# On the Students Creative-Innovative Thinking Skills in Solving Two-Dimensional Arithmetic Sequence Problems Through a Research Based Learning

**Prof. DAFIK, M.Sc, Ph.D**

THE UNIVERSITY OF JEMBER

Tradition of Excellence

# My Profile

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**2020**

**RESEARCH ACHIEVEMENT**
**Sopus: Documents 148/h-index 10**
**National Sinta Rank: 34/30.48**
**Nationally Combinatorics Sinta Rank: 1**
**Nationally Applied Math Sinta Rank: 1**
**Nationally Graph Theory Sinta Rank: 1**
**Nationally Math Education Sinta Rank: 1**

**1992**

**BACHELOR DEGREE**
Mathematics Eduction
Universitas Jember

**1998**

**MASTER DEGREE**
Mathematical Computing
The University of Manchester, UK

**2007**

**DOKTORAL**
Combinatorics and Graph Theory
The University of Ballarat, Australia

**2013**

**PROFESSOR**
Combinatorics and Graph Theory
FKIP The University of Jember

# THE RELEVANT REFERENCES

## H-Antimagic, Dafik, *et.all*

- **Constructions of H-antimagic graphs using smaller edge-antimagic graphs** (Ars Combinatoria 2017, vol 133)
- **$P_2 \triangleright$H-super antimagic total labeling of comb product of graphs** (AKCE International Journal of Graphs and Combinatorics 2019, vol 16 issue 2)
- **On H-supermagic labelings of m-shadow of paths and cycles** (International Journal of Mathematics and Mathematical Sciences 2019, vol 2019)

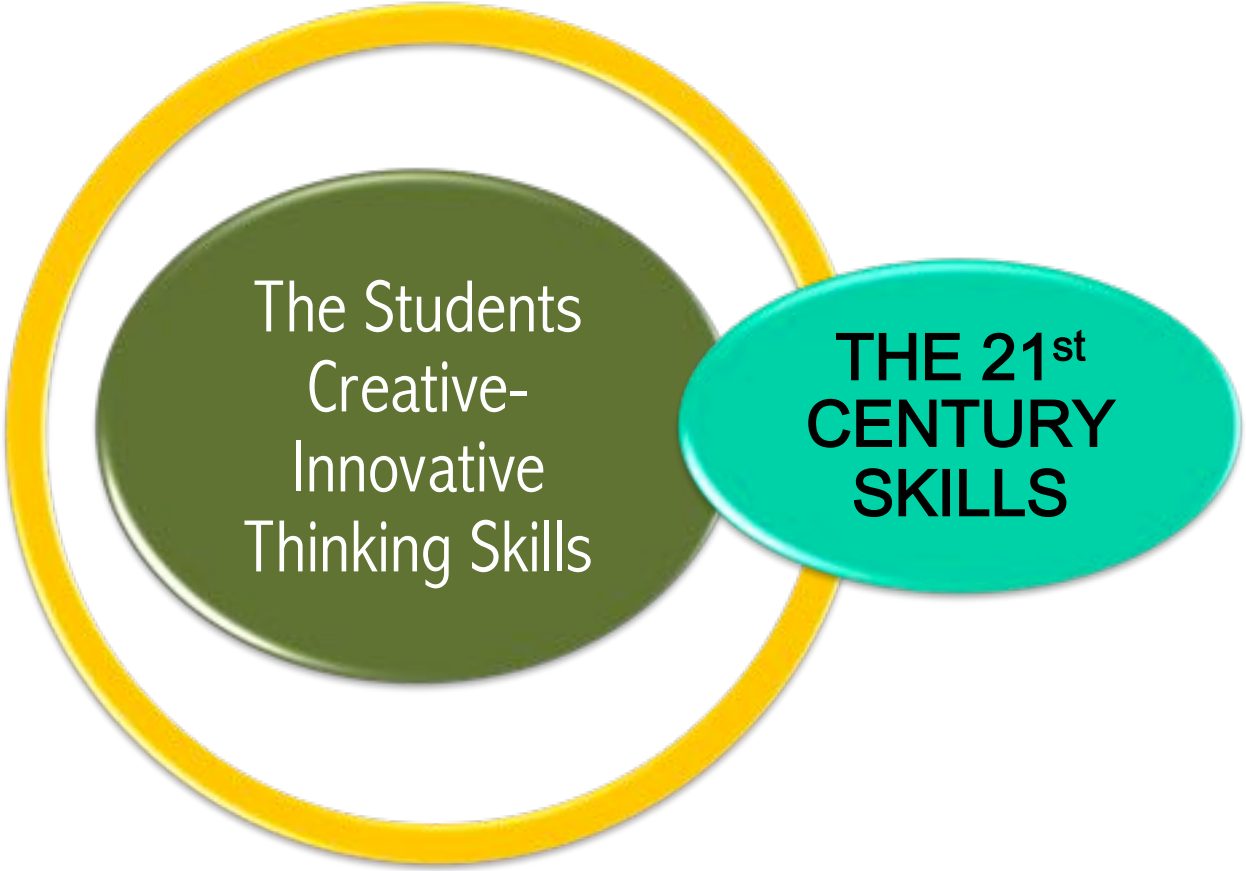
## Cryptosystem Techniques, Dafik, *et.all*

- **The Construction of Encryption Key by Using a Super H-antimagic Total Graph** (Program and Abstract the Asian Mathematical Conference AMC 2016, vol 408)
- **Implementation of Super H-antimagic Total Graph on Establishing Stream Cipher** (Indonesian Journal of Combinatorics 2019, vol 3 issue 1)
- **The Construction of Block Cipher Encryption Key By Using A Local Super Antimagic Total Face Coloring** (Advances in Mathematics: Scientific Journal 2020, vol 9 issue 3)

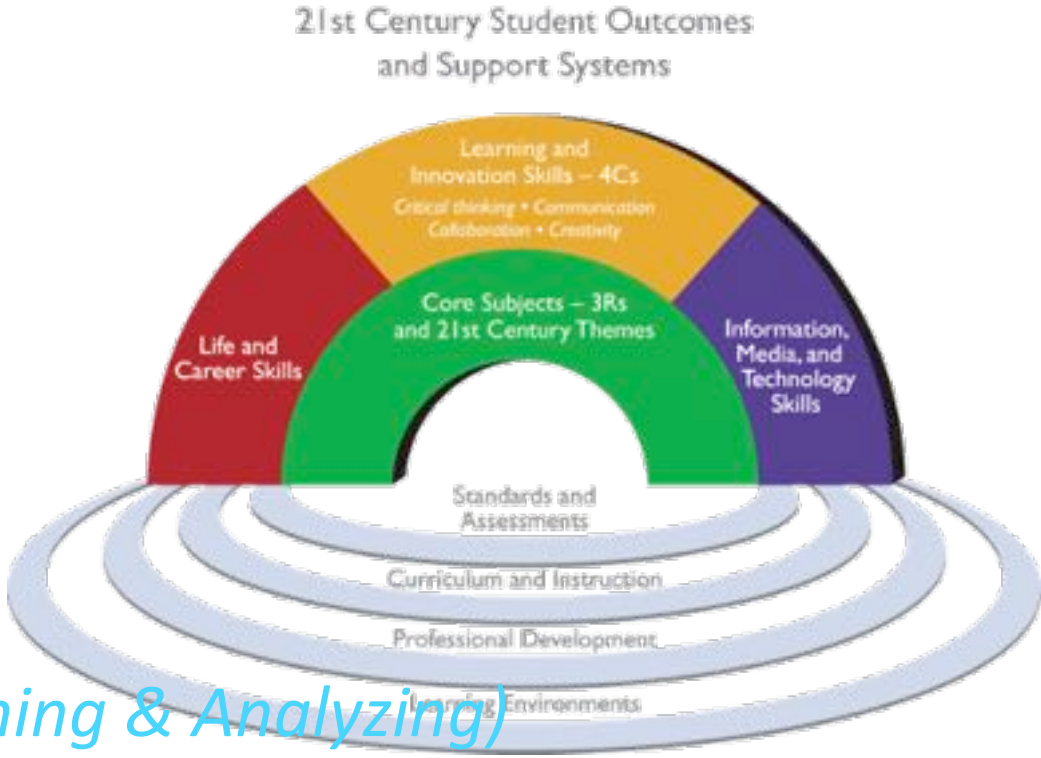
## Research Based Learning, Dafik, *et.all*

- **The effectiveness of Research Based Learning in improving students' achievement in solving two-dimensional arithmetic sequence problems** (International Journal of Instruction 2019, vol 12 issue 1)
- **The effectiveness of problem-based learning to improve students' conjecturing ability in solving block-paving problems** (International Journal of Scientific and Technology Research 2019, vol 8 issue 10)

