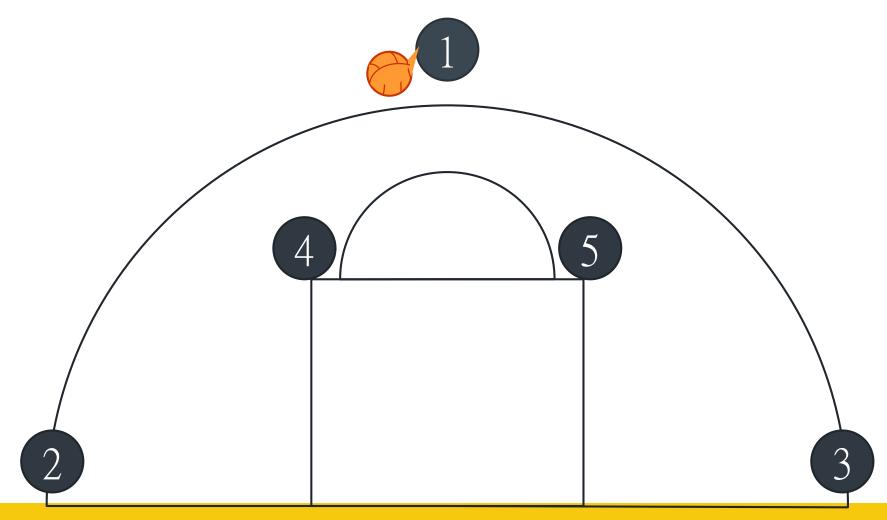 - A camera beside the court
- VR
  - HTC Vive

Result – Hesitation time

Group	Stage	Tactic 1	Tactic 2	Tactic 3	Tactic 4
Control	1st	0.047s (0)	0.267s (1)	2.595s (21)	2.287s (14)
	2nd	0.320s (2)	1.078s (4)	0.857s (7)	0.833s (5)
Experiment	1st	0.000s (0)	0.733s (3)	3.338s (31)	2.260s (15)
	2nd	0.000s (0)	0.000s (0)	1.023s (9)	0.493s (3)

Average hesitation time(number of times of forgotten steps)

Result – Quantitative Test

- ## Pair-sample t-test
  - If the two sets of data are significantly different from another
  - Suited for small groups of data
  - Both BTB and VR system help the trainees to be more familiar with advanced level tactic

	Group	Tactic 1	Tactic 2	Tactic 3	Tactic 4
P-Value	Control	0.100900	0.082300	0.000500	0.004200
	Experiment	0.000000	0.041700	0.000028	0.001000

Result – Quantitative Test

- ## Pair-sample t-test
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Result – Questionnaire

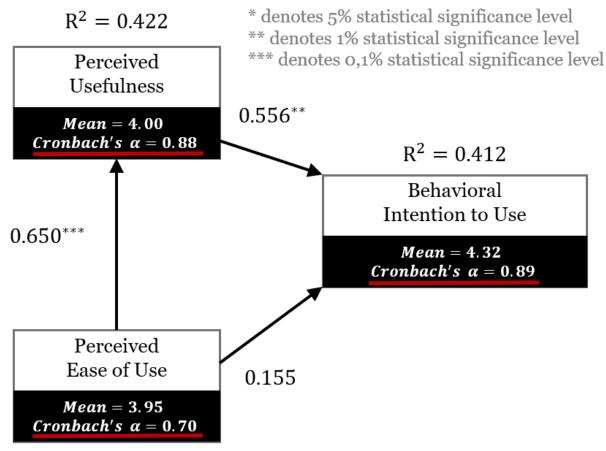| Faces	Question				
	Strongly disagree	Disagree	Neither agree or not	Agree	Strongly agree
Perceived Usefulness	a01. Compared with the conventional physical BTB, virtual reality system is easier to learn tactics.				
	a02. Virtual reality system make me know the content of tactics better.				
	a03. Compared with the conventional physical BTB, I can know what my teammates will do better.(where to go, pass to whom).				
	a04. Compared with the conventional physical BTB, I can memory the content of tactics easier.				
	a05. Compared with the conventional physical BTB, I can know what I should do better. (where to go, pass to whom).				
	a06. Use this system to learn tactics is helpful.				
	a07. Use this system can understand tactics faster.				

User acceptance of information technology: system characteristics, user perceptions and behavioral impacts.
Fred D Davis International journal of man-machine studies, 38(3):475 – 487, 1993.

Result – Questionnaire

Faces	Question
Perceived Ease Of Use	b01. The hint of orientation is intuitive.
	b02. The hint of tactical path is intuitive.
	b03.This system can improve the willingness to tactic training.
Behavioral Intentions	c01. I am willing to use this system for basketball tactic training.
	c02. I would recommend others to use this system for tactic training.
	c03. This system is a good tactic training system.
	c04. Overall, I think the system is a worth trying tactic training method.

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Result – Qualitative Test

Technology Acceptance Model

User acceptance of information technology: system characteristics, user perceptions and behavioral impacts.
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Conclusion

- Conclusion
  - User can practice anytime without coaches and sufficient trainees.

- Future work
  - Apply motion capture to recognize pose
  - Spawn different intelligence level defenders

Q&A

Thank you for listening!