

From AI companion for learning To AI companion for Global Harwell

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Thoughts on AI companion in this talk are in collaboration with Taiwanese colleagues:

Chih-Yueh Chou, Zhi-Hong Chen, Calvin C. Y. Liao, Hercy Cheng, Ju-Ling Shih,
Ying-Tien Wu, Ben Chang, Charles Y. C. Yeh, Tak-Wai Chan

(Chou, et al., submitted for publication)

**Thoughts on Global Harwell in this talk are,
besides my Taiwanese colleagues, based on
collaboration with many international researchers,
for example,**

**Chee-Kit Looi, Siu-Cheung Kong, Su-Luan Wong,
Wenli Chen, Lung-Hsiang Wong, Weiqin Chen,
..... and some Western scholars**

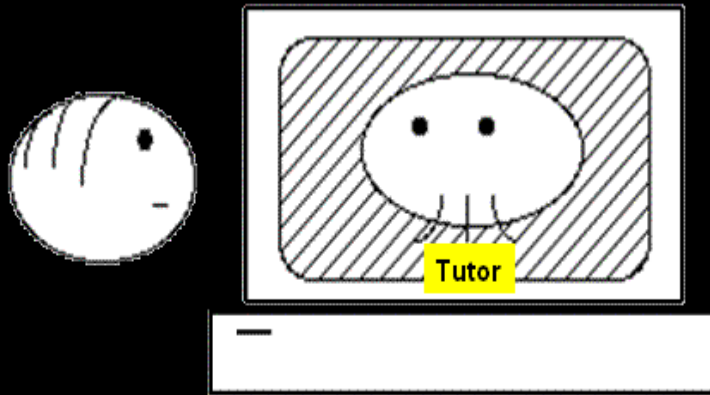
Outline

- **Part 1 the Past**
 - The origin of AI learning companion (ALC)
 - Early collaborative learning and online learning
- **Part 2 the Present and the Future**
 - Seamless learning
 - The Metaverse and the seamless world
 - The dawn of BIG AI era
 - What is a companion and companionship?
 - A research agenda for AI learning companion
 - Interest-Driven Co-Creator Theory
 - Seamless AI World
- **Part 3 the ‘Urgent’ (education cannot ‘wait’)**
 - The globe is at stake
 - Global Harwell
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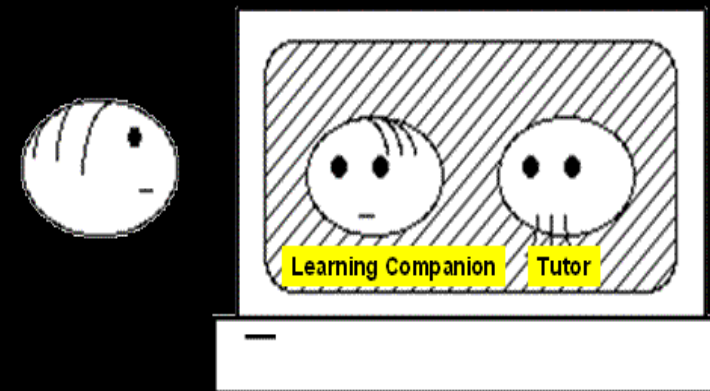
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Educational version of Turing Test



Intelligent Tutoring System (ITS)
(Carbonell, 1970)

???????

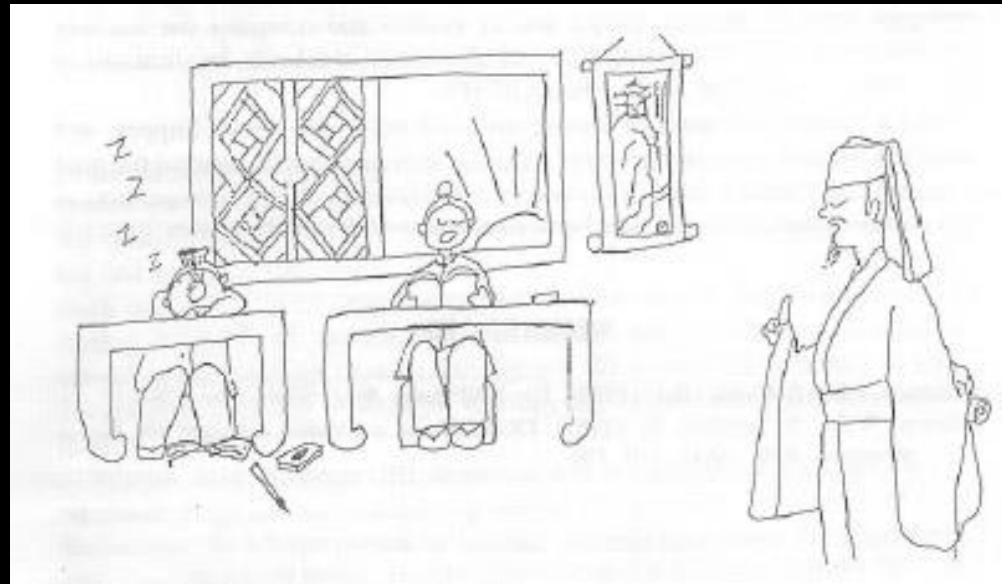


Learning Companion System
(Chan & Baskin, 1988)

Artificial Learning Companions

(Chan & Baskin, 1988)

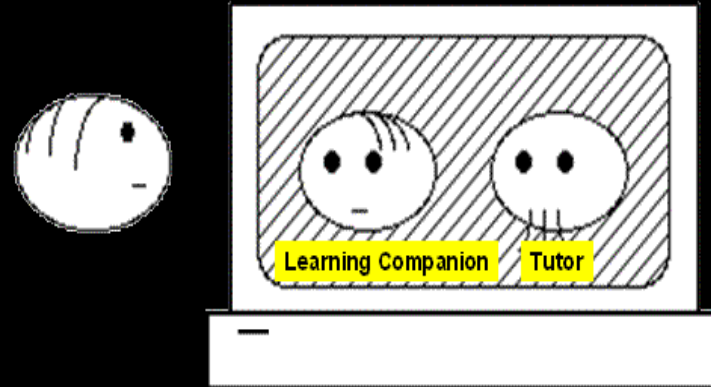
- Studying with the prince
- It is assumed that the prince will learn better when he studies with his classmate (in a social context)



But this is not the real story!

The truth is:
my frustration in doing my PhD degree in computer science
and my wife's study for her master degree in education

??????



Combination of
machine learning
and education

Learning Companion System
(Chan & Baskin, 1988)

Vygotsky's socio-cultural theory

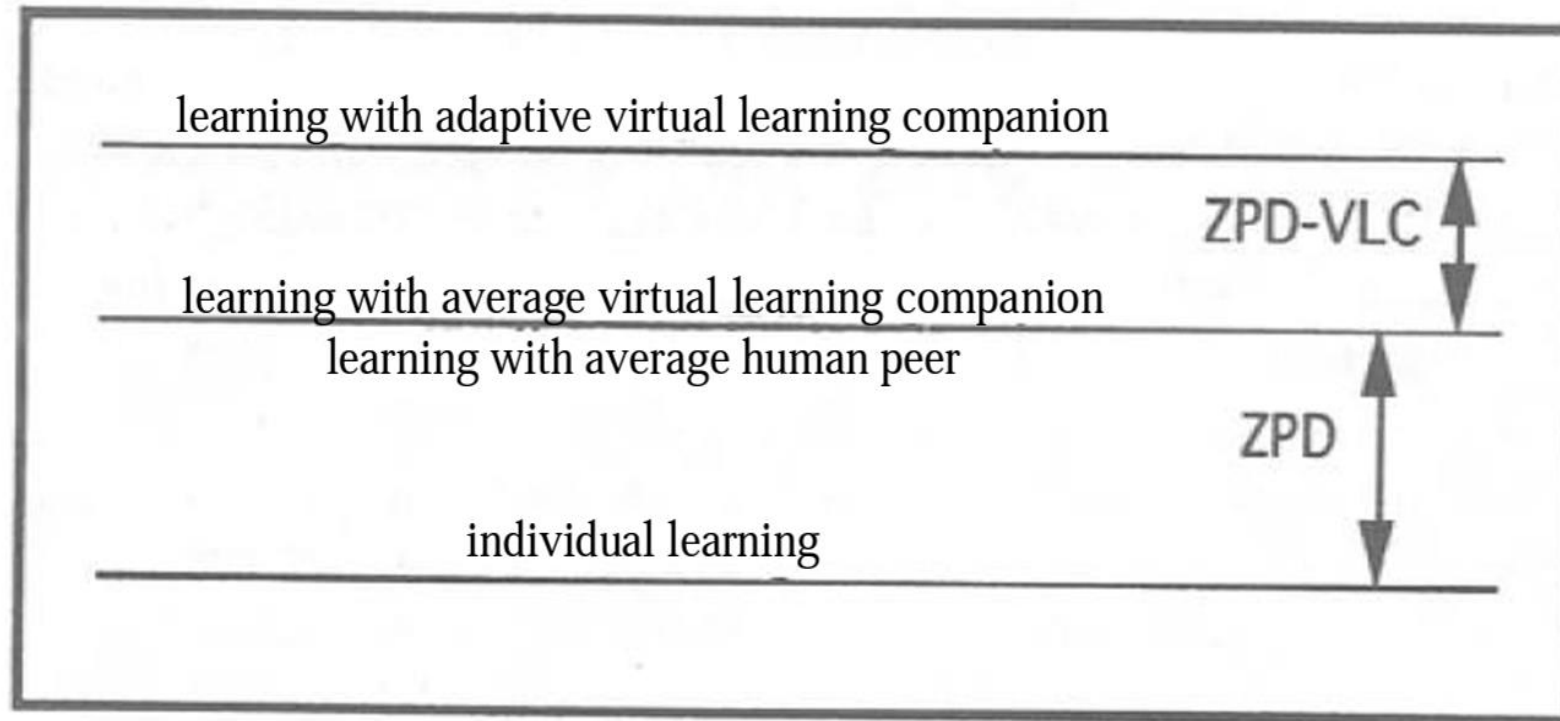
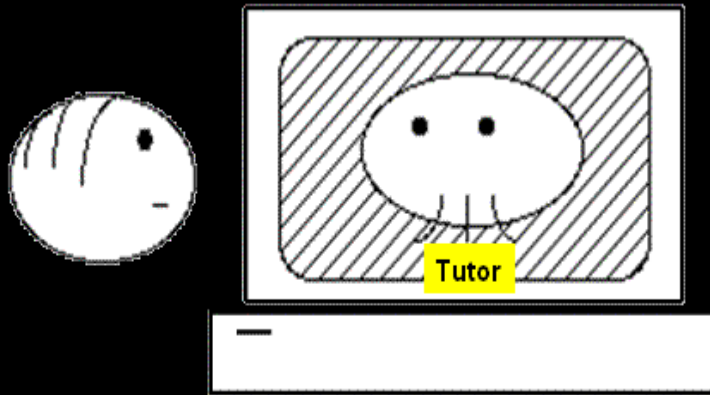