# CREATIVE-INNOVATIVE: THE 21st CENTURY SKILLS



# CREATIVE-INNOVATIVE: THE 21st CENTURY SKILLS




## The 4Cs

- Creative-Innovative

  *(Novelty)*

- Critical Thinking

  *(Questioning, Reasoning & Analyzing)*

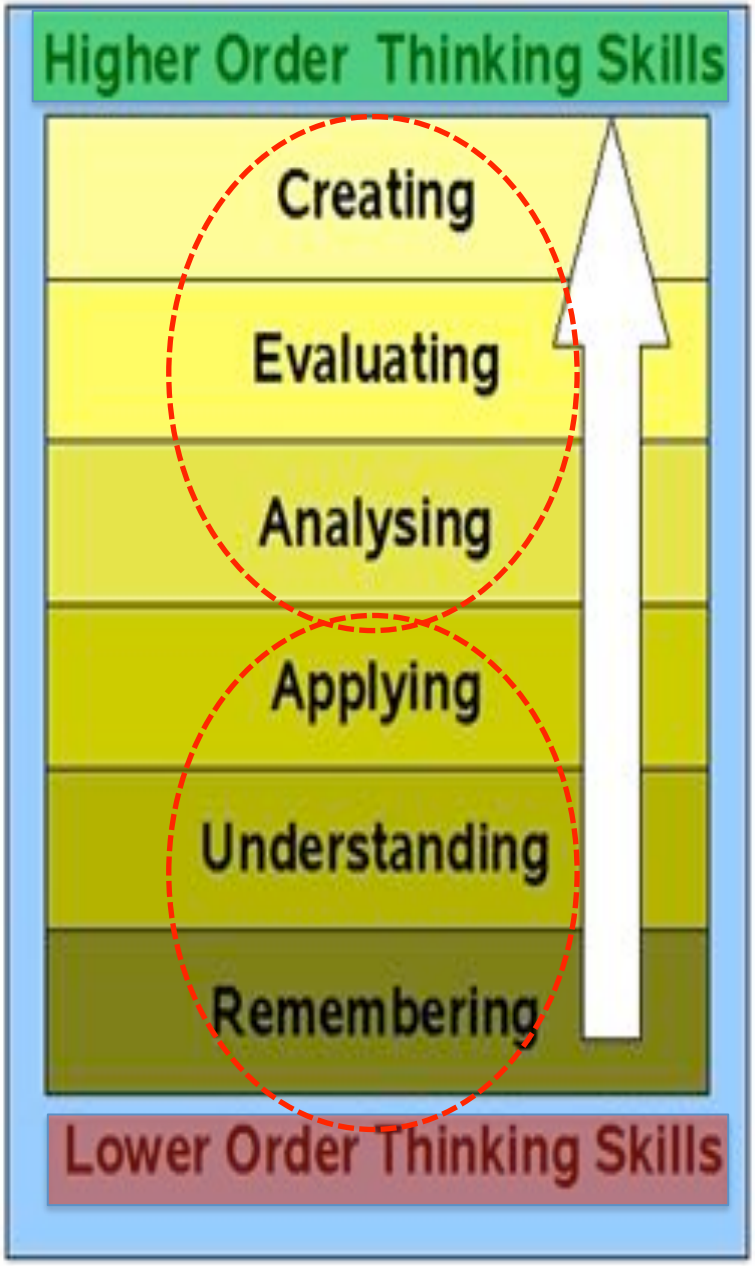
- Communication

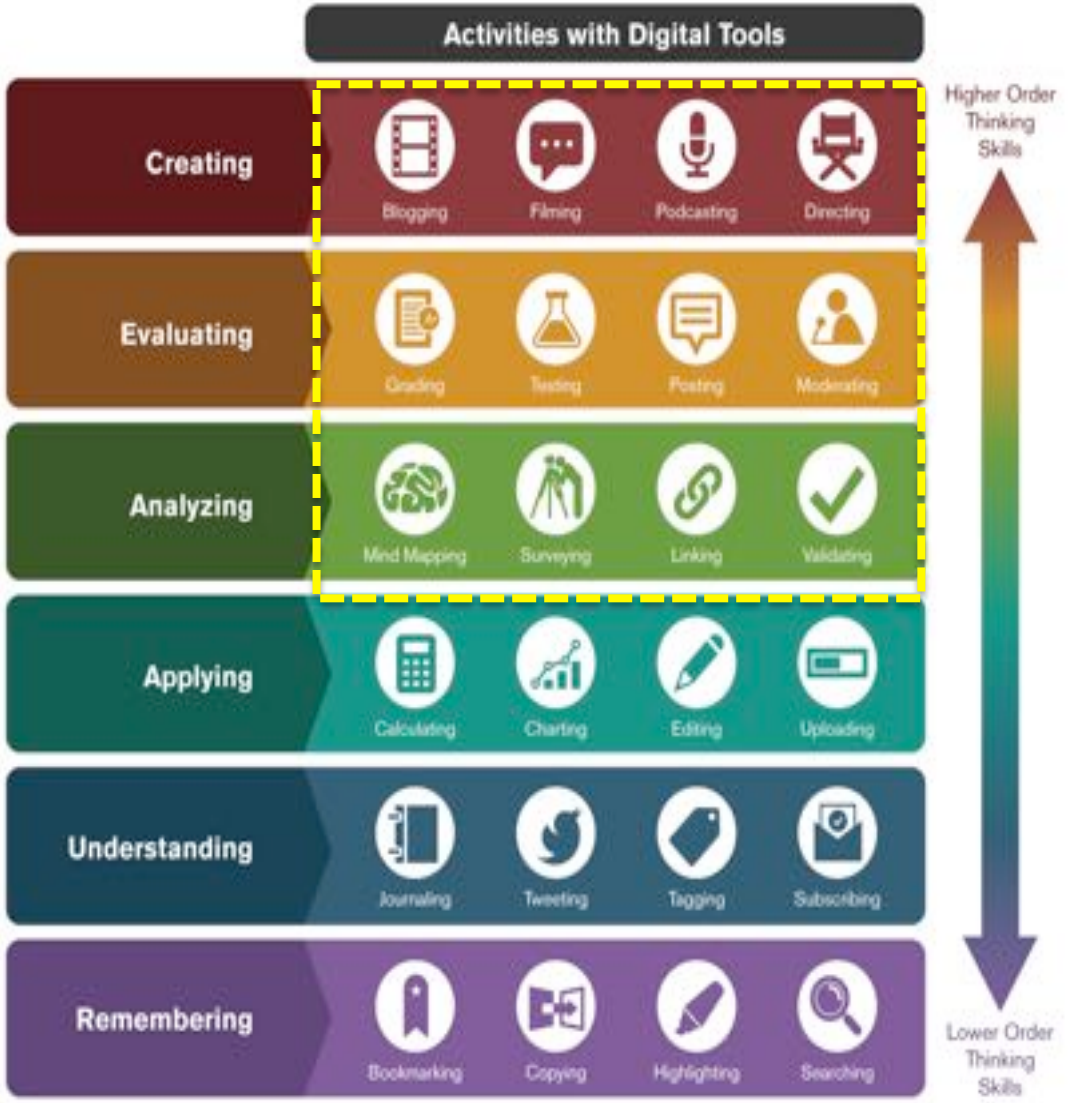
  *(Use of Hypermedia in Communication)*

- Collaboration

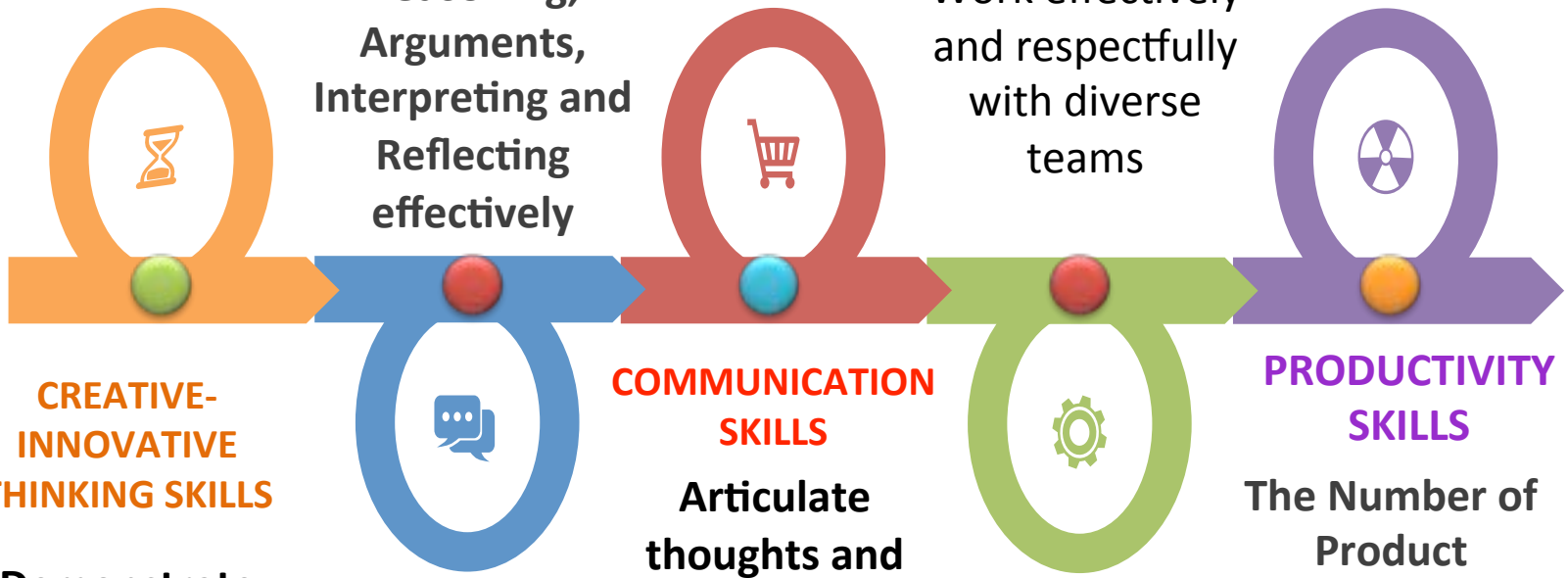
  *(Cross Country Diversity Collaboration)*

# CREATIVE-INNOVATIVE: ON BLOOM DIGITAL TAXONOMY



# CREATIVE-INNOVATIVE: THE 21st CENTURY SKILL INDICATORS



**CREATIVE-INNOVATIVE THINKING SKILLS**

**Demonstrate originality and inventiveness (NOVELTY)**

**CRITICAL THINKING SKILLS**

**Questioning, Analysing, Reasoning, Arguments, Interpreting and Reflecting effectively**

**COMMUNICATION SKILLS**

**Articulate thoughts and ideas using oral, written and nonverbal skills in a variety of forms and contexts**

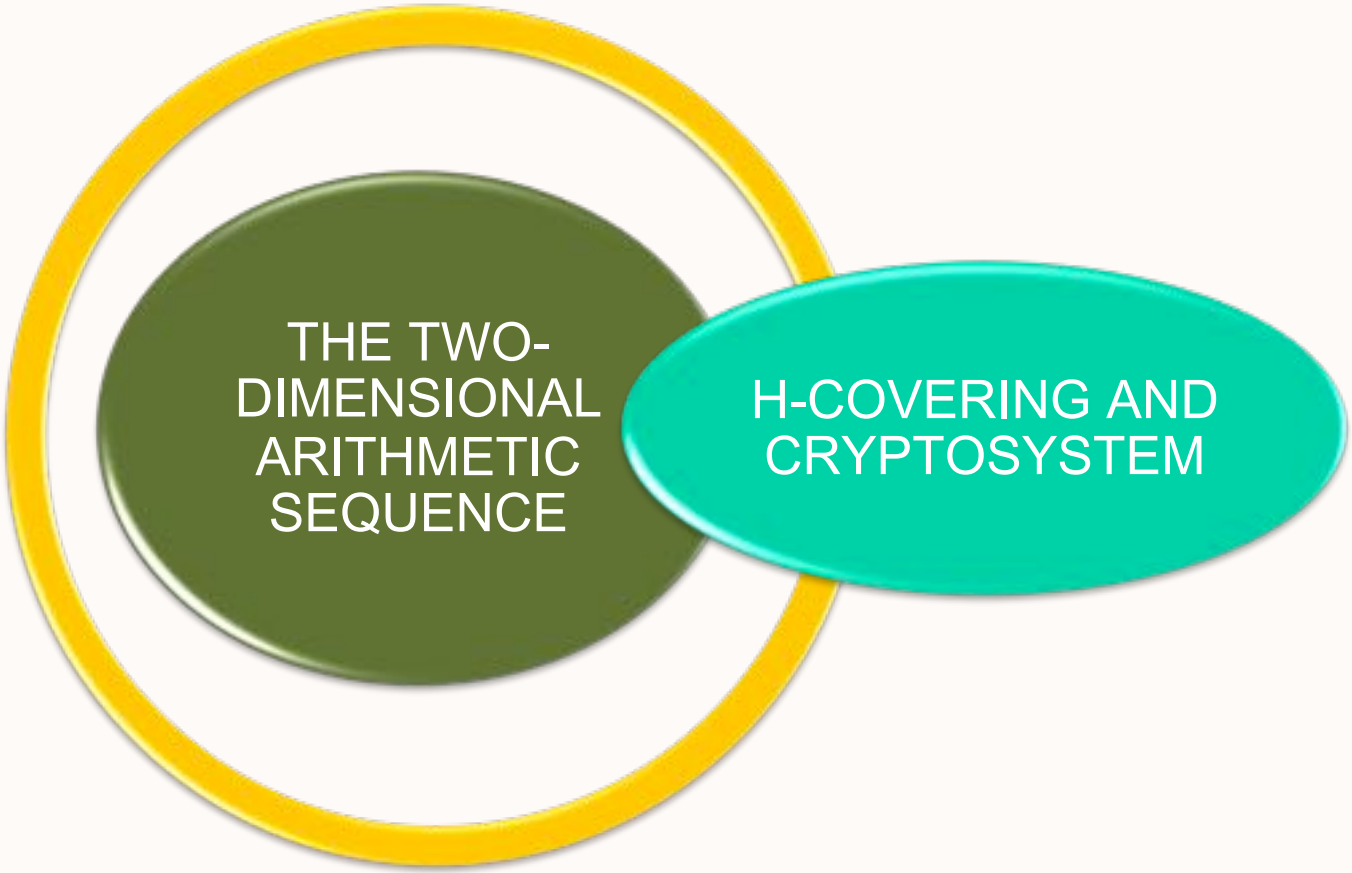
**COLLABORATION SKILLS**

Work effectively and respectfully with diverse teams

**PRODUCTIVITY SKILLS**

**The Number of Product Achievements, Speed, Average numbers of Innovation and improvements**

# TWO-DIMENSIONAL ARITHMETIC SEQUENCE: H-COVERING AND CRYPTOSYSTEM



# TWO-DIMENSIONAL ARITHMETIC SEQUENCE: THE SIMPLE CONCEPT

**Let *a* be an initial value, and *d* be a diffrence. The Arithmetic sequence can be written as follows:**

| $U_1$, | $U_2$, | $U_3$, | $U_4$, | … , | $U_n$ |
|---|---|---|---|---|---|
| *a*, | *a*+d, | *a*+2d, | *a*+3d, | … , | $a + (n - 1)d$ |

**The *i-term* of arithmetic sequence is $U_n = a + (n - 1)d$. The two dimensional Arithmetic sequence is the sequence consists of *m,n* elements.**

# TWO-DIMENSIONAL ARITHMETIC SEQUENCE: THE SIMPLE CONCEPT

Table 2.1.a
Base Terms
$n = 3$ and $m = 2$

| $i$ \ $j$ | 1 | 2 | 3 |
|---|---|---|---|
| 1 | 1 | 2 | 3 |
| 2 | 4 | 5 | 6 |
| Jml | **5** | **7** | **9** |

$d$ : +2 +2

$$P^{n}_{m,d} = P^{3}_{2,2}$$

Table 2.1.b
Local Generalisation
$n = 4$ and $m = 2$

| $i$ \ $j$ | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1 | 1 | 2 | 3 | 4 |
| 2 | 5 | 6 | 7 | 8 |
| Jml | **6** | **8** | **10** | **12** |

$d$ : +2 +2 +2

$$P^{n}_{m,d} = P^{4}_{2,2}$$

Table 2.1.c
Local Generalisation
$n = 5$ and $m = 3$

| $i$ \ $j$ | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1 | 1 | 2 | 3 | 4 | 5 |
| 2 | 6 | 7 | 8 | 9 | 10 |
| 3 | 11 | 12 | 13 | 14 | 15 |
| Jml | **18** | **21** | **24** | **27** | **30** |

$d$ : +3 +3 +3 +3

$$P^{n}_{m,d} = P^{5}_{3,3}$$

# TWO-DIMENSIONAL ARITHMETIC SEQUENCE: THE SIMPLE CONCEPT

Table 2.2.a
Base Terms
$n = 3$ & $m = 2$

| $i$ \ $j$ | 1 | 2 | 3 |
|---|---|---|---|
| 1 | 1 | 3 | 5 |
| 2 | 2 | 4 | 6 |
| Jml | 3 | 7 | 11 |

$d$ : +4 +4

$$P^{n}_{m,d} = P^{3}_{2,4}$$

Table 2.2.b
Local Generalisation
$n = 4$ & $m = 3$

| $i$ \ $j$ | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1 | 1 | 4 | 7 | 10 |
| 2 | 2 | 5 | 8 | 11 |
| 3 | 3 | 6 | 9 | 12 |
| Jml | 6 | 15 | 24 | 33 |

$d$ : +9 +9 +9

$$P^{n}_{m,d} = P^{4}_{3,9}$$

Table 2.2.c
Local Generalisation
$n = 5$ & $m = 4$

| $i$ \ $j$ | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1 | 1 | 5 | 9 | 13 | 17 |
| 2 | 2 | 6 | 10 | 14 | 18 |
| 3 | 3 | 7 | 11 | 15 | 19 |
| 4 | 4 | 8 | 12 | 16 | 20 |
| Jml | 10 | 26 | 42 | 58 | 74 |

$d$ : +16 +16 +16 +16

$$P^{n}_{m,d} = P^{5}_{4,16}$$

# TWO-DIMENSIONAL ARITHMETIC SEQUENCE: THE SIMPLE CONCEPT

Tabel 2.3.a
Base Terms
$n = 3$ and $m = 2$

| $i$ \ $j$ | 1 | 2 | 3 |
|---|---|---|---|
| 1 | 1 | 4 | 2 |
| 2 | 5 | 3 | 6 |
| Jml | 6 | 7 | 8 |

$d$ : +1 +1

$$P^n_{m,d} = P^3_{2,1}$$

Tabel 2.3.b
Local Generalisation
$n = 5$ and $m = 4$

| $i$ \ $j$ | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1 | 1 | 6 | 2 | 7 | 3 |
| 2 | 8 | 4 | 9 | 5 | 10 |
| 3 | 11 | 16 | 12 | 17 | 13 |
| 4 | 18 | 14 | 19 | 15 | 20 |
| Jml | 38 | 40 | 42 | 44 | 46 |

$d$ : +2 +2 +2 +2

$$P^n_{m,d} = P^5_{4,2}$$

Tabel 2.3.c
Local Generalisation
$n = 5$ *and* $m = 6$

| $i$ \ $j$ | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1 | 1 | 6 | 2 | 7 | 3 |
| 2 | 8 | 4 | 9 | 5 | 10 |
| 3 | 11 | 16 | 12 | 17 | 13 |
| 4 | 18 | 14 | 19 | 15 | 20 |
| 5 | 21 | 26 | 22 | 27 | 23 |
| 6 | 28 | 24 | 29 | 25 | 30 |
| Jml | 87 | 90 | 93 | 96 | 99 |

$d$ : +3 +3 +3 +3

$$P^n_{m,d} = P^5_{6,3}$$

Table 2.6.a

Global Generalization of $m,n$

| $i$ / $j$ | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1 | 1 | 2 | 3 | 4 | 5 | 6 |
| 2 | 7 | 8 | 9 | 10 | 11 | 12 |
| 3 | 13 | 14 | 15 | 16 | 17 | 18 |
| 4 | 19 | 20 | 21 | 22 | 23 | 24 |
| 5 | ... | ... | ... | ... | ... | ... |

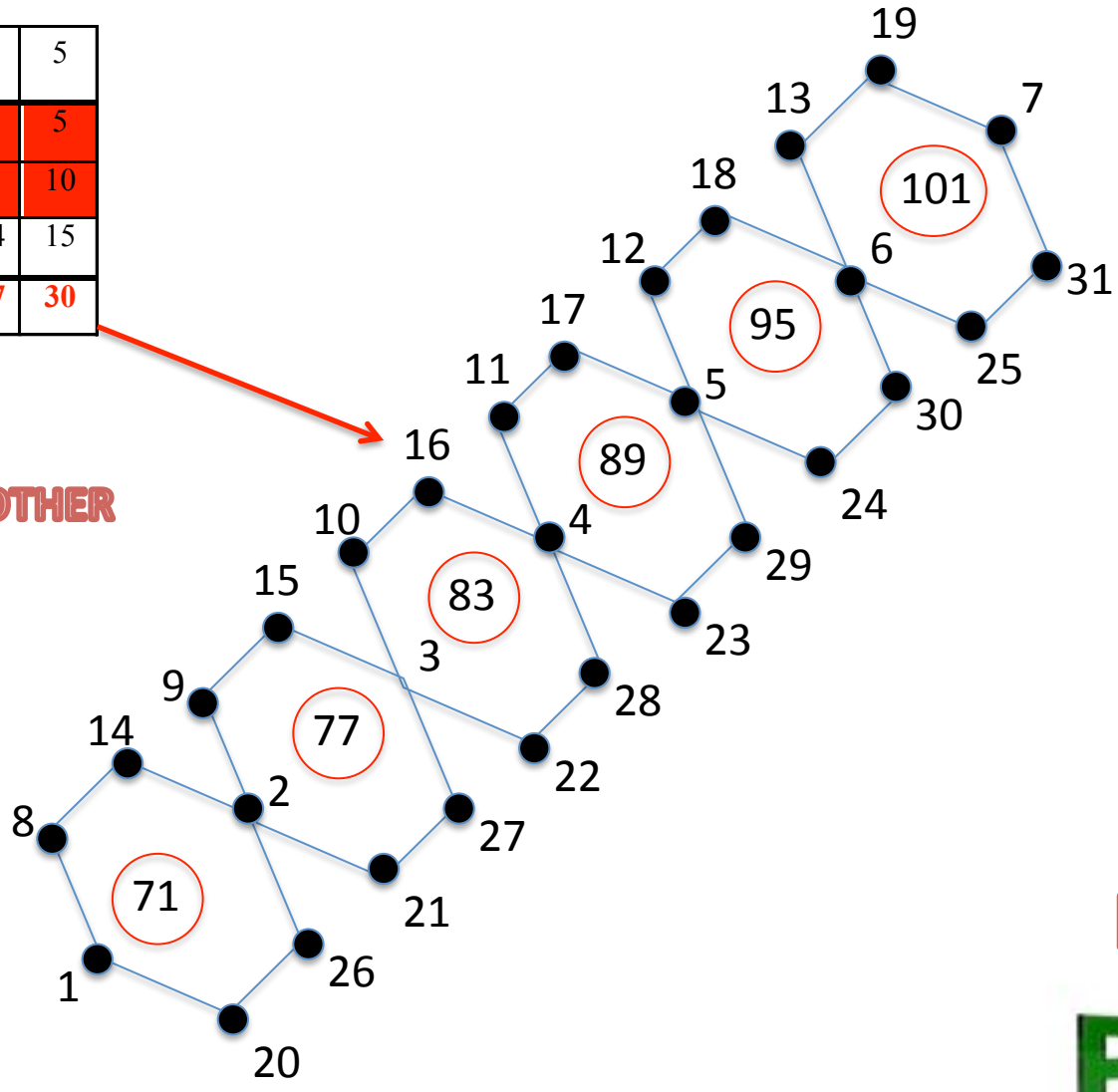
$$\ldots U_n = a + (n-1)d$$
$$= 1 + (i-1)1$$

$$\ldots U_m = a + (m-1)d$$
$$= 1 + (j-1)n$$

$$P^n_{m,d}(i,j) = (j-1)n + i$$

# TWO-DIMENSIONAL ARITHMETIC SEQUENCE: THE TRANSFORMATIONS

| i \ j | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1 | 1 | 2 | 3 | 4 | 5 |
| 2 | 6 | 7 | 8 | 9 | 10 |
| 3 | 11 | 12 | 13 | 14 | 15 |
| Jml | 18 | 21 | 24 | 27 | 30 |

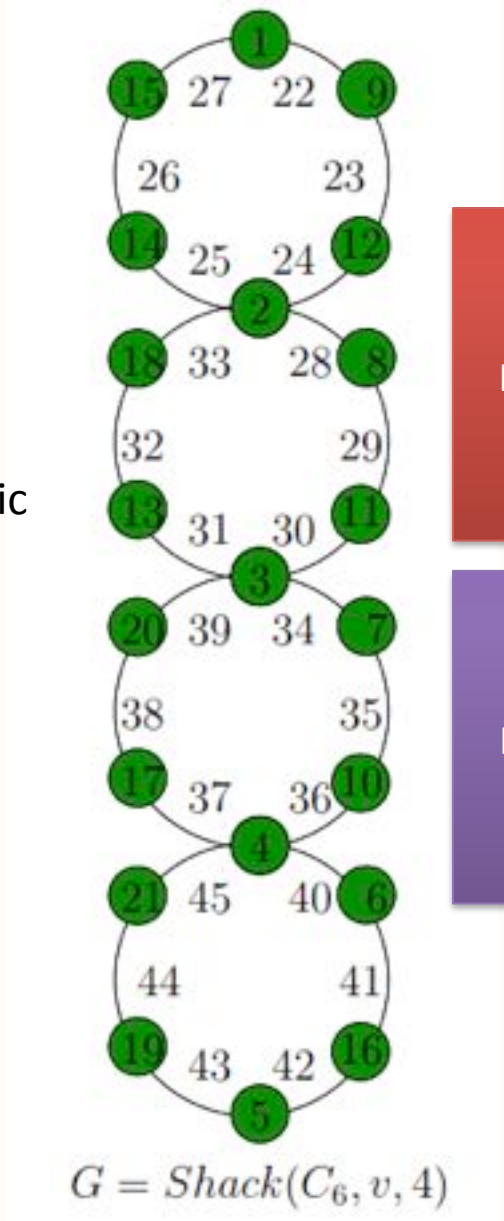



CAN YOU FIND OTHER PATERNS?

IT IS RG PROBLEMS

# TWO-DIMENSIONAL ARITHMETIC SEQUENCE: THE APPLICATIONS

The result of super H-antimagic total graph on *G=Shack($C_6$, v, 4)*



$G = Shack(C_6, v, 4)$

ENCRYPTION → $y_i=(x_i+k_i)(mod\ 26)$

DECRYPTION → $x_i=(y_i-k_i)(mod\ 26)$

Affine Chiper

# TWO-DIMENSIONAL ARITHMETIC SEQUENCE: THE CONCEPT OF CRYPTOSYSTEM

***Cryptosystem*** is a system which converts plain text to cipher text or cipher text to plain text by the application of encryption or decryption algorithm.

The strength of cryptosystem relays on the management of *encryption key*.

The key should be managed such that it is hard for any intruder to analyze the key.

The main issue is how to develop a secure modern cryptosystem such that the key between plaintext and ciphertext is hidden.

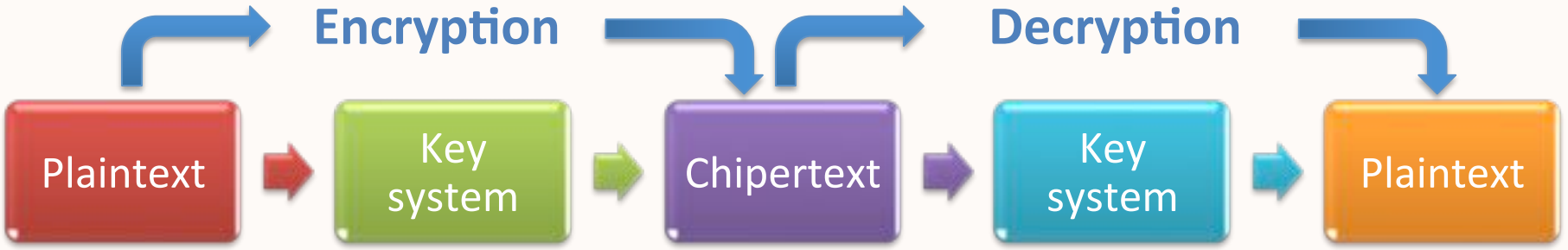
# TWO-DIMENSIONAL ARITHMETIC SEQUENCE: THE ENCRYPTION AND DECRYPTION

## Encryption

- the process of transforming information so it is unintelligible to anyone but the intended recipient

## Decryption

- the process of transforming encrypted information so that it is intelligible again



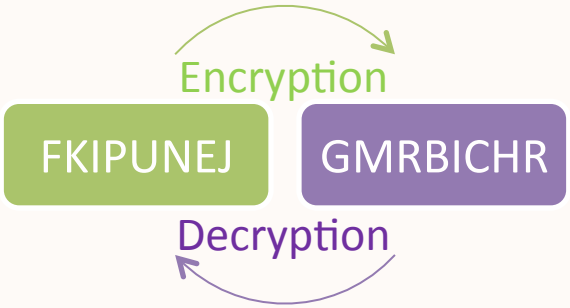
# TWO-DIMENSIONAL ARITHMETIC SEQUENCE: THE APPLICATIONS

The result of encryption process which super H-antimagic total graph on *G=Shack($C_6$, v, 4)* as keystream

| Plaintext | $x_i$ | $k_i$ | $x_i+k_i$ | $y_i$ | Chipertext |
|---|---|---|---|---|---|
| F | 5 | 1 | 6 | 6 | G |
| K | 10 | 2 | 12 | 12 | M |
| I | 8 | 9 | 17 | 17 | R |
| P | 15 | 12 | 27 | 1 | B |
| U | 20 | 14 | 34 | 8 | I |
| N | 13 | 15 | 28 | 2 | C |
| E | 4 | 3 | 7 | 7 | H |
| J | 9 | 8 | 17 | 17 | R |