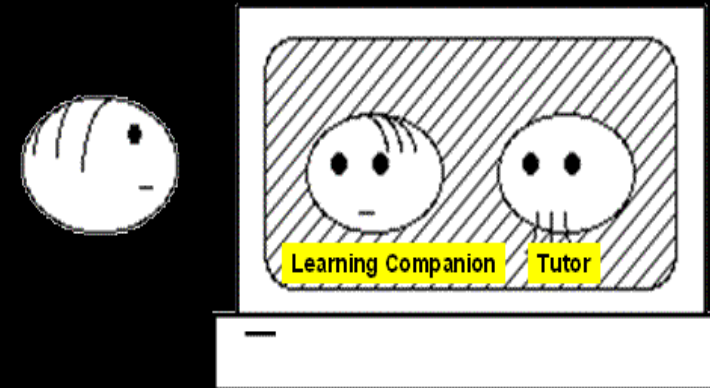
Figure 1. Zone of proximal development with respect to VLC (Chan, 1995d)

Educational version of Turing Test



Intelligent Tutoring System (ITS)
(Carbonell, 1970)

Taking into account of Vygotsky's socio-cultural theory

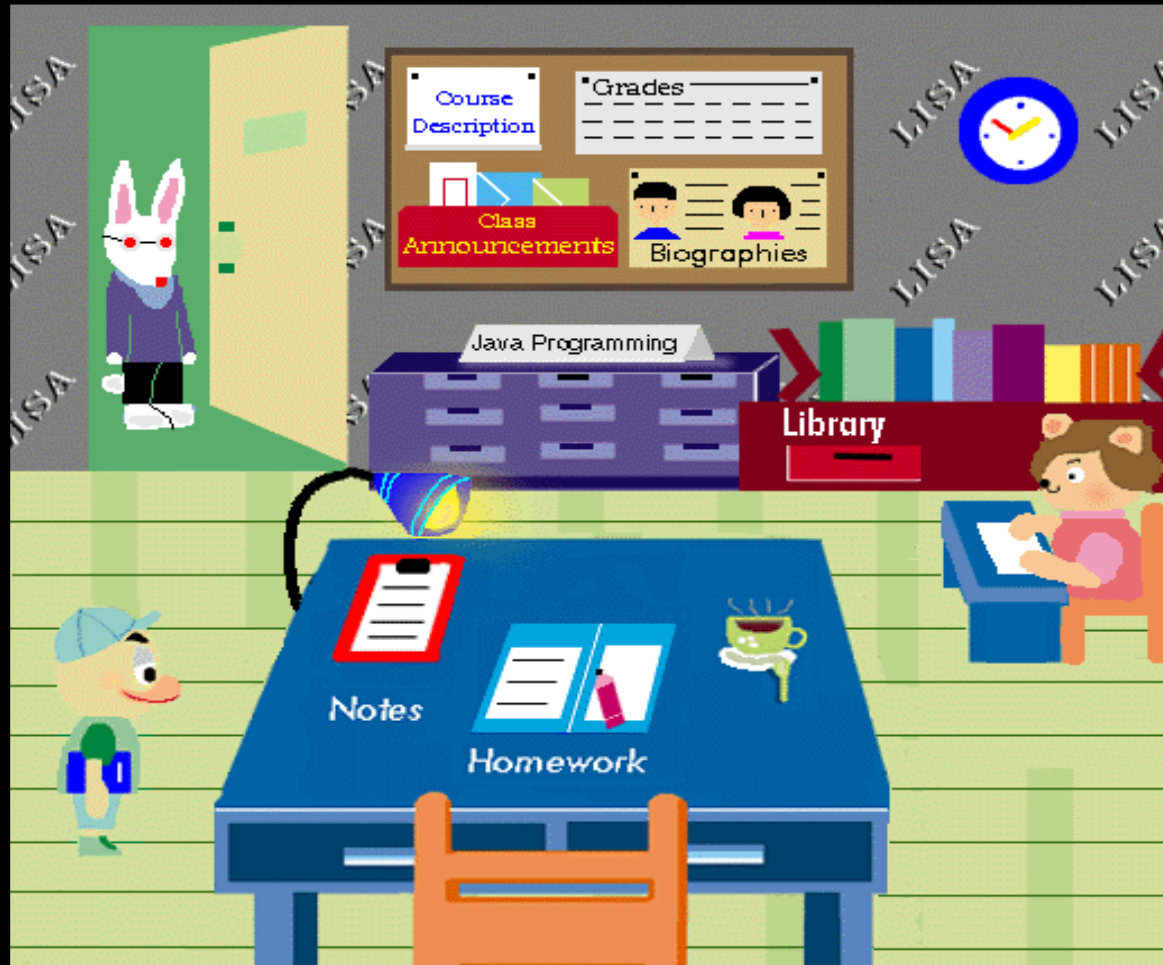


Learning Companion System
(Chan & Baskin, 1988)

(Chan, GCCCE1997)

teacher's
secretary

AI learning
companion



student's
secretary

My animal companions

Disneyfying the learner (Chen, et al, 2007, 2011, 2012)



Lifelong AI Companion

(Chan, 2000; Chan, et. al., 2001; Chou & Chan, 2003)

baby: learning companion as a magic cradle



small kid: learning companion as a toy



pupil: learning companion as a pet



teenager: learning companion as a peer



adult: learning companion as a mentor



elder: learning companion as a pet



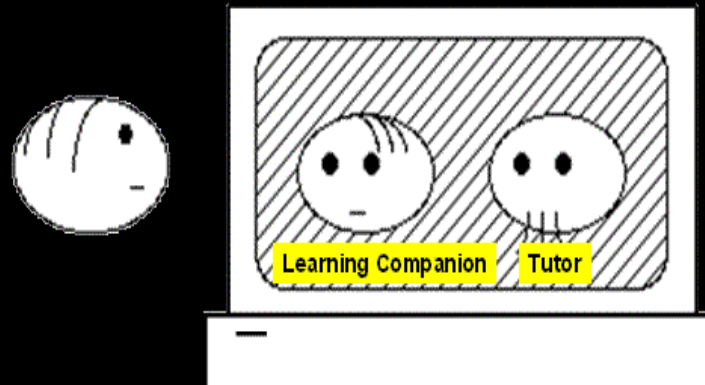
Robotic Learning Companion

(Shu, et al, 2007)



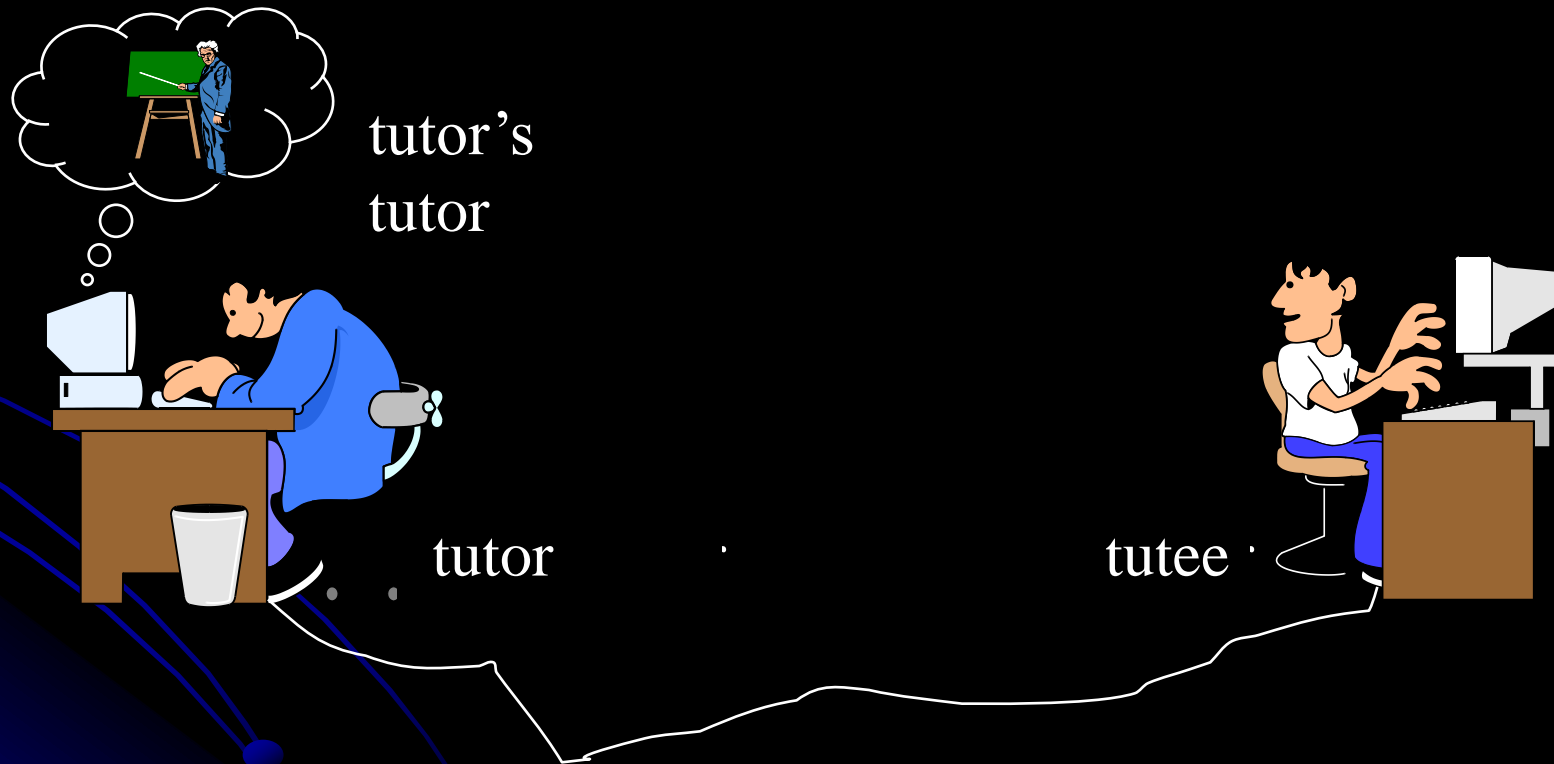
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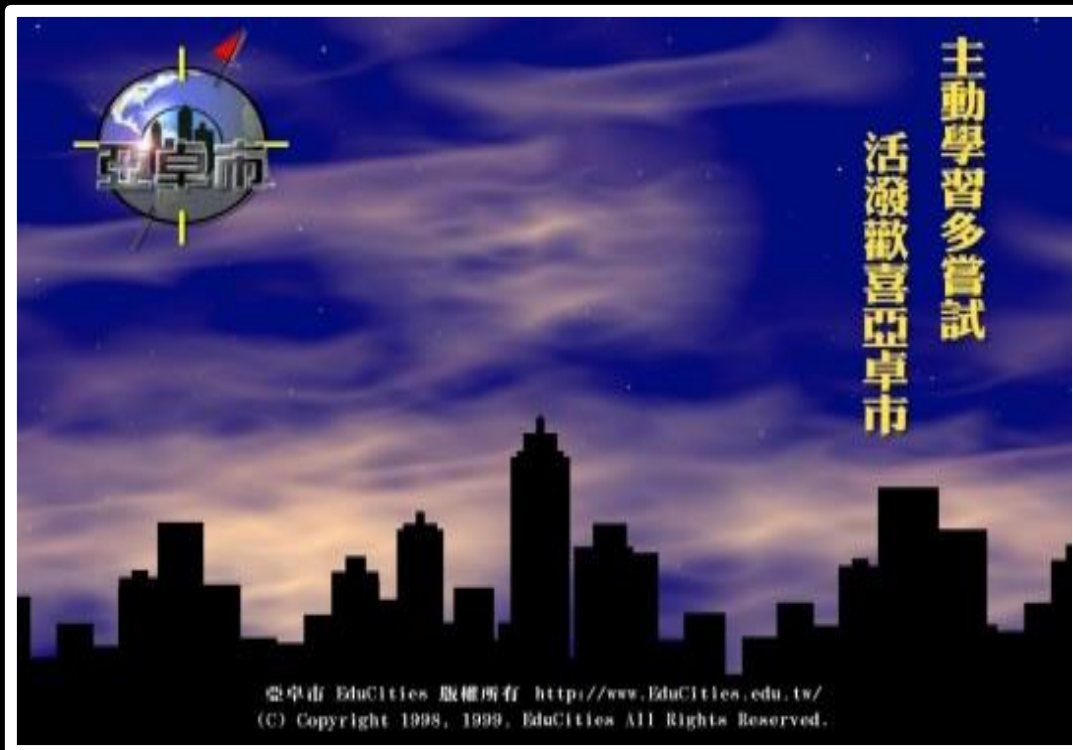
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**Learning Companion System
(Chan & Baskin, 1988)**

AI Learning companions in networked learning environment, (Chan et al., 1992, 1993, 1995)





In **2000**, we built a large online learning community, **EduCity**, possibly the largest one early in this century (1.5 millions users in 2004)

2000年5月10日 星期三 第四版 聯合報

亞卓市開埠 網路公民進駐

中央、清大、陽明及花師合作開辦虛擬城市 訓練參與者成為優質公民

【本報記者張淑玲報導】有意實踐終身學習、成為網路公民的現代人來說，「亞卓市」無疑是最佳學習園地，更是教育工作者一展活力、與大眾分享資源的絕佳選擇。由中央、清大、陽明及花蓮師範學院四所大學合作開辦的網路虛擬城市「亞卓市」，在創市近一個月時間，已湧入超過四千人進駐，扮演網路公民角色。

也許外界初聽到「亞卓市」，可能以為只是某個遠端網路的名稱，或是房地產推案網站，其實，亞卓市是「亞洲卓越城市」的簡稱，它雖然只是個學校教育網站，但提供的服務不比时下流行的社群網站遜色，使用者不但可以申請免費帳號，還包括WEB MAIL、BBS網路論壇、檔案下載、討論廣場、教育精選網站及一般精選網站、研究專區、教學網頁等，希望邀請中小學生擔任市民，學習各種知識，甚至可扮演政府官員等各種角色，達到運用網路科技的目的。

談起「亞卓市」的來由，中大校長劉兆漢說，網路是新時代極重要的科技，也是知識取得的來源之一，但若網路中沒有好的內容，上網就沒有什麼意義。因此曾在一次會議上，該校劉校長曾提出在網路上建構一個虛擬城市的想法，希望提供多方面資源，讓民眾，特別是中小學學生學習做個「網路公民」，他便邀請清大、陽明及花師加入，將這個網路虛擬城市命名為「亞卓市」，也就是「亞洲卓越城市」之意。

懷抱著讓學生們都能成為優秀的網路公民理念，校長們還特別傾力推廣教育改革的中研院院長李遠哲，擔任亞卓市的榮譽市長，除替亞卓市的發展提供意見，還希望透過亞卓市和網路無遠弗屆的特性，讓教育改革理念，能由上而下深植到參與者心中。

亞卓市網站在七月中旬開張後，目前已有超過四千名的網路使用者進駐該城市。在亞卓市中，註冊的網路市民不但可以享受一般社群網路提供的服務，網站中會提供機會讓市民扮演各種角色，如法官、學生、老師、市議員等，體驗、了解社會各角色的工作與責任。

除提供社群網站的各項服務外，亞卓市還有個相當特殊的地方，就是與清大的網路博物館「清大園」合作，提供各項科學、文藝資訊，讓亞卓市的參與、能成為兼具知性與感性的網路公民。亞卓市網址：www.educities.com.tw

趕緊加入亞卓市的行列吧！

目前已有超過四千名的網路使用者進駐該城市。

亞卓市網址：www.educities.com.tw

影像合成/體珍

The logo for Asia City (亞卓市) features a stylized globe with a city skyline silhouette in the center. A red flag is positioned at the top right of the globe. The text "亞卓市" is prominently displayed in the foreground, with a yellow crosshair-like graphic behind it.

網路教育高峰會 勾勒未來發展遠景 提供多元環境 更多互動關係 產生集體智慧 記錄／李宗祐、胡德平 攝影／鄭南光

[illegible]

主持人中國時報社長吳勝鵬(以下略)：在千禧年的市廛中，不管你是否知道它，牠們已經進入人類資訊網路時代，牠們正以迅雷萬代取代傳統媒體功能。網路，如掌間在袖中，如耳邊在耳邊什麼好東西，你可以買到一百個一個你還不知道的東西。上網是人類新學問，但是它正確嗎？有價值嗎？還是沒有？因為網路是即時性的，它對所謂社會工作學習成為可能。李達智已經推動多年「每個學年上三次」的散點式教育，也因此帶來落實的可能。我們不是不可以從這些目標裡的一個個網點中的偶然觸發，真正建立終身學習的社會學努力，就是我們今天學習的動機。

(第一輪討論)

劉允濤：我想正如黃社長所提到的，現在網絡上有豐富的網站非常多，可是大部分的教育網站，都是以提供

現：再讓我們來精確一下，亞馬遜的教育的內容包括哪



▲李達世 (中研院院長)	▲吳清基 (教育部次長)	▲許丙添 (中央大學校長)	▲劉炯明 (清華大學校長)	▲曾志朗 (陽明大學校長)	▲陳自強 (花蓮縣政府副議長)	▲李登和 (中國時報社長)
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吳清基：我想基本上，我贊成陳校長所提倡的意見，因為由亞市帶動網絡創新的教學，給老師是一種權力，同時也是一種動力。所謂動力可能包含兩種動力：主動去接受更多一個課程主題的問題，我想是陳校長的話。我們希望用上的資料，跟今天網絡上的資料比較起來，實在差得太遠。第四，我們有一個反應很快的好老師，一個開朗的，電腦上會告訴你客語是怎麼講的老師。第五，我們可以有那麼

的資訊來源，然後來鼓勵學生去做更有目的學習。基本上，我們可以問、隨時可以學，那我們這個教育方式是最理想的。很多的同學互相討論。

中華民國八十九年十二月六日 星期三

北市與虛擬城市亞卓市簽約 敲定八項合作計畫

[illegible]

2000



課開校學民全市卓亞在豪康呂的歲三十僅年
到得組年少青列系用應技科訊資礎基課開民全在
影攝／松若李者記

【記者李若松／台北報導】距離教師節還有半個月，虛擬學校「亞卓市」舉辦的「全民開課」比賽，昨天頒獎給優秀的網路教師。最年輕的開課老師呂康豪僅十三歲，目前還就讀師大附中中國中部三年級。他教授「程式設計與應用」，學生多達一百多人，全都比他年長。

虛擬學校「亞卓市」(www.EduCities)

亞卓市網路教師最年輕13歲

虛擬學校開課比賽頒獎 十五名獲獎教師多是學生 康康才國三 學生百餘人都比他大

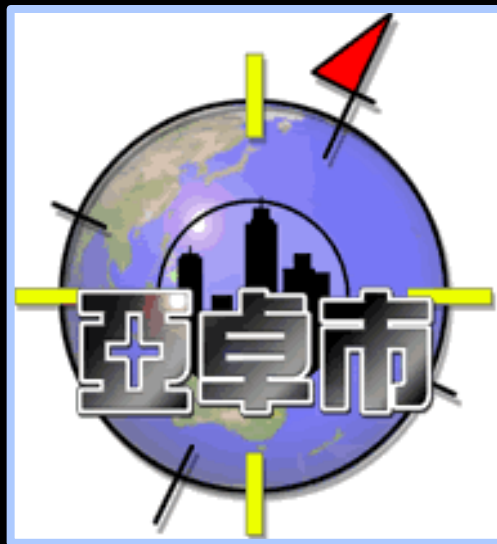
「亞卓市」計畫主持人、中央大學資訊工程所教授陳德懷表示，在網路上舉辦全民開課比賽，在台灣，甚至在全世界都是創舉。這次開課比賽主要以基礎資訊科技的應用為主，包括電腦入門、網路網路應用、網頁製作等，根據開課老師的年齡，細分為青少年組與成人組，上課的學生則沒有年齡的限制，為了讓其他優秀課程也能參賽，還增設「不限定科目創新教學課程」組，使開課內容更多元。

全民開課比賽評審、清華大學教授楊淑卿表示，與賽者的年齡從國中生到五十歲以上的人都有，職業則包括學生、地檢署觀護人、醫院心理師等，最後得獎的十五位開課老師，多數仍在學，白天是學生，晚上搖身一變成網路名師，他們在網路上應用心理測驗，有獎徵答等許多不同於傳統教室教學法，吸引學生追隨他們學習。

呂康豪在網路上暱稱「康康」，年僅十三歲，卻是「亞卓市」全民學校「最年輕的電腦老師」，學生的年齡都比他大。這次比賽他獲選為青少年電腦組的甲等獎。康康興趣濃厚，國小時就當選兒童資訊小楷模，長大想做程式設計師。

康康說，他會到亞卓市開課，主要是因為有一次他參加科展，評審老師認為以他的年齡不可能做出那麼好的作品，認定他作假，因而落選。康康不服氣，因此在全民開課比賽中，以「輕鬆學會應變」在資訊教學科獲獎，他的「金字塔之謎」課程也在不限定科目得獎，是唯一雙料得獎的網路教師。

亞卓市宣布，第二屆全民學校開課比賽訂於今年十月十五日至十一月卅一日進行，歡迎有興趣的學生或老師加入全民開課行列。



2001



亞卓市-網路科展

National Central University

國立中央大學

中華民國九十九年十二月二十二日 星期一

亞卓網路科展 颶風大贏

廖于寔跨組參與兩颱風研究 分獲一三名 四位特別獎得主 國小剛

【本報訊】由國立中央大學主辦的「亞卓網路科展」，自即日起至十二月二十二日止，在國立中央大學圖書館舉行。今年共有來自全國各地的學生參加，競爭激烈。在網路科展中，廖于寔同學表現優異，跨組參與兩項颱風研究，分別獲得第一名和第三名，並獲得四位特別獎。廖同學表示，參加網路科展不僅能展現自己的才華，還能與來自各地的同學交流學習，收穫良多。

網路學習加溫 高中地球科學

【本報訊】隨著網路科技的發展，網路學習已成為一種重要的學習方式。在高中地球科學課程中，透過網路學習，學生可以更方便地獲取最新的科學資訊，並進行互動式學習。許多老師也利用網路平台進行教學，提高教學效率。網路學習不僅能打破時間和空間的限制，還能讓學生在自主學習中培養學習興趣和探究精神。

網教路學 不應排斥面對面溝通

【本報訊】網路教學雖然具有許多優點，但並不應完全排斥面對面的溝通。面對面的溝通能幫助學生更好地理解知識，並與老師進行即時互動。老師在面對面的教學中，可以觀察學生的學習情況，及時給予指導和鼓勵。同時，面對面的溝通也有助於培養學生的社交能力和團隊合作精神。因此，在網路教學的基礎上，加強面對面的溝通，才能達到最佳的教學效果。