The result of decryption process which super H-antimagic total graph on *G=Shack($C_6$, v, 4)* as keystream

| Chipertext | $y_i$ | $k_i$ | $y_i-k_i$ | $x_i$ | Plaintext |
|---|---|---|---|---|---|
| G | 6 | 1 | 5 | 5 | F |
| M | 12 | 2 | 10 | 10 | K |
| R | 17 | 9 | 8 | 8 | I |
| B | 1 | 12 | 15 | 15 | P |
| I | 8 | 14 | 20 | 20 | U |
| C | 2 | 15 | 13 | 13 | N |
| H | 7 | 3 | 4 | 4 | E |
| R | 17 | 8 | 9 | 9 | J |



# TWO-DIMENSIONAL ARITHMETIC SEQUENCE: THE COMBINATORIAL PROBLEMS

**Combinatorics** is an area of mathematics primarily concerned with counting, both as a means and an end in obtaining results, and characterizing a property of finite structures

The well-known founding fathers of combinatorial problems were Pascal (1623-1662), Jacob Bernoulli (1654-1705) and Leonhard Euler (1707-1783)

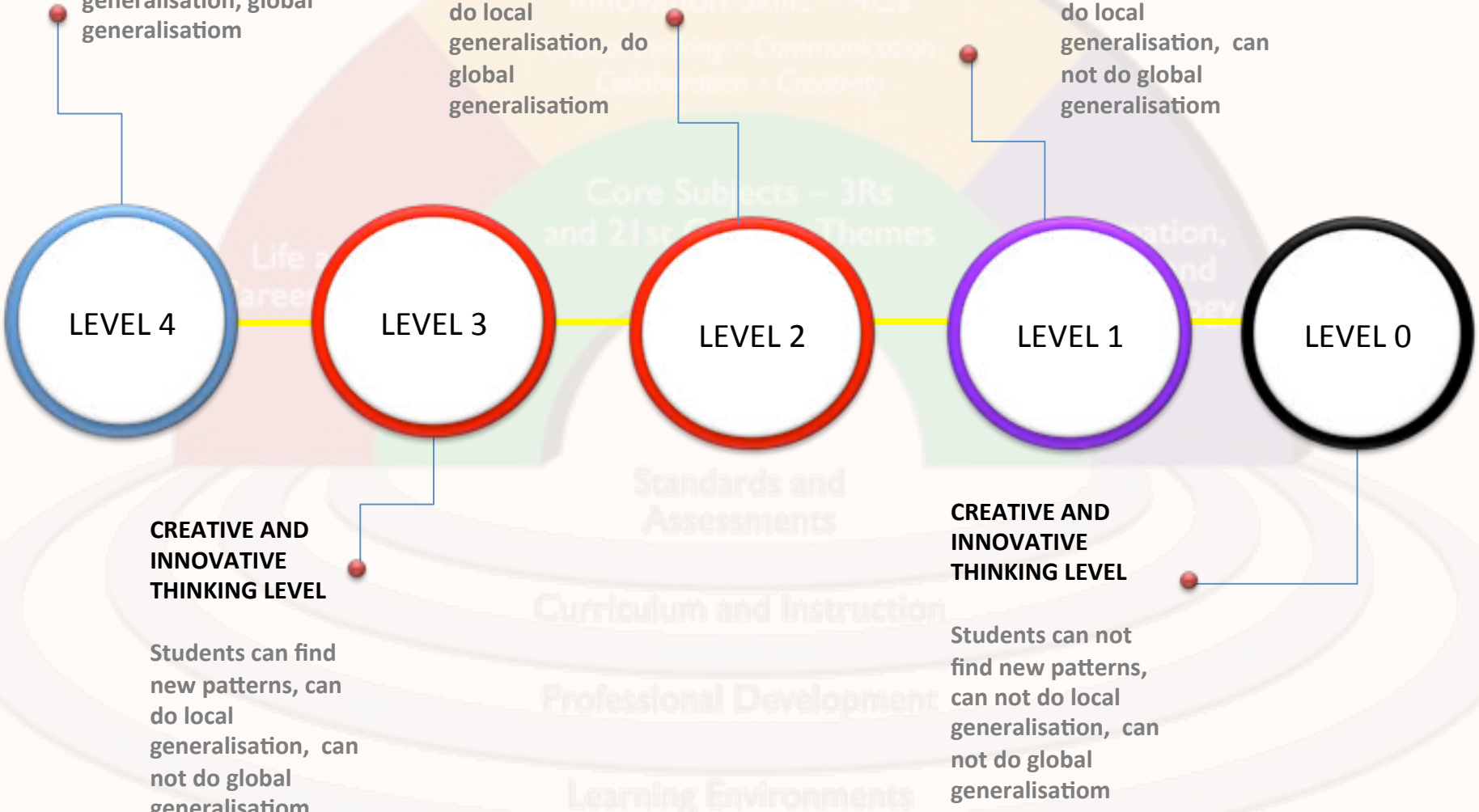
**Combinatorial Problems**

- Does the solution exist?
- How unique are they?
- How optimum are they?
- Can we generalize it?
- Can we prove it?

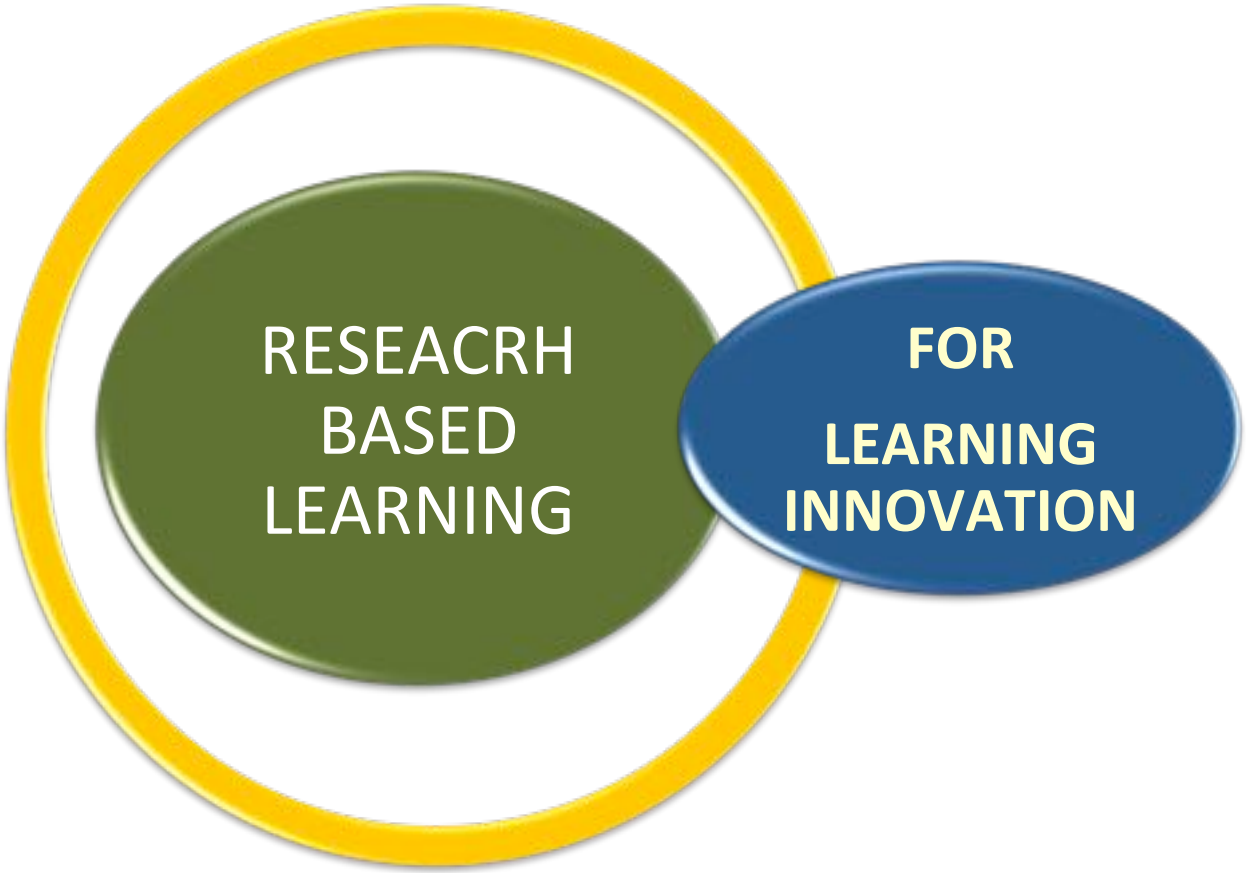
**21st Century Skills**

- Innovative Thinking Skills
- Creative Thinking Skills
- Critical Thinking Skills
- Communication Skills
- Collaboration Skills

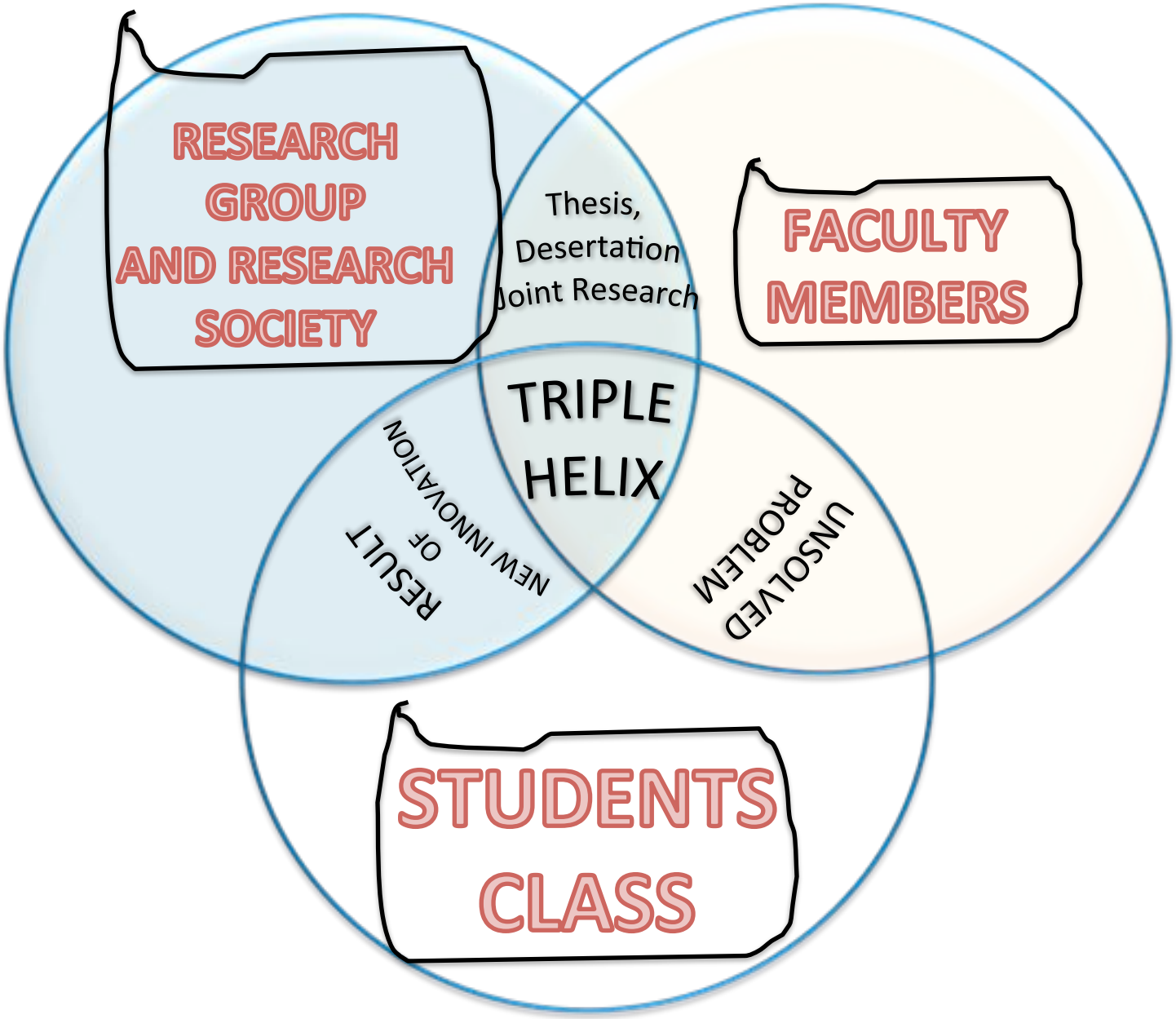
# TWO-DIMENSIONAL ARITHMETIC SEQUENCE: THE CREATIVE-INNOVATIVE INDICATORS



# RESEARCH-BASED LEARNING: FOR LEARNING AND RESEARCH DEVELOPMENT



# RESEARCH BASED LEARNING: THE TRIPLE HELIX RELATION



# RESEARCH BASED LEARNING: THE PRINCIPLES ON RESEARCH PROCESS

STUDENTS RESEARCH

IS

A LECTURER RESEARCH

# RESEARCH BASED LEARNING: THE RESEARCH GROUP CONCEPT

**DEFINITION OF RESEARCH GROUP**

RESEARCH GROUP is a group of researchers who work on teaching, researching and supervising on specific research of interest to solve a fundamental problem from a simple to complex, from invention, innovation and diffusion to pursue a real-life applications, journal publications, books, patents, prototype for, and copyrights containing a high novelty results.