學輔老師賣力 學員結業率提升

【本報訊】為了提高學員的結業率，許多學輔老師都賣力工作。他們不僅在課後為學員提供輔導，還在課前為學員做好準備工作。學輔老師的辛勤付出，讓學員在學習過程中得到了更多的幫助和支持。學員們也表示，在學輔老師的指導下，他們的學習成績有了明顯的進步。結業率的提升，也反映了學輔老師教學質量的提高。

首屆網路科展 研究台灣天災

【本報訊】首屆網路科展以「研究台灣天災」為主題，吸引了眾多學生參加。在網路科展中，學生們利用網路資源，對台灣的天災進行了深入研究。他們通過收集資料、分析數據、撰寫論文等方式，展現了對天災研究的興趣和才華。網路科展不僅為學生提供了一個展示才華的平台，也為他們提供了一個交流學習的機會。

冠雙奪究研層斷孩女區災是科路網

【本報訊】在網路科展中，一名來自災區的女孩憑藉其優秀的研究成果，奪得了冠軍和亞軍。她的研究成果引起了評審團的廣泛關注。這位女孩表示，她對網路科展非常感興趣，並通過網路科展展示了自己的研究成果。她的成功也為其他同學樹立了榜樣，鼓勵他們積極參加網路科展，展現自己的才華。

2001 e-schoolbags



classroom
clickers

民生報 91.6.6 今日話題 A3

電子書包 讓上課變輕鬆

黑板變成電子大白板 PDA 取代書本 還能無限上網 北市試辦 師生都覺得有趣多了

【記者林麗雪／報導】前一陣子，台北市南湖國小五年四班學生林育正到蘭陽國小進行城鄉交流，昨天他透過戲劇表演，與同學分享他在蘭陽收到的「意外禮物」。當他演得正入戲，老師使用電子大白板呈現他的劇本內容，讓同學更能進入狀況，體會他要表現的意涵；落幕後，全班利用電子書包的評價投票功能，為林育正的演出打分数。十秒鐘後，電子大白板顯示了：全班二十九名同學給林育正最高分四分，林育正笑得很開心。

語課時，傳統黑板由電子大白板所取代；PDA 也取代了傳統書本；第十六課小說體裁的「最後一片葉子」全文同時出現在電子大白板及學生電子書包螢幕上；老師用手指輕輕一觸，紅色線條立即顯現那一段落是伏筆？那個句子是高潮？突然一位小朋友的電子書包斷訊，未連上線，電子大白板右下方訊號燈變色，講課老師馬上掌握現況。王資翔同學說，「上課用電子書包後，可不打馬虎眼，老師一看就知道。」

本，連接到哈書網，搜尋少年小說資料庫；小朋友的作品透過電子書包，與全班同學同時一起分享，帶給學生很大的成就感。

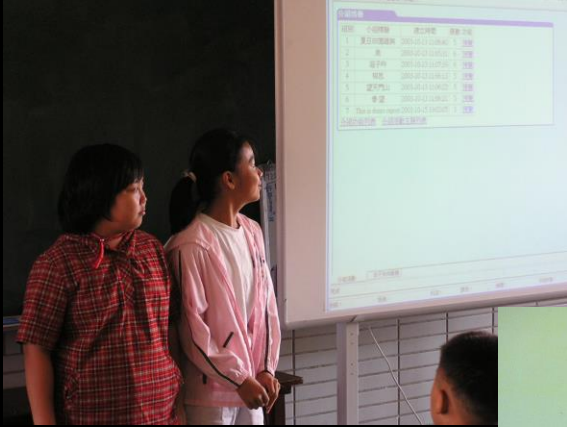
南湖國小五年級學生蔡函殷說，電子書包當然比書本好玩多了！重量又輕，比起每天背五、六公斤重的書包，快活多了！又能隨時上網找資料，和同學在班級的網站上討論功課、畫圖、寫作業，實在太有趣了。

北市教育局與中央大學資工系、生產電子書包的業者合作推動電子書包計畫，業者表示，目前每一電子書包售價約三萬二千元，預計三年後可降到一萬元左右，價格下降有助於全面推廣。北市教育局資訊室主任韓長澤則說，未來各級學校全面使用電子書包，家長必須付費購買，而教育局會提供免費的電子書包，給予低收入戶、弱勢族群學生使用。



2002

one tablet per student or 1:1 Learning





1012
President Ma's Visit

2004 EduCart



2002 mobile learning

learning
in the campus





2002 mobile learning



Taipei Zoo study



bird watching



USA: National Education Technology Plan Draft 2010

EduCity established in the early 2000s was the first learning society in the world

Moreover, the least effective educators are most likely to be teaching in schools serving students from homes that are economically and educationally disadvantaged. Limited access to excellent teaching is a source of inequity in our education system (Darling-Hammond, 2010). A recent study found that students in urban and suburban high schools can choose from between three and four times as many advanced mathematics courses (which typically earn "extra credit" in the college admission process) than students in rural schools (Graham, 2009).

Technology can make it possible to extend the reach of specialized and exceptional educators through online learning activities made available to students in every zip code. When a school is unable to attract educators qualified to teach courses that its students need or want, students should be given the option of taking the course online. Many schools have found that K-12 students taking online courses benefit from having an educator who keeps track of their progress and provides encouragement, but that staff member does not need the depth of content expertise of a person solely responsible for teaching a class.

Support for a learning society

Not surprisingly, connected teaching quickly moves beyond the walls of the school, immersing all learners in a learning society. The concept of a learning society is not a vision for the future: Examples already exist.

Starting in 2000, a research team in Taiwan developed a network of websites called **EduCity** that breaks down the walls of the school to involve broader communities in supporting learning (Chan et al., 2001). As the lead innovator, Tak Wai Chan, describes it, **EduCity** comprises a hierarchy of communities that have reached more than 1.5 million students and over 1,700 schools.

Support for a Learning Society

Taiwan's online **EduCity** represents an entire community, consisting of school websites called **EduTowns**. An **EduTown** represents a school and consists of the websites of that school's classes, called **EduVillages**. An **EduVillage** represents a class and is composed of the personal websites of the students and the educator in that class, called **EduCitizens**. **EduCity** provides students with online resources and activities. For example, using Web 2.0 technologies, **EduTowns** (schools) can adopt online application programs called service items, which are provided by the **EduCity**. An **EduTown** can also develop its own service items and share them with other **EduTowns**. The system also supports teacher collaboration for developing learning materials and lesson plans as open content. Furthermore, every **EduCitizen** can open an online course in **EduCity** (Chan, 2009, personal communication).

In one striking story, a 13-year old student named Ah-Chung won the online teacher of the year contest in **EduCity** in 2000 (Young, Chan, & Lin, 2002) by teaching Visual Basic to other students. The other students did not know that their online educator was a boy younger than all of them. Since that time, **EduCity** has developed a facility for **EduClasses** – a system in which any **EduCitizen** can offer a course on any topic to other students and educators. **EduClasses** now has more than 1,000 courses in operation and use is spreading from K-12 education to corporate training.

As successful as **EduCity** is, many participants' experience with the site is more superficial than the original researchers would like. Ultimately, educators should learn how to structure networked learning societies so that they continuously improve and deepen the experiences they provide to participants.

Transforming American Education:

Learning Powered by Technology

DRAFT

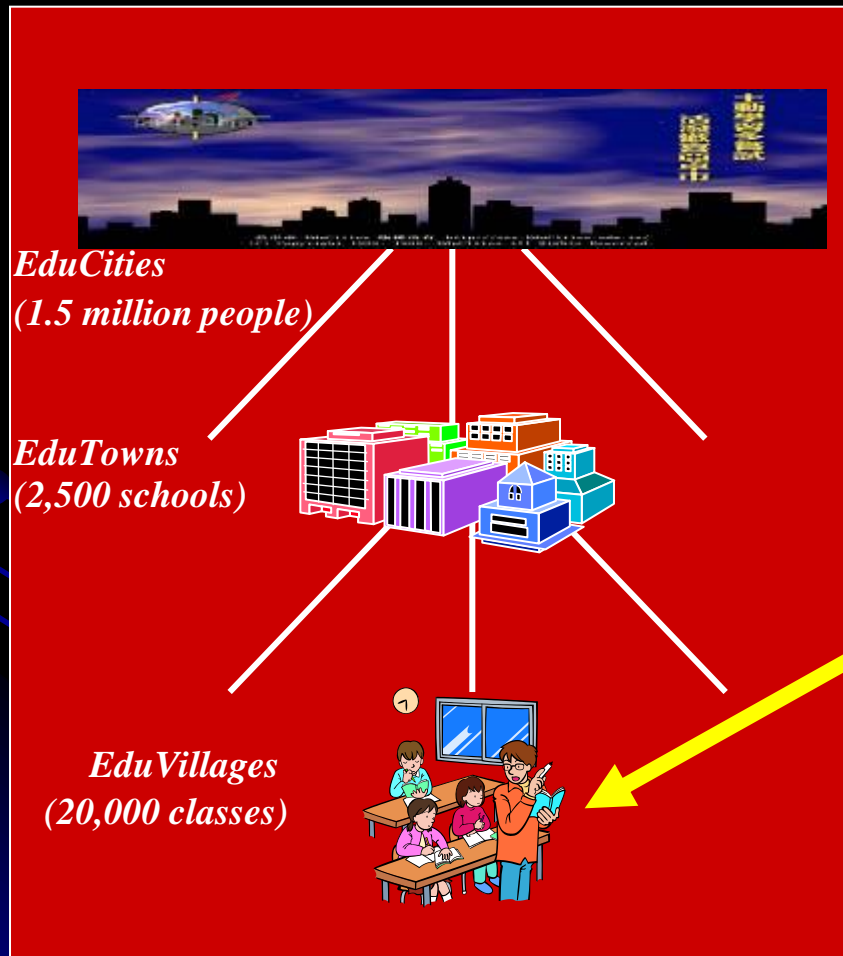
National Educational Technology Plan 2010

March 5, 2010

Office of Educational Technology
U.S. Department of Education

But I noticed there was a **seam** there...

virtual learning community



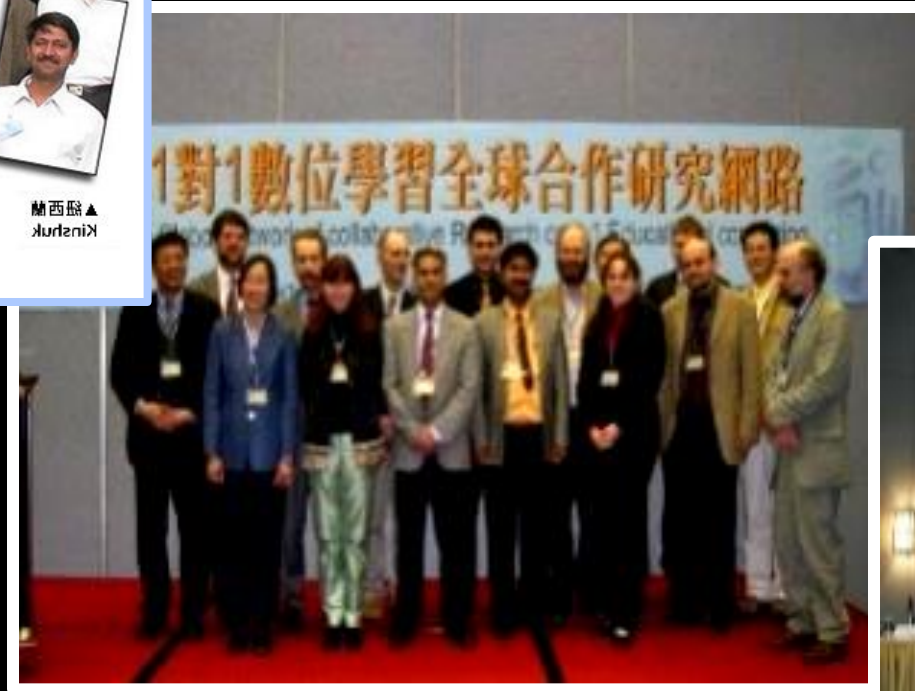
1:1 learning in physical space



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Co-authoring **one-to-one** Technology Enhanced Learning & **seamless learning** notion