**THE EXISTENCE OF RG**

1. **Research Group ca be in departmental level**
2. **Research Group ca be in faculty level**
3. **Research Group ca be in university level**

**For National or international level, we name as a research society**

# RESEARCH-BASED LEARNING: THE RESEARCH GROUP DEVELOPMENT

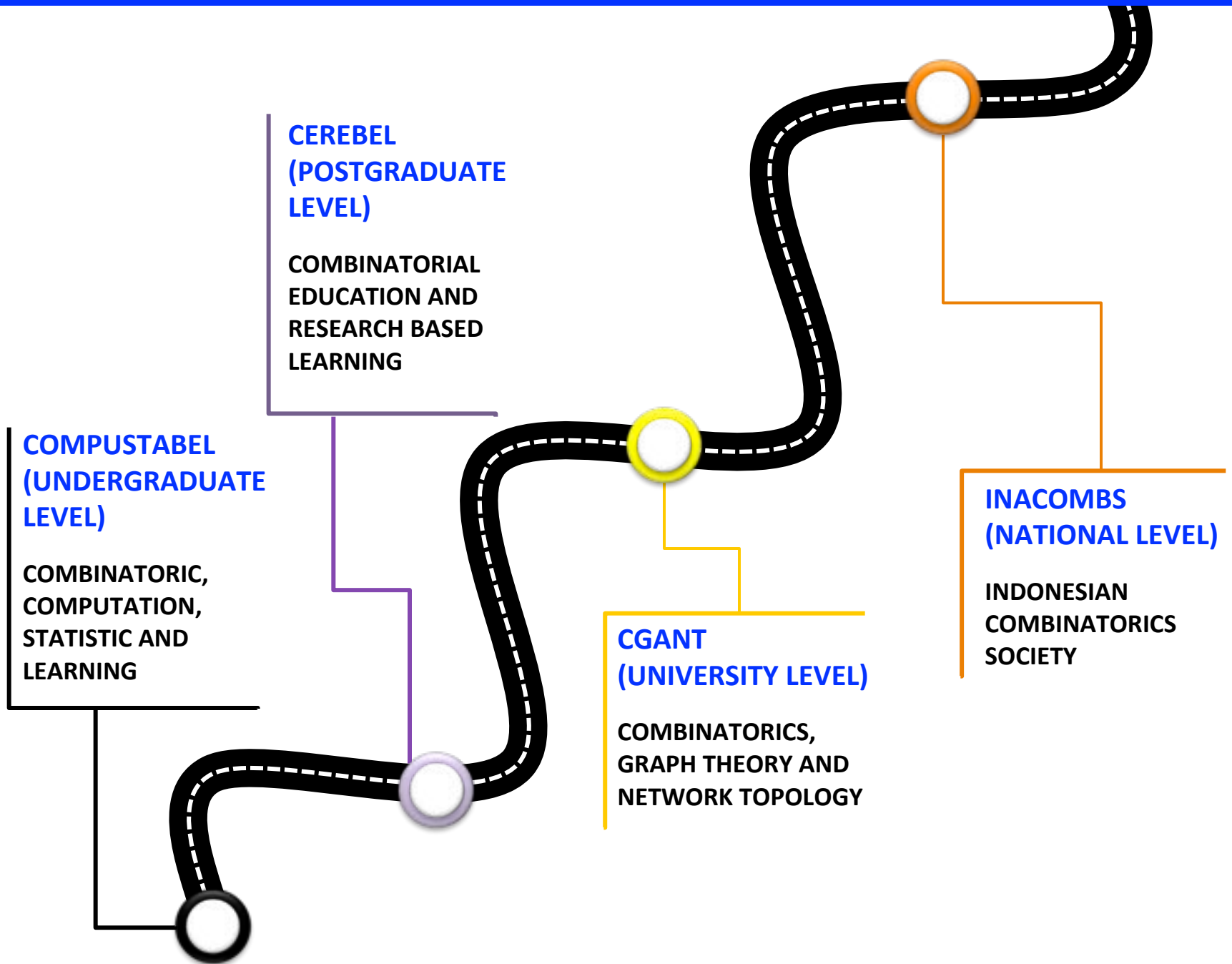
| 2010 | 2011 | 2012 | 2013 | 2014-Now |
|---|---|---|---|---|

**GTA**
**(Graph Theory and Aplication)**
**WORLD WIDE**

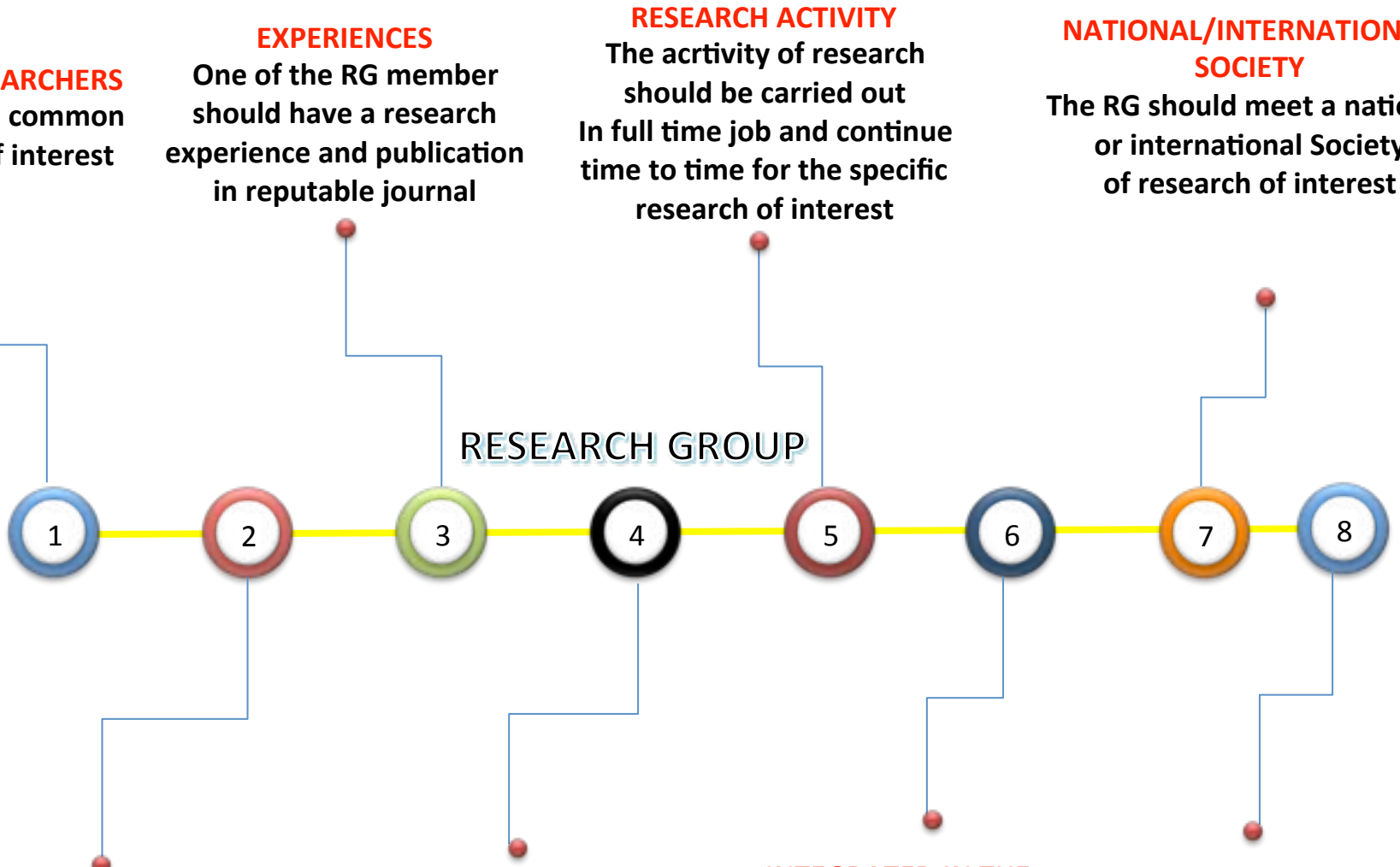
**CGANT**
**(Combinatorics Graph Theory and Network Topology)**
**UNEJ**

**INACOMBS**
**(Indonesian Combinatoric Society)**
**INDONESIA**

# RESEARCH-BASED LEARNING: THE RESEARCH GROUP DEVELOPMENT



# RESEARCH BASED LEARNING: THE SYNTAX OF LEARNING PROCESS IMPLEMENTATION



# RESEARCH-BASED LEARNING: THE DEFINITION

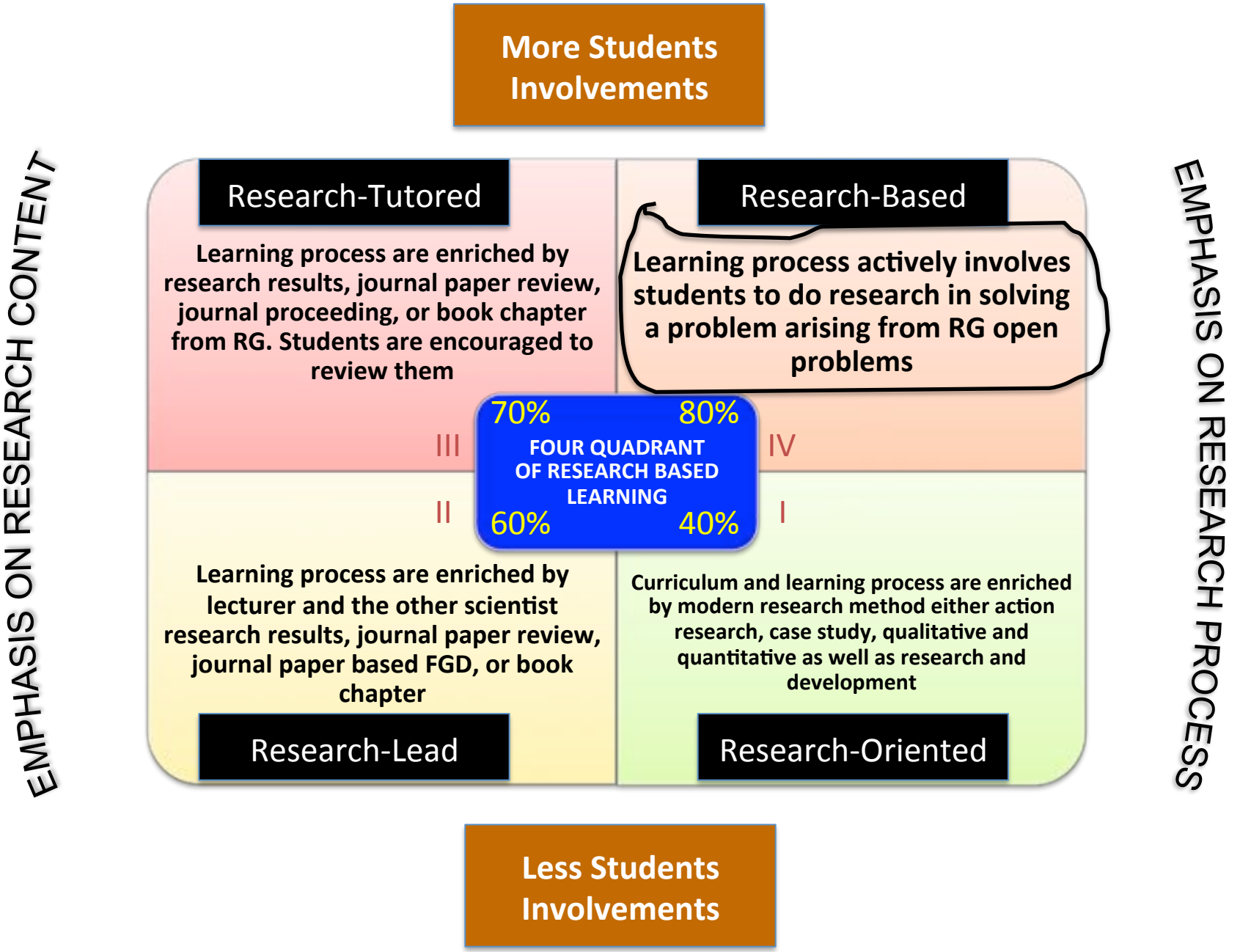
THE CONCEPT OF RESEARCH BASED LEARNING (RBL)