Seamless Learning (2006)

International Research Coauthors

Asia

Tak-Wai Chan, National Central University,
Taiwan

Chee-Kit Looi, Nanyang Technological
University, Singapore

Europe

Mike Sharples, Nottingham University, UK

Nicolas Balacheff, Laboratoire Leibniz, France

Pierre Dillenbourg, Ecole Polytechnique Fédérale
de Lausanne, Switzerland

Marcelo Milrad, Växjö University, Sweden

Ulrich Hoppe, University Duisburg-Essen

America

Jeremy Roschele, Stanford Research
International, USA

Roy Pea, Stanford University, USA

Elliot Soloway, University of Michigan, USA

Sherry Hsi, The Exploratorium, USA

Charles Patton, Stanford Research
International, USA

John Cherniavsky, National Science
Foundation, USA

Cathie Norris, University of North Texas, USA

Marlene Scardamalia, University of Toronto,
Canada

Africa

Tom Brown, University of Pretoria, South Africa

Seamless Learning Space

seamlessly learning across over
learning scenarios from

Physical Space X Virtual Space X Social Space

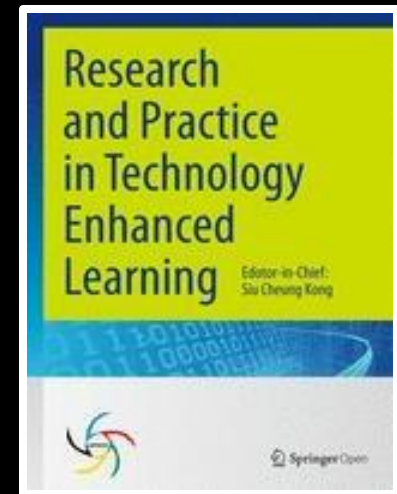
Physical Space X Virtual Space: classroom, campus, home, museum, etc.

Social Space: individual, small group, class, online community, agents, etc.

Seamless Learning: a long definition

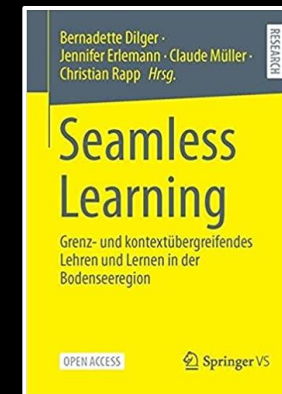
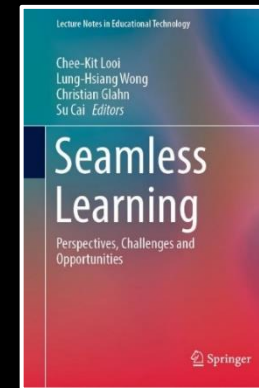
(International Researcher Coauthors, 2006)

“Seamless learning implies that a student can learn whenever they are curious in a **variety of scenarios** and that they can **switch from one scenario to another easily and quickly** using the personal device as a mediator. These scenarios include learning individually, with another student, a small group, or a large online community, with possible involvement of teachers, mentors, parents, librarians, workplace professionals, and members of other supportive communities, face-to-face or at a distance in places such as **classroom, campus, home, workplace, zoo, park, and outdoors**. Seamless learning space refers to the collection of the various learning scenarios supported by one-to-one technology.”



“... marked by a continuity of the learning experience across different environments.”

Mainly advocated by Lung-Hsiang Wong & Chee-Kit Looi



7 books on seamless learning

Outline

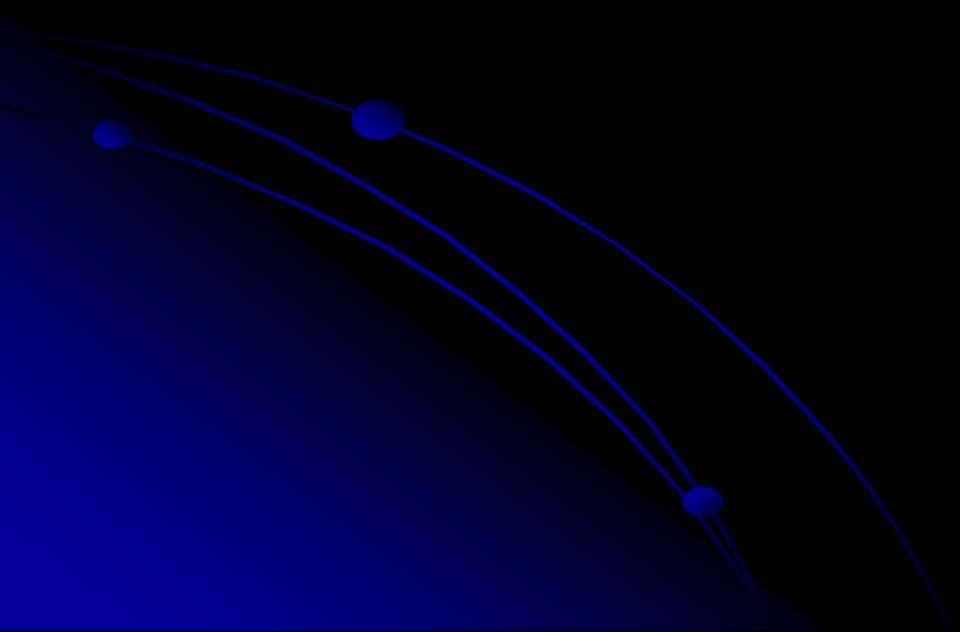
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Imagination of metaverse



But much more beyond AR/VR/MR.....

Metaverse VS Seamless World



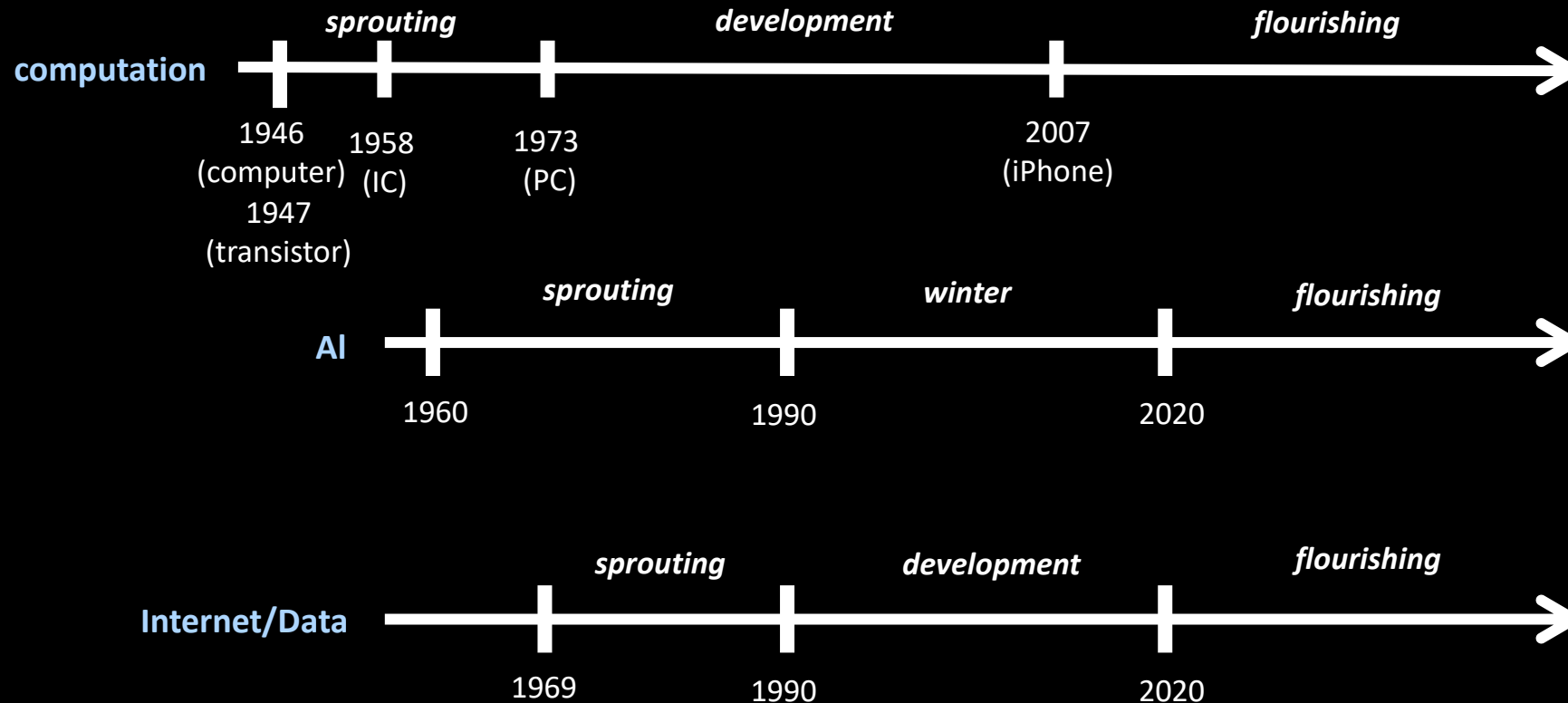
Metaverse VS Seamless World

- **Metaverse** is an interconnected digital world that seamlessly integrates physical and virtual spaces (Chris Wang, MetaACES2022)
- **Seamless World** is a real world that seamlessly integrates physical and virtual spaces

Outline

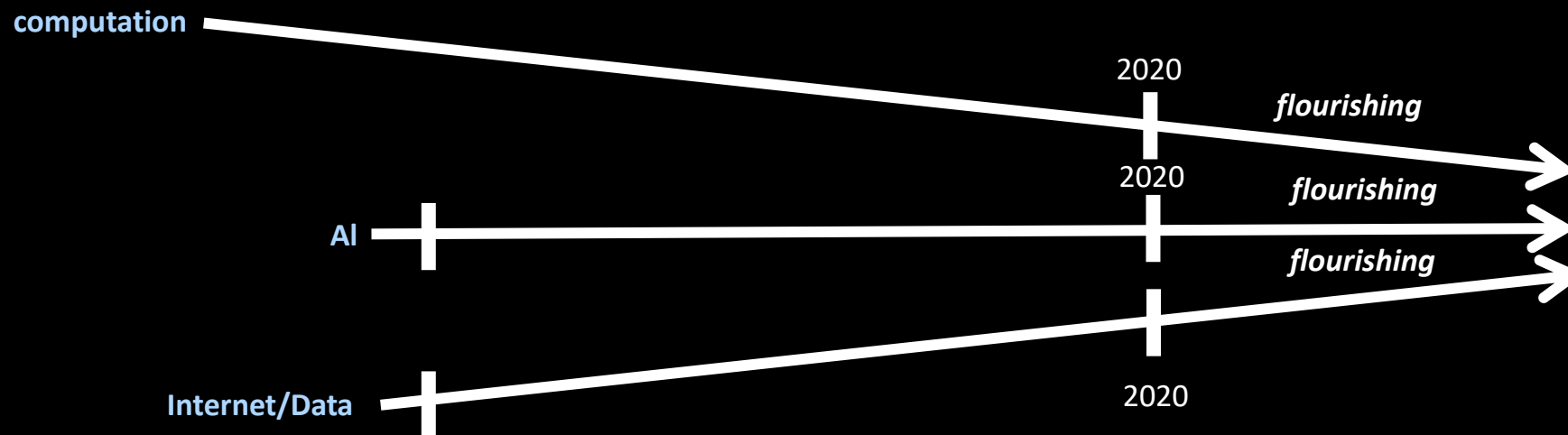
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Computation, AI & Internet/Data