RESEARCH BASED LEARNING IS A TYPE OF SCL MODELS THAT BRINGS THE RESEARCH ELEMENTS INTO THE LEARNING PROCESS (*BLACKMORE, P. AND FRASER, M. 2010*)

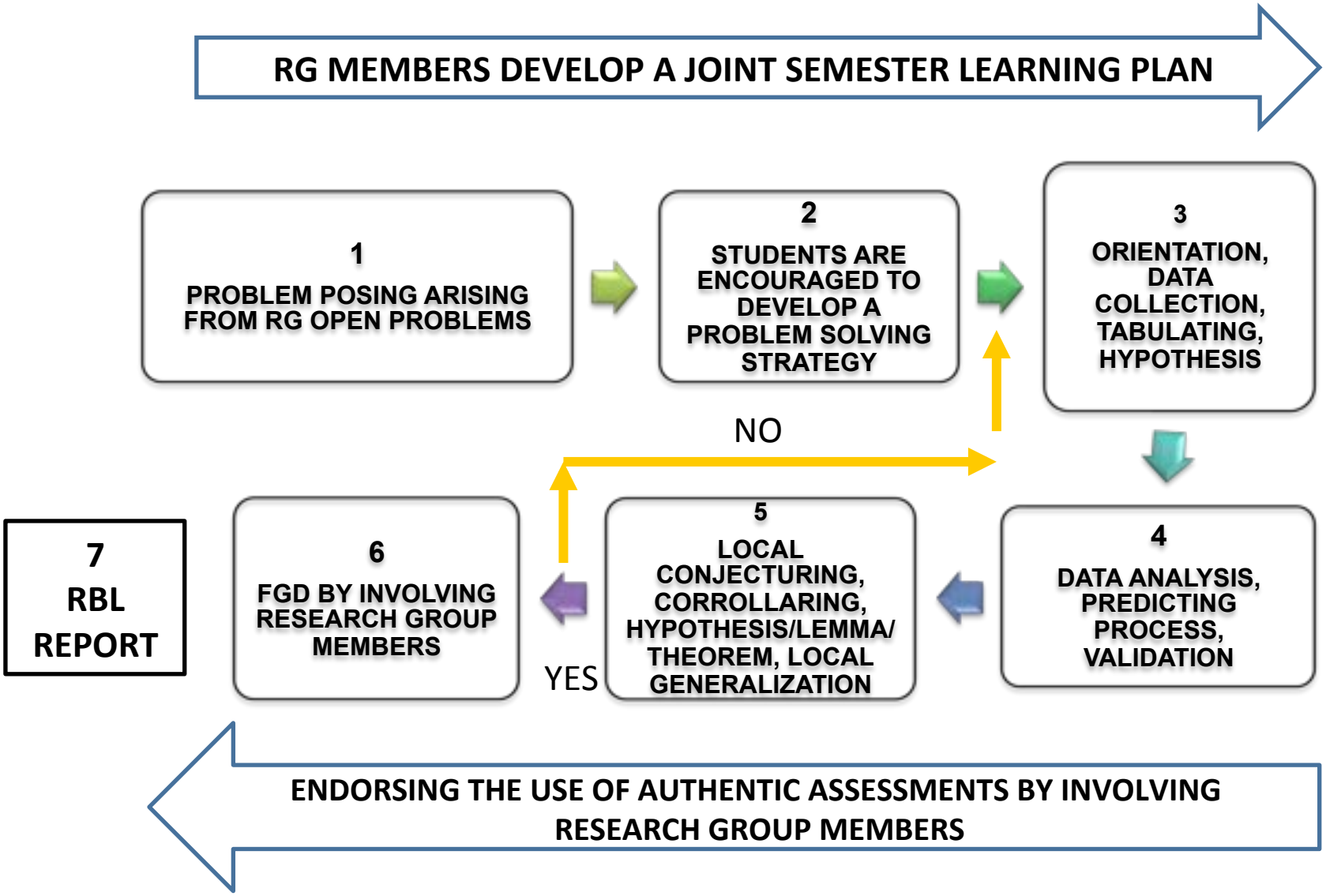
Research based learning is a constructivism based learning involving four aspects: Problem posing regarding on the research open problems, conceptual orientation respecting to the problems, collaboration in collecting and and analyzing data regarding to the problem solving, communicating the research result both oral or writing.

Luanganggoon, Nuchwana, 2012 stated that RBL can improve 5 students skills, namely: 1) Cognitive, 2) Knowledge, 3) Ethics Skill, 4) Social skill and 5) Communication, Arithmetic, Information and Technology skill.

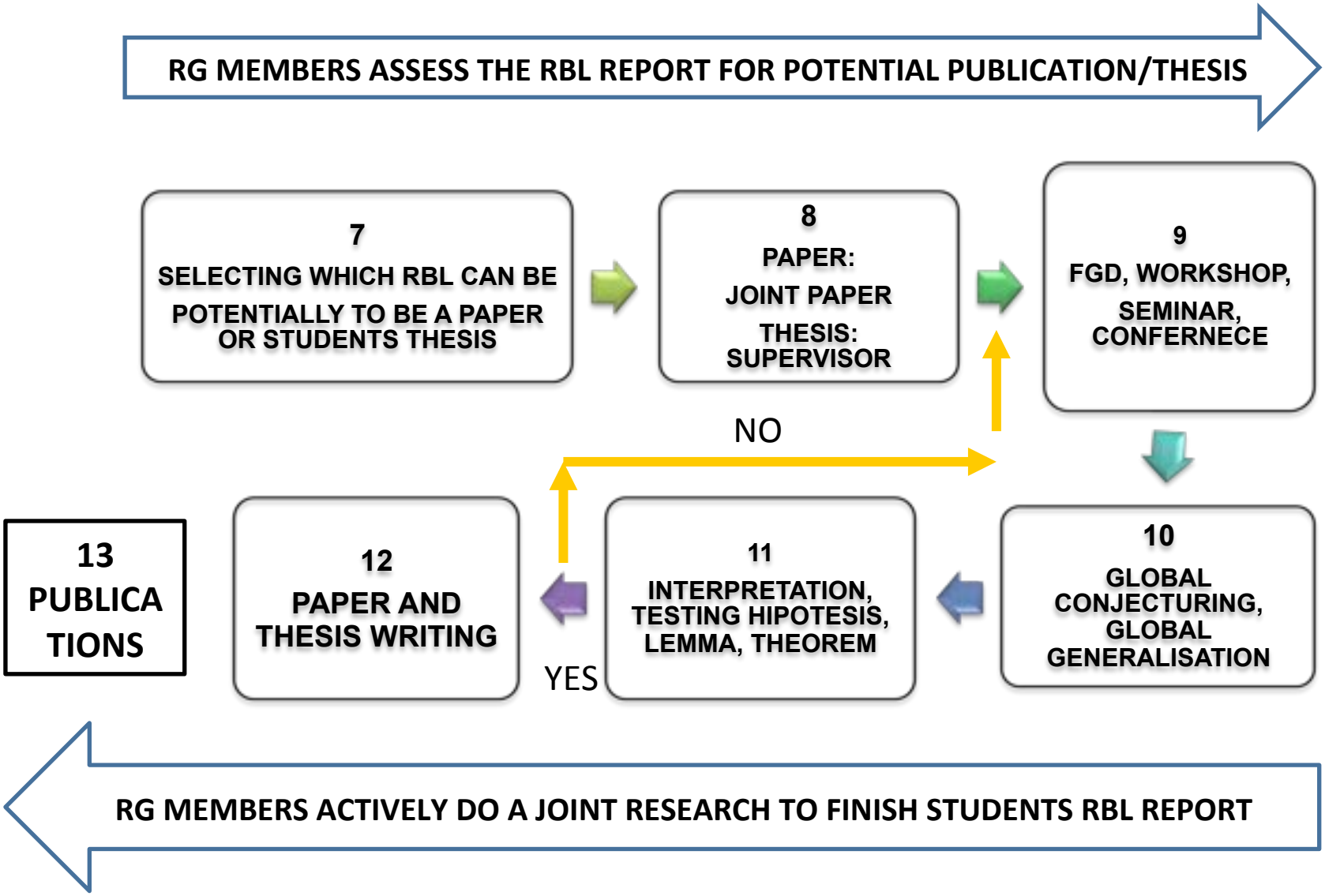
# THE INTEGRATION OF RESEARCH INTO LEARNING PROCESS ( HEALEY, 2013)



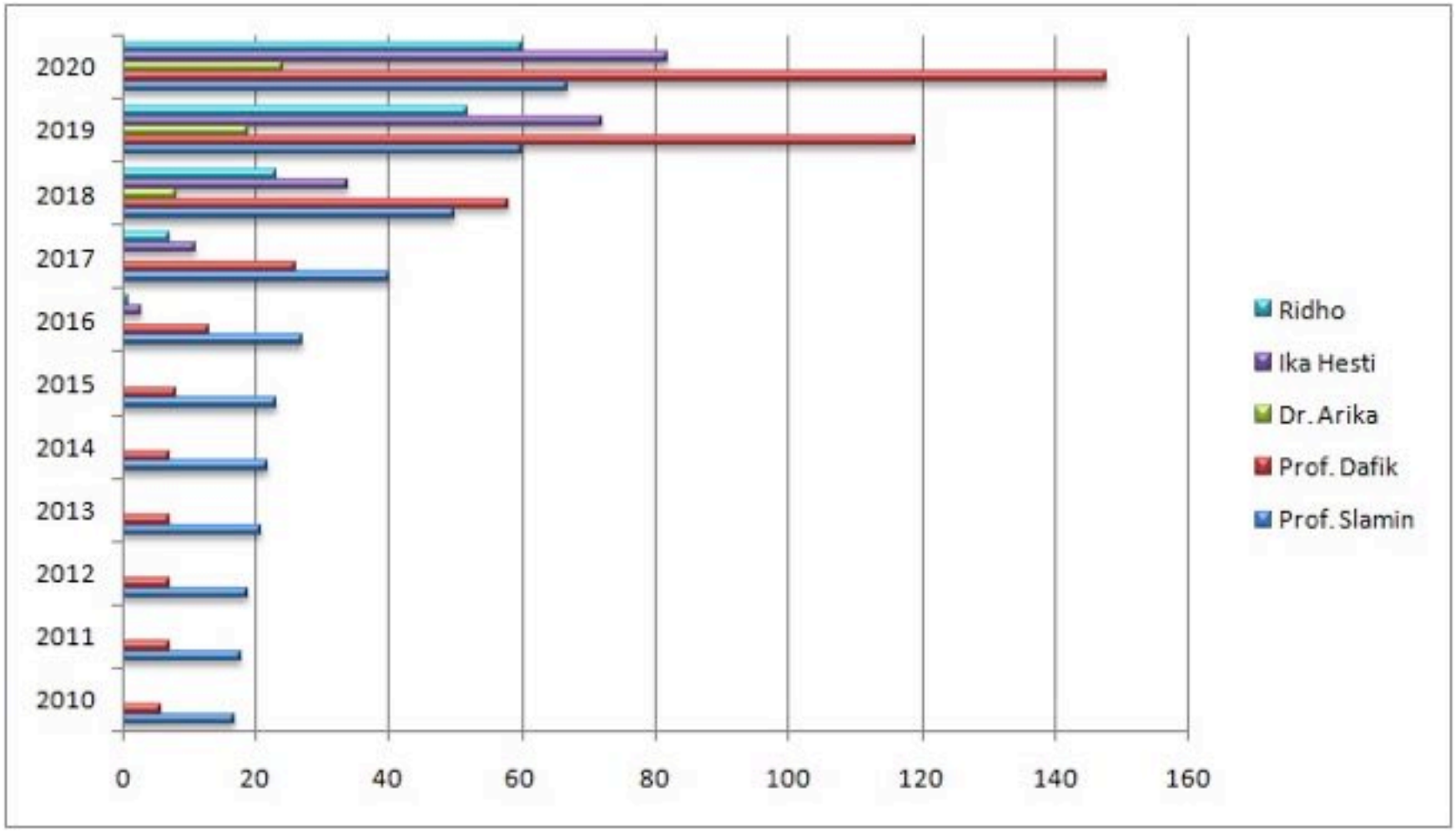
# RESEARCH BASED LEARNING: THE SYNTAX OF LEARNING PROCESS IMPLEMENTATION



# RESEARCH BASED LEARNING: THE SYNTAX OF LEARNING PROCESS IMPLEMENTATION



# THE PUBLICATION ACHIEVEMENTS GAINED BY CGANT RESEARCH GROUP



# THE COUNTRY COMPARISON OF SCOPUS JOURNAL PUBLICATIONS

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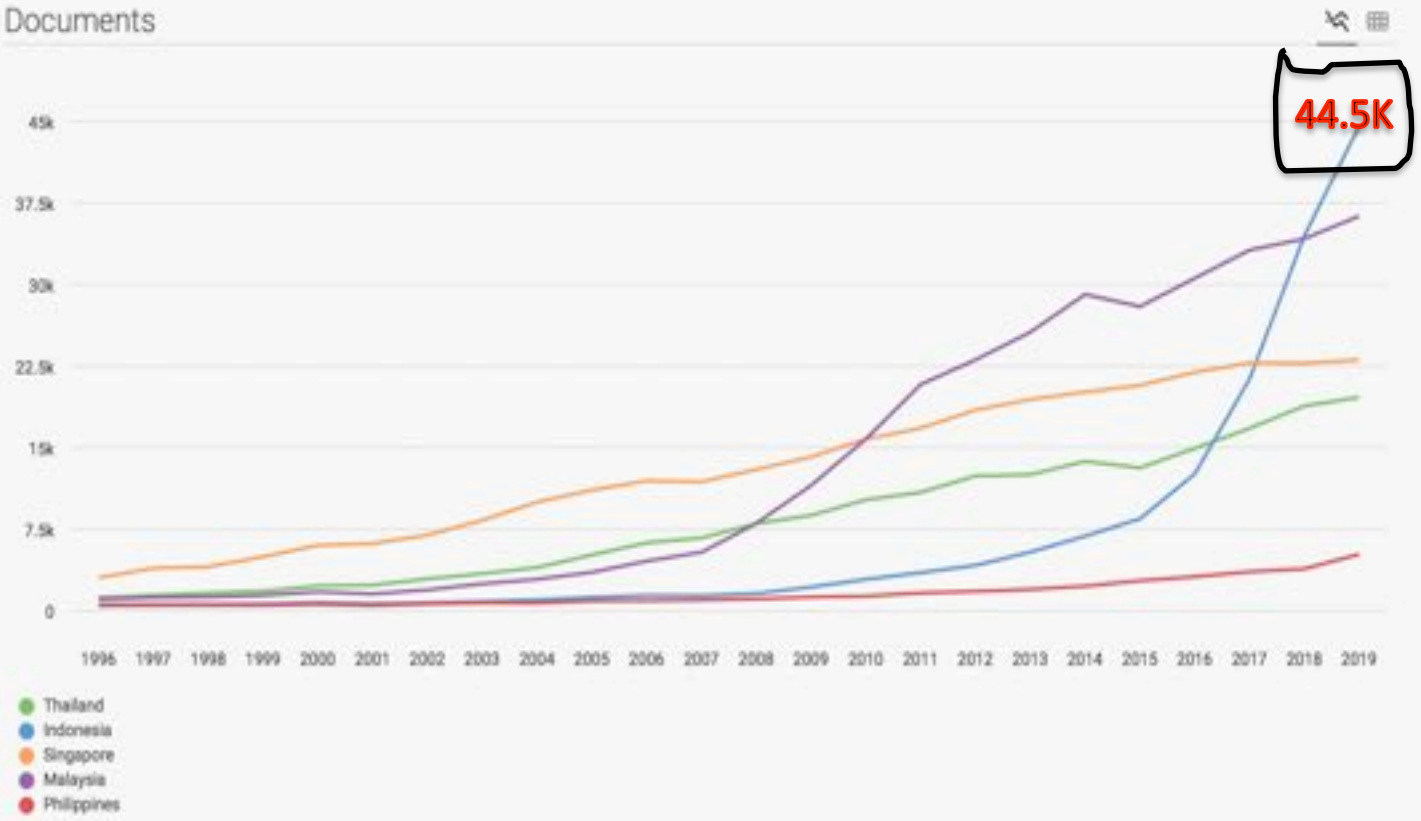
## Country Comparison

enter country name to compare

Thailand × Indonesia × Singapore × Malaysia × Philippines ×

All subject areas

Documents

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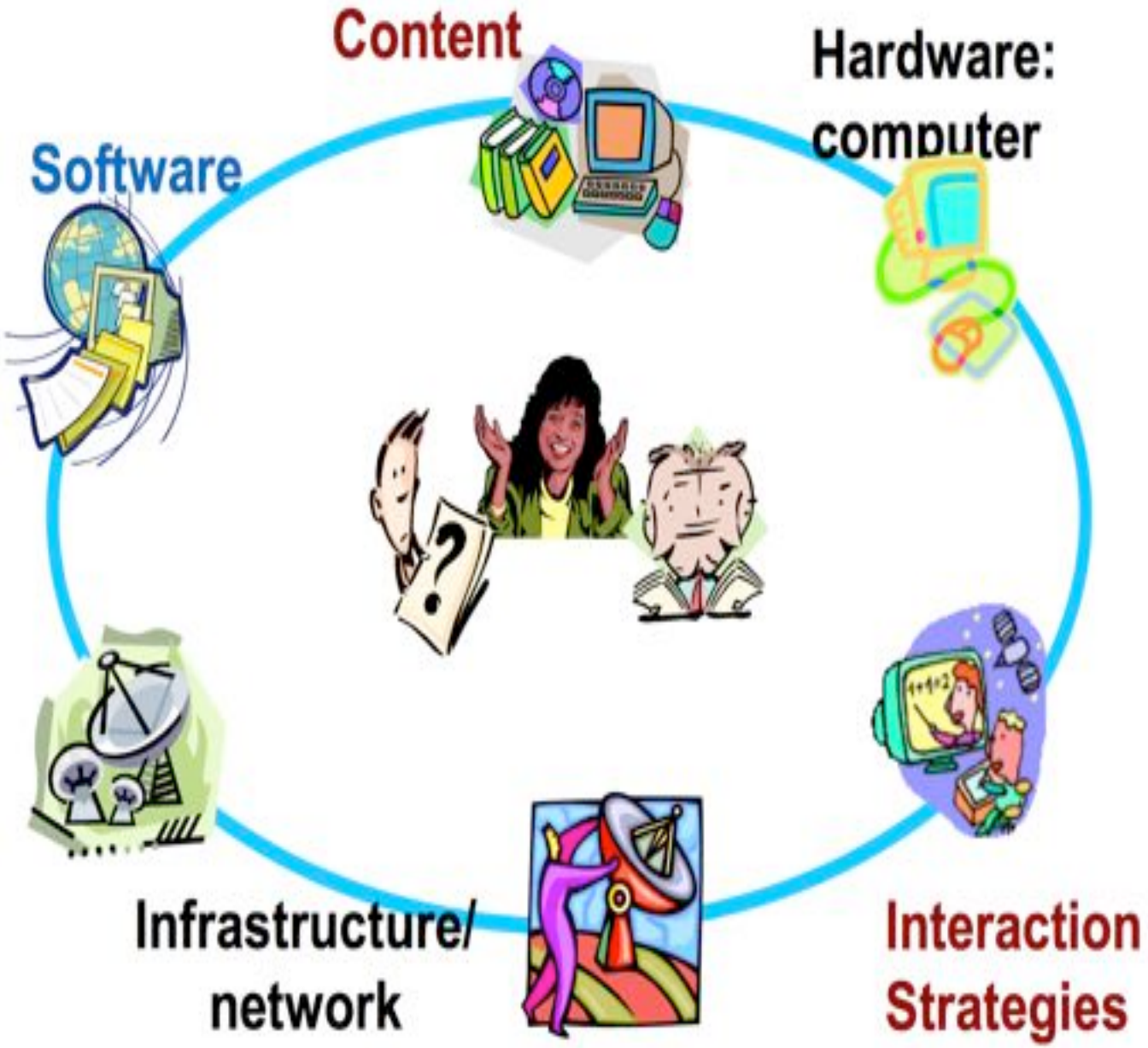
# RESEARCH BASED LEARNING: HOW DO WE INTERACT EACH OTHERS

**Research Topics Identification**

**Hypermedia-Based Research Worksheet**

**Research Process**

**RESEARCH GROUP BRAINSTORMING, FGD AND WORKSHOP FOR PAPER PUBLICATION**

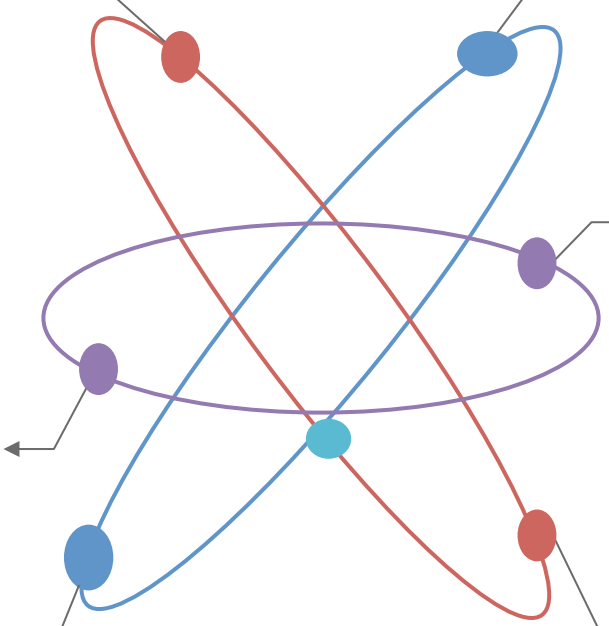


# RESEARCH BASED LEARNING: HOW DO WE INTERACT EACH OTHERS

DEVELOPING A LEARNING MATERIALS BY USING A SIMPLE TUTORIAL AZ-SCREEN RECORDER

DEVELOPING A SLIDE POWERPOINT PRESENTATION BY INSERTING AUDIO AND VIDEO FEATURES

DEVELOPING A SLIDE PRESENTATION BY USING CANVA, CAMTASIA, OR SCREECAST -O- MATIC



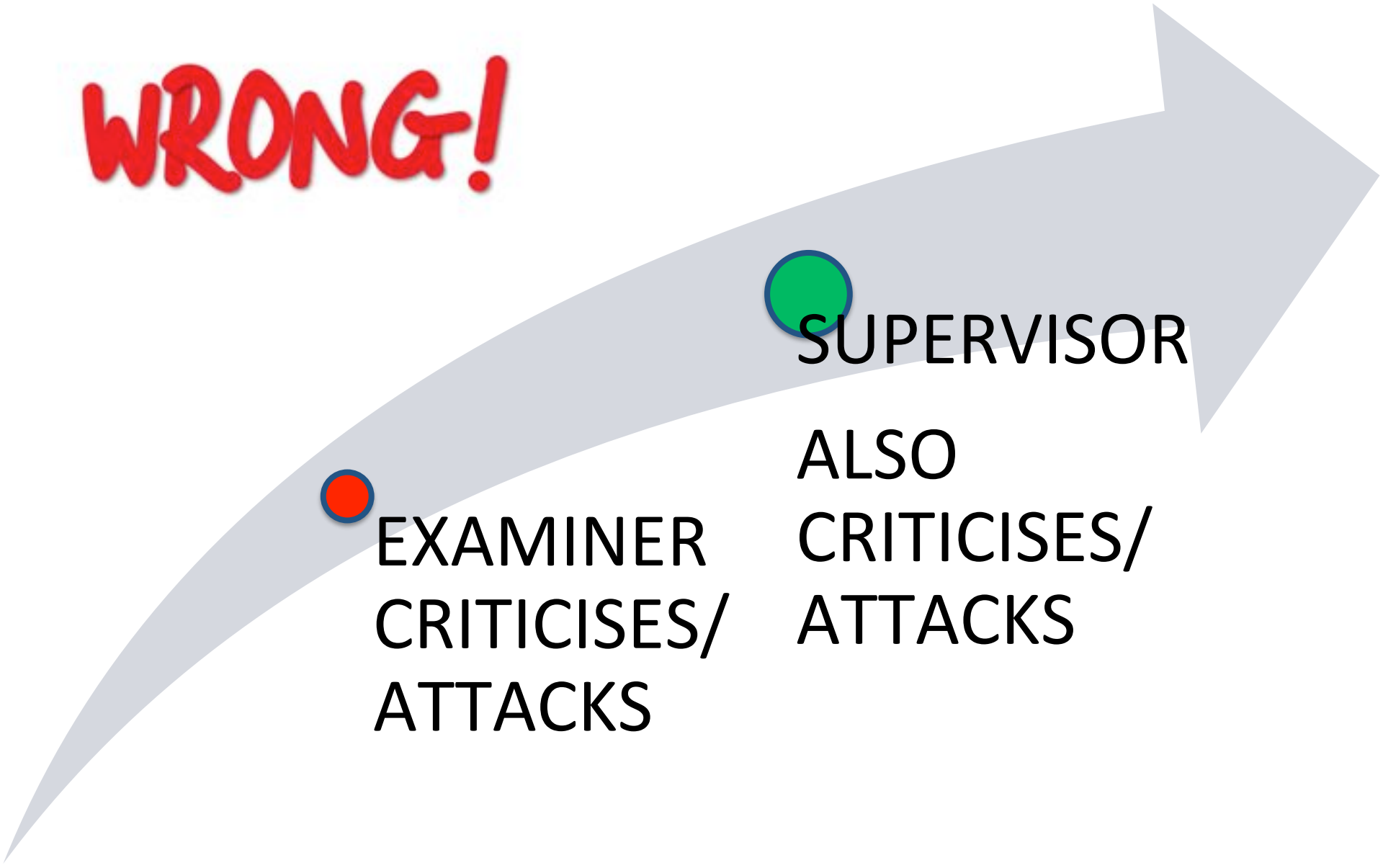
DEVELOPING A GREENSCREEN PODCASTING BY USING THE SOFTWARE APPLICATION FILMORA

DEVELOPING A STUDENTS RESEARCH WORKSHEET BY INSERTING QR-CODE WITH AUDIO, VIDEO AND WEBPAGE LINK

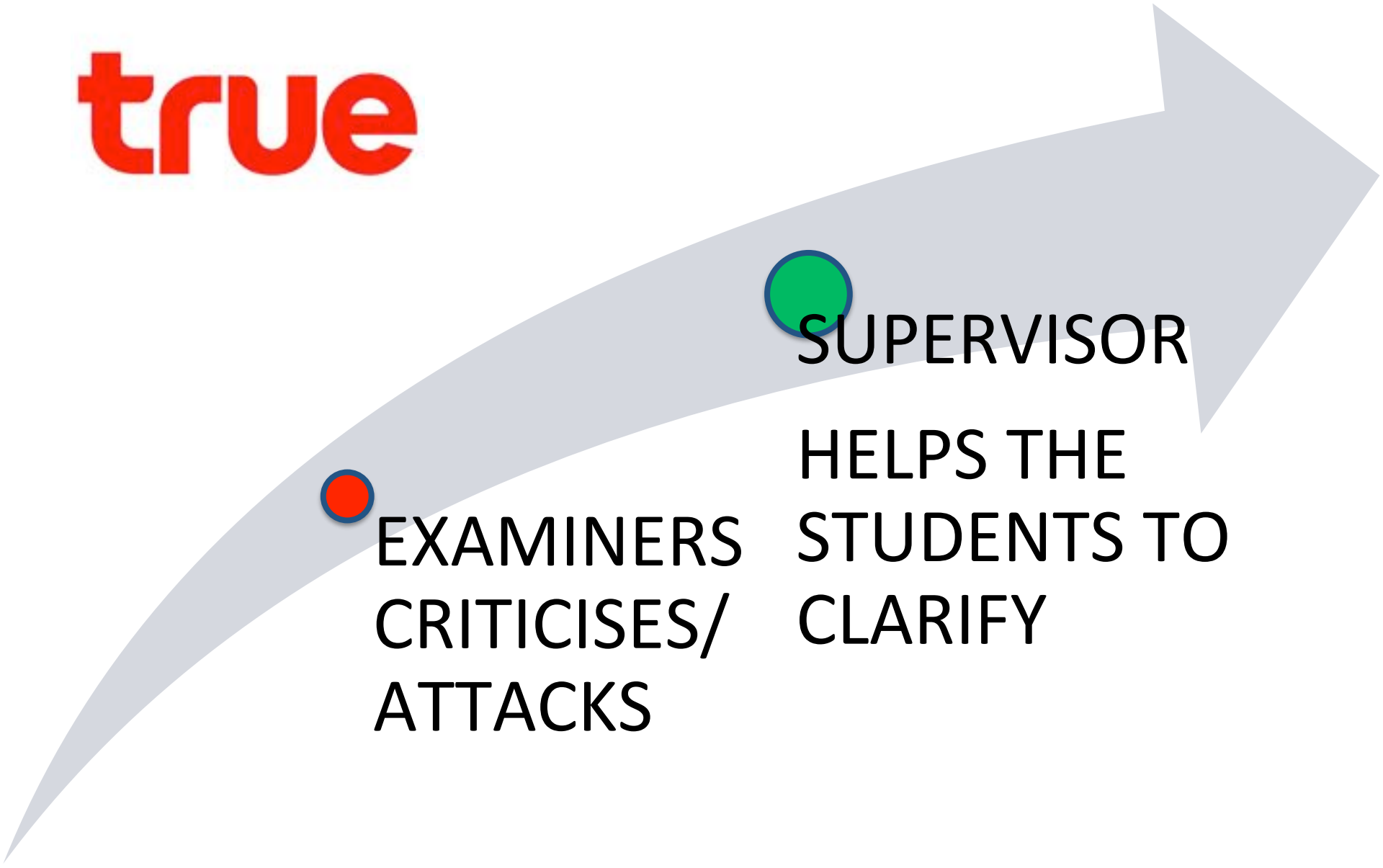
UTILIZING A ZOOM CLOUD MEETING TO DO A BRAINSTORMING, FGD AND WORKSHOP ON THE SEARCH-BASED LEARNING ACTIVITIES

Thank you

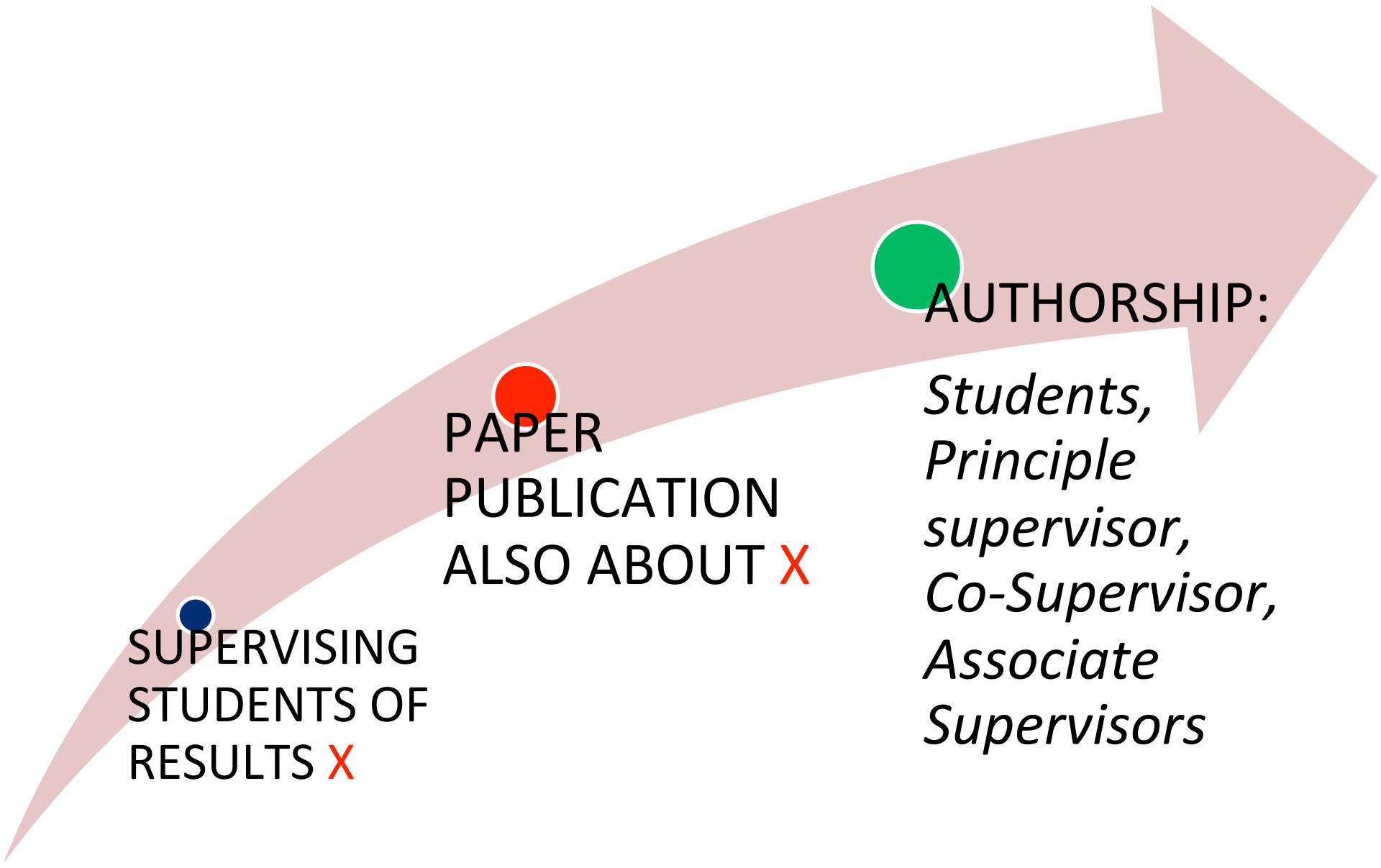
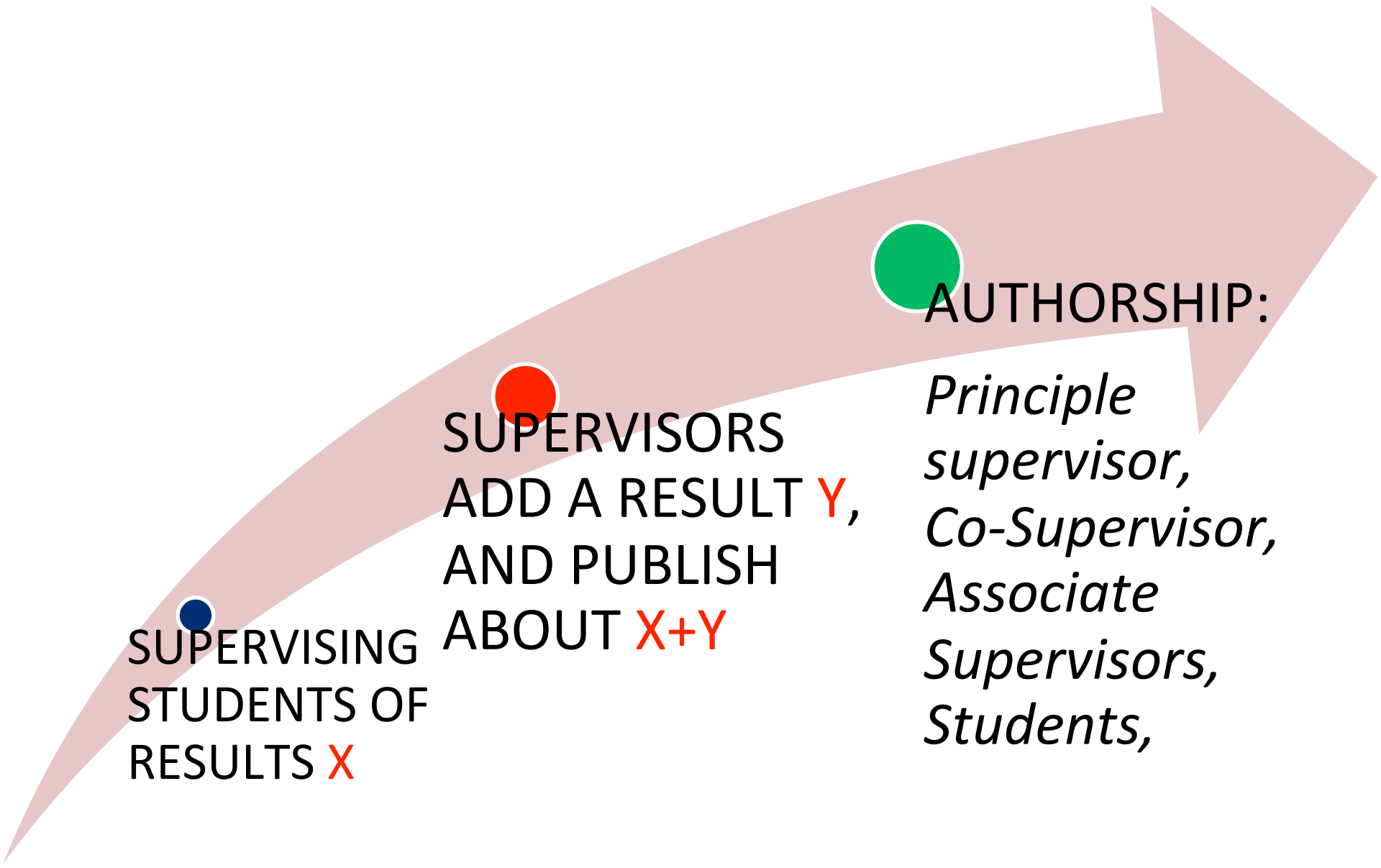
# RESEARCH BASED LEARNING: THE POTENTIAL MISGUIDANCE MINDSET



# RESEARCH BASED LEARNING: THE POTENTIAL MISGUIDANCE MINDSET



# RESEARCH BASED LEARNING: THE ETHIC CODE OF AUTHORSHIP



# RESEARCH BASED LEARNING: THE ETHIC CODE OF AUTHORSHIP