Co-flourishing: convergence and synergy

Impact comes faster and bigger than we expect



Neural Network Simulation



Human Brain

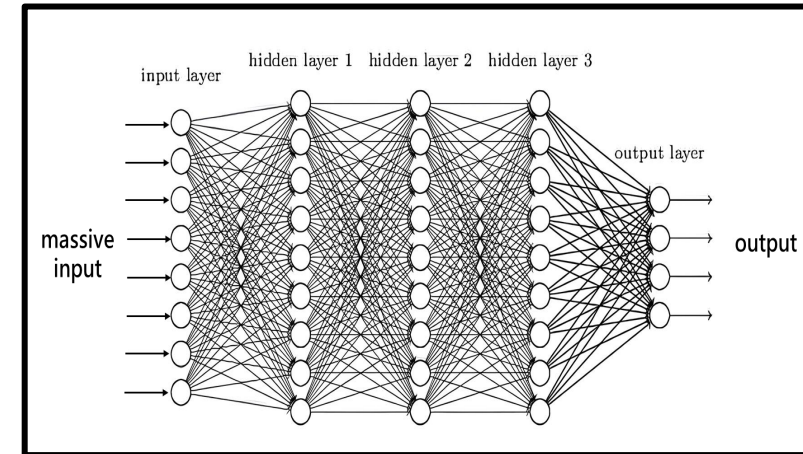


**Simple
Simulation**

Neural Network Simulation



Simulation



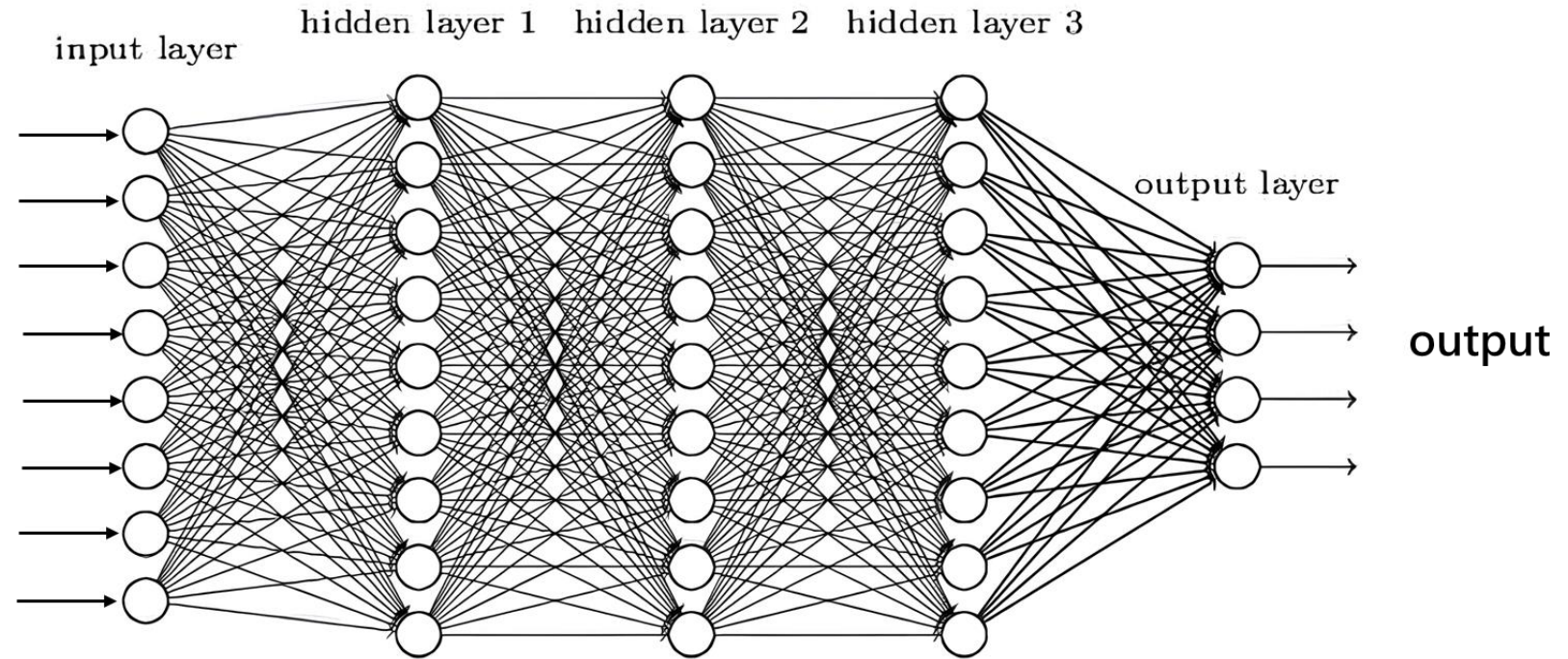
Computer-modeled Simulation
DEEP LEARNING (more layers)

Big Data, Big Computation

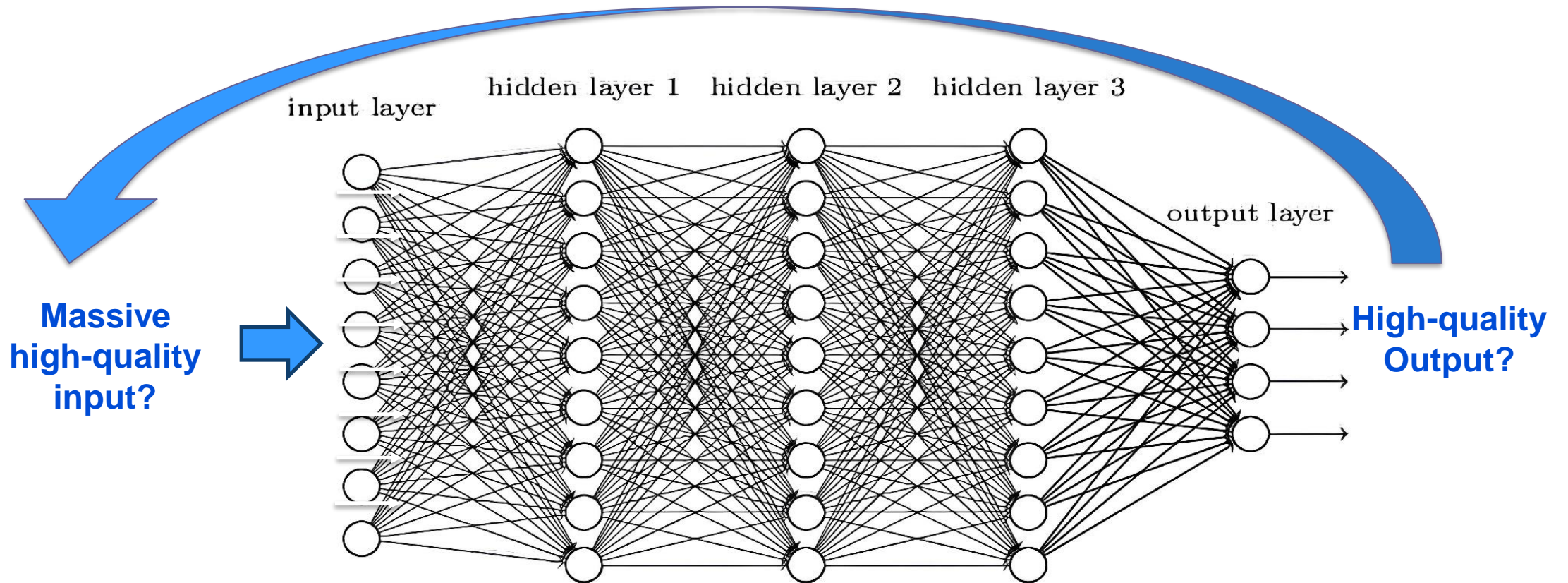
Human's
emotion
sociability
ethics/value



massive
input



Positive Feedback



What is the biggest impact when technologies such as ChatGPT or Generative AI emerged since 2022?

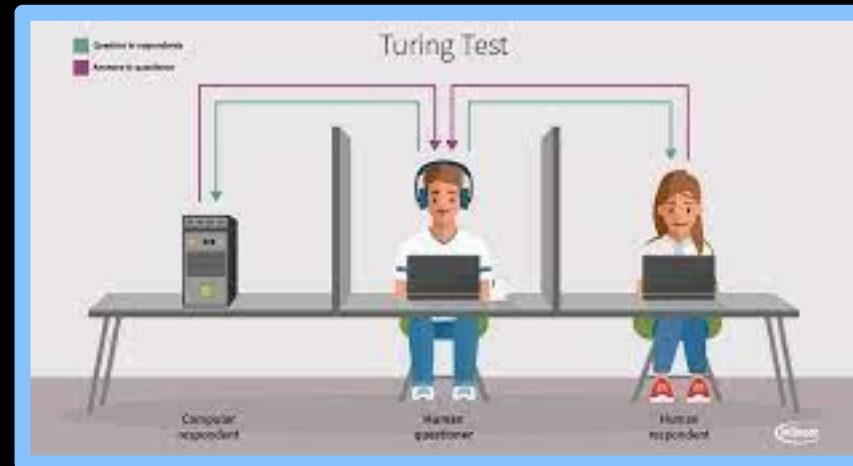
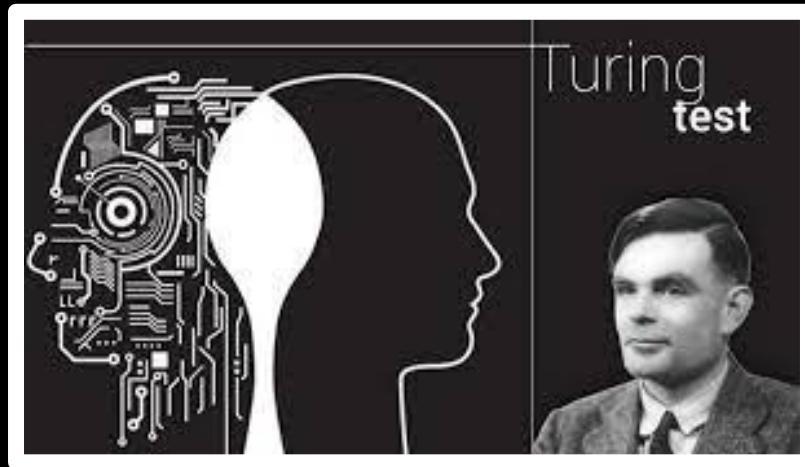
AI Companion

“The learning companion is almost there!”

**I murmured to myself
when ChatGPT emerged.**

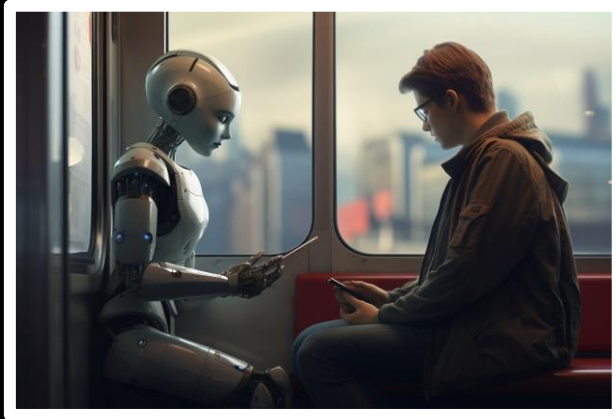
AI Companion will go beyond Turing Test

Turing Test (1950)

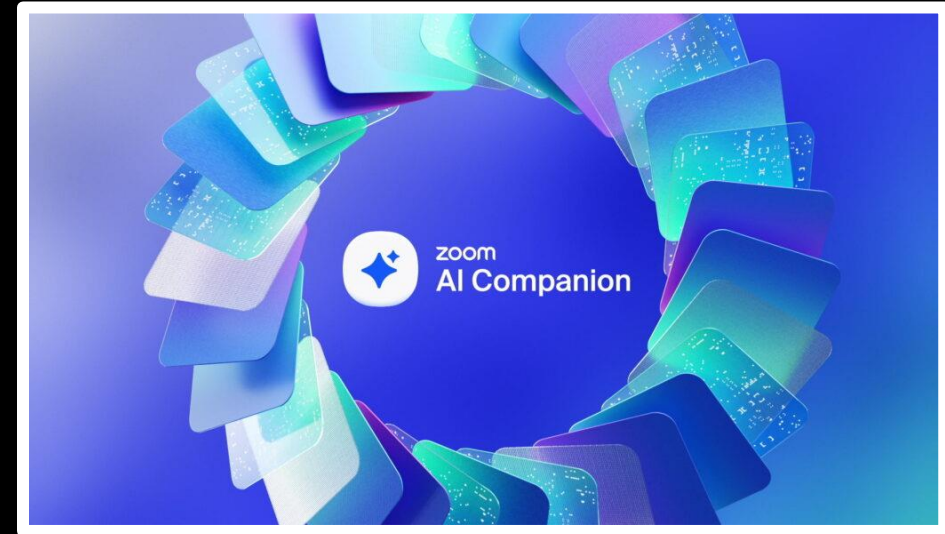


Ping Pong Robot

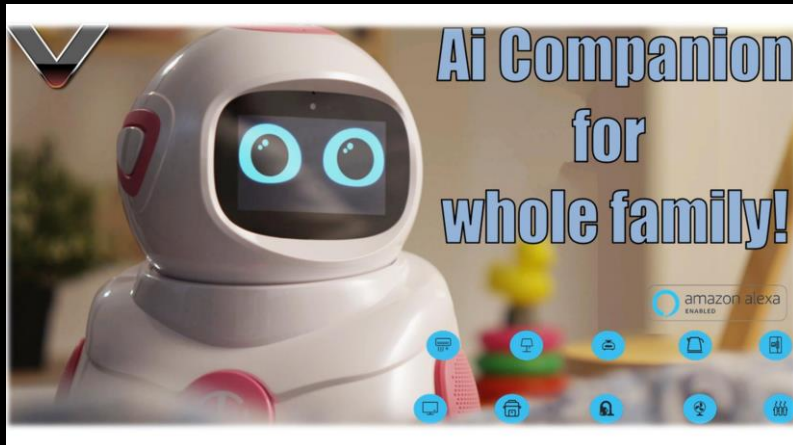
the Rise of AI Companions



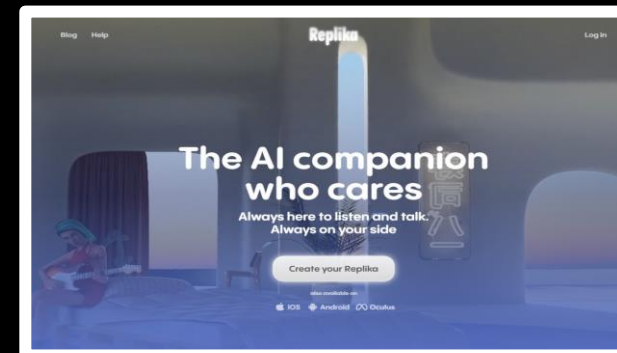
<https://replika.com/>



<https://www.pcguide.com/ai/zoom-ai-companion/>



<https://anyflip.com/ekqm/gsfq>

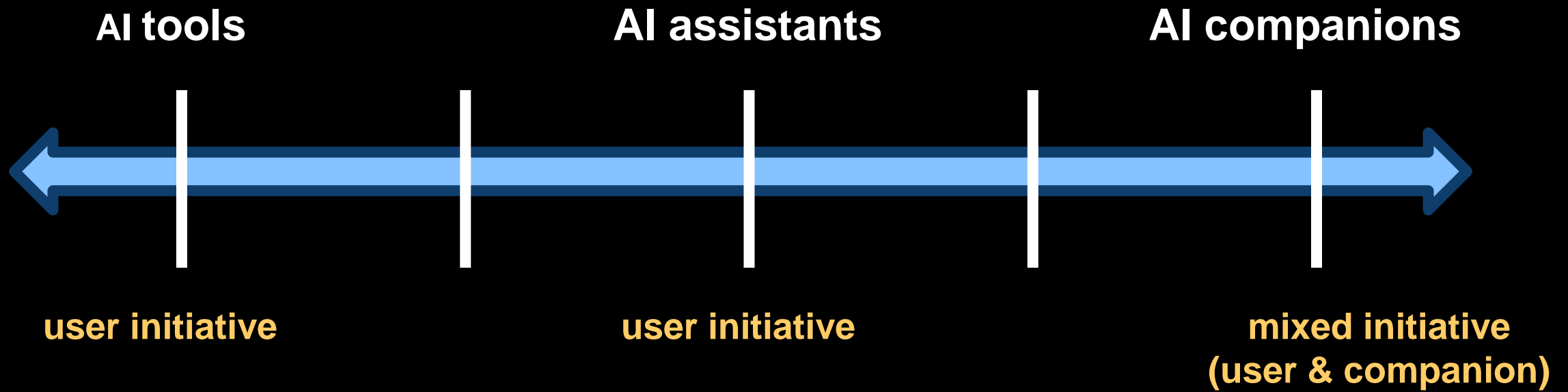


<https://neurosciencenews.com/ai-robot-loneliness-23616/>

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A spectrum **from tools to 'AI as an artificial human companion'**



Tool, Assistant, & Companion

- **As a tool, AI acts as a piece of equipment that we manually operate to accomplish a task.**
- **As an assistant, AI aids us by performing certain tasks for us or by providing intricate support to complete a task.**
- **As a companion, AI.....**

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What is companion?

**Can we consider my mother, spouse, child,
friend, teacher, tutor, fellow classmate, doctor
or even my pet as my companions?**

What is companionship?

Companionship is some sort of positive dyadic social relationship!

- **Emotional Support:** Offering empathy, understanding, and comfort.
- **Join Activities:** Engaging in common interests or activities together.
- **Dependability and Faith:** Being dependable and trustworthy.
- **Mutual Respect:** Valuing each other's opinions, feelings, and needs.
- **Dialogue and Exchange:** Open and honest dialogue about thoughts and feelings.
- **Enjoying Togetherness:** Finding pleasure in spending time together.

Companionship is usually some social relationship with specific shared goal

- Our companionship can be more precisely defined by our 'relationship', such as parent-child relationship, doctor-patient relationship
- That means the relationship between the two actors in a dyad has a specific shared goal.
- Overall, interactions between the actors are driven by this shared goal.

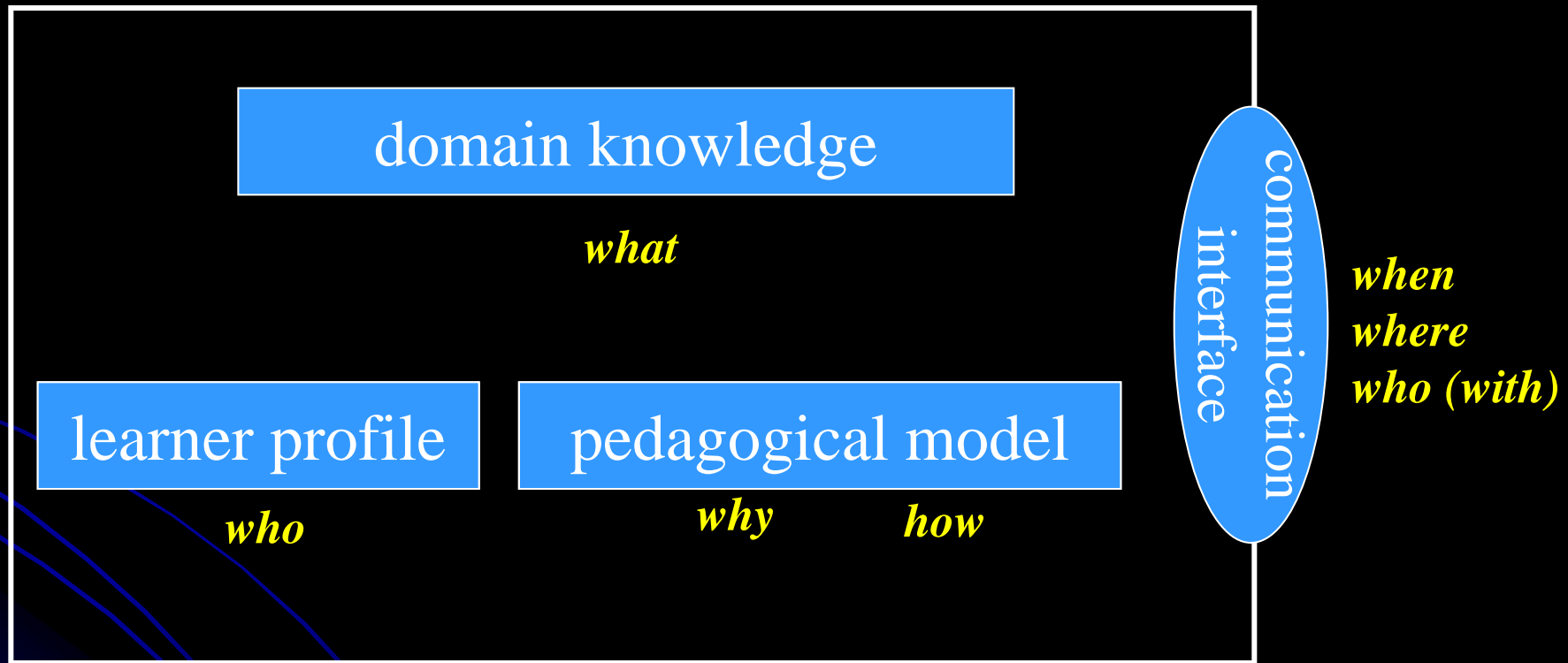
companionship of two actors = (relationship, shared goal, interactions)

Outline

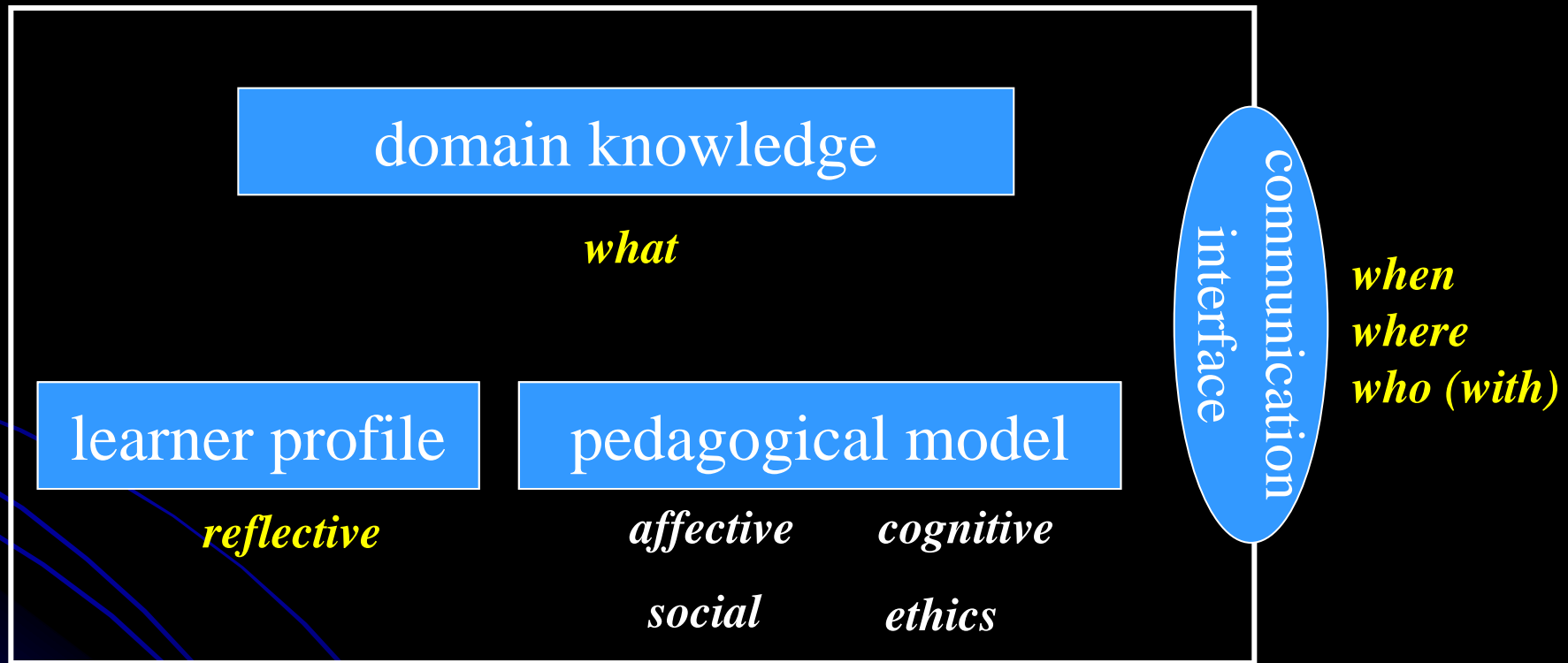
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AI in Education research has evolved through three periods:

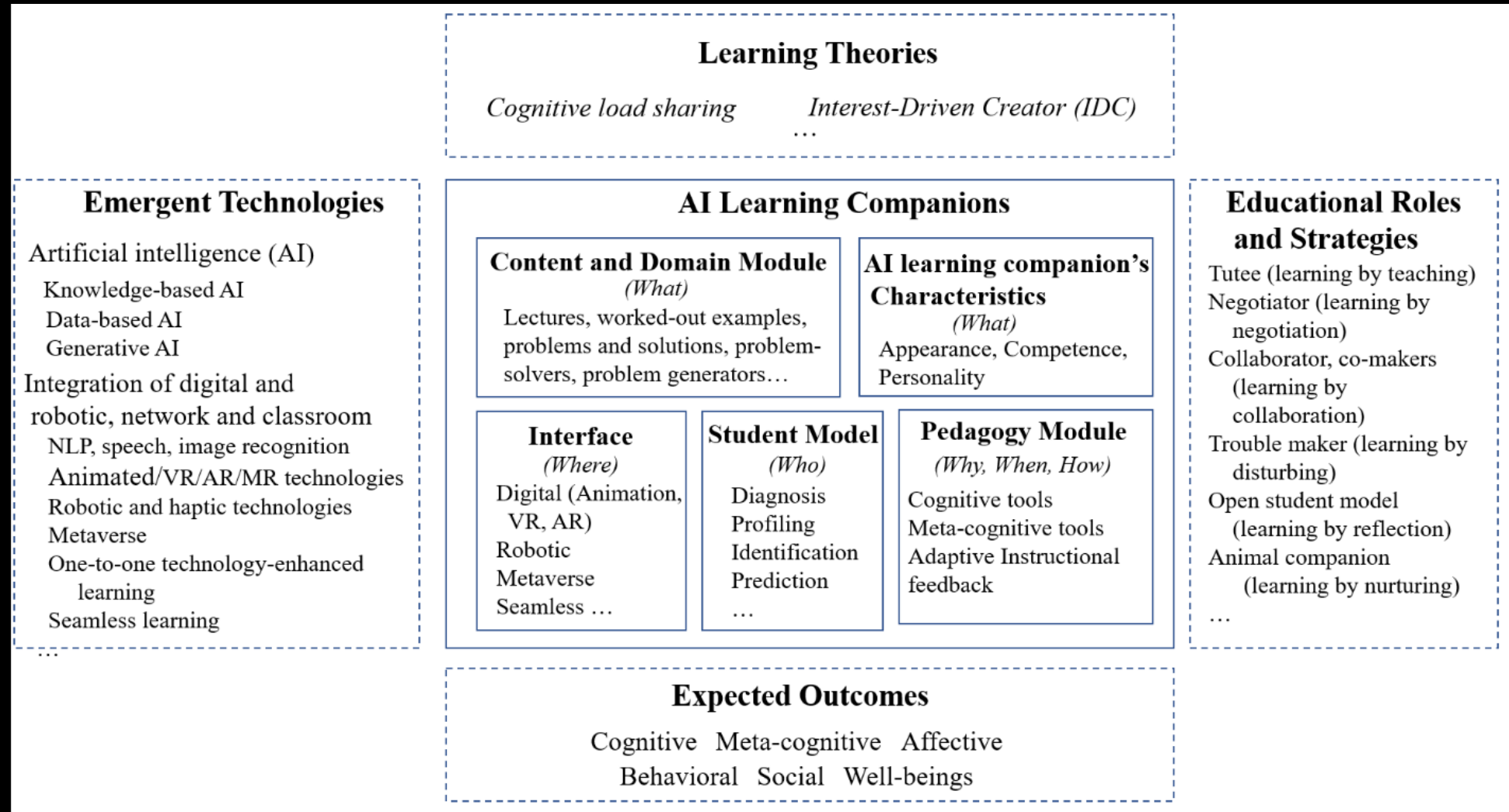
knowledge-based AI, data-based AI, and generative AI



Learning beyond knowledge acquisition



Research Agenda of AI Learning Companions



Research issue #1.

How emergent technologies are used to support the design of AI learning companions?

- Integration of digital and robotic, network and classroom learning
- Multimodal detection, recognition and analytics
- Animated/VR/AR/MR Technologies
- Robotic and Haptic Technologies
- Metaverse
- One-to-One Technology-Enhanced Learning
- Seamless Learning

Research issue #2.

Are there learning theories suitable for designing AI learning companions?

- Interest-Driven Creator Theory
- Cognitive Load Sharing
- Self-Regulated Learning
- Cognitive Apprenticeship
- Experiential Learning

Research issue #3.

Are there learning theories suitable for designing AI learning companions?

- Interest-Driven Creator Theory
- Cognitive Load Sharing
- Self-Regulated Learning
- Cognitive Apprenticeship
- Experiential Learning

Research issue #3.

What are the educational roles and strategies of AI learning companions?

- Collaborator (learning by collaboration)
- Competitor (learning by competition)
- Tutees (learning by teaching)
- Negotiators (learning by negotiation)
- Animal companion (learning by nurturing)

Research issue #4.

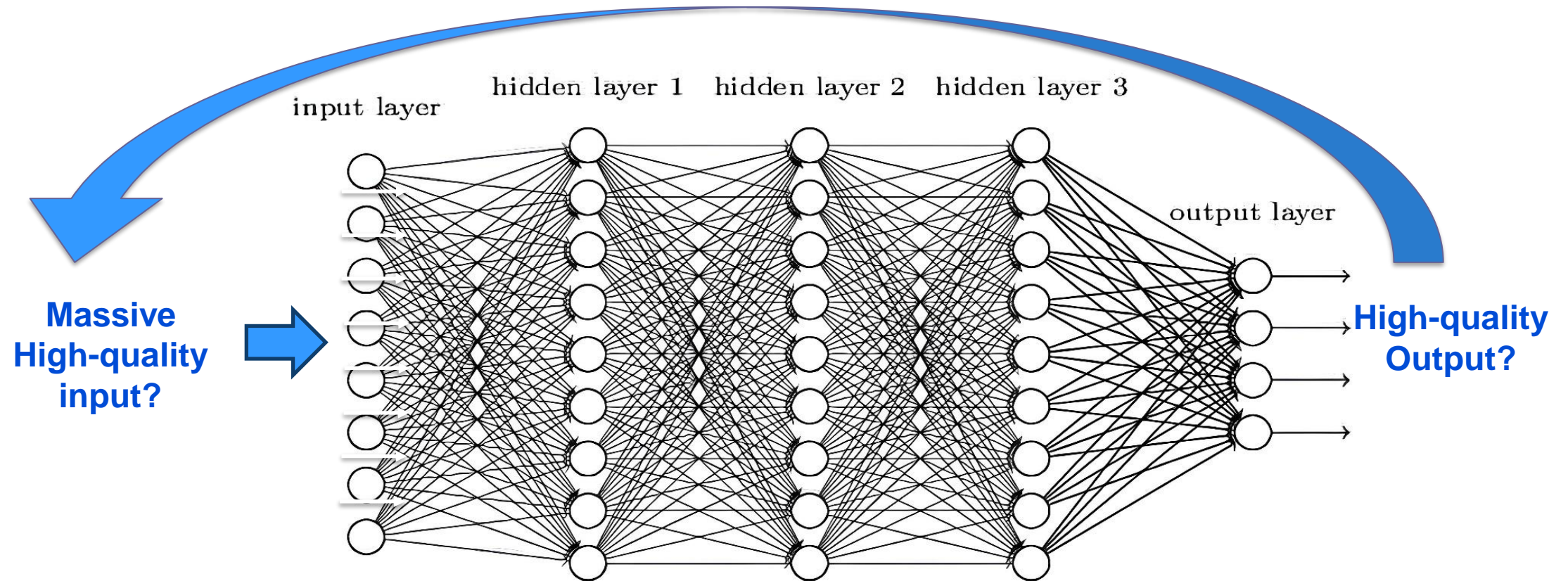
What are the expected outcomes and related evaluations of AI learning companions?

- Cognitive Outcomes
- Meta-Cognitive Outcomes
- Affective Outcomes
- Behavioral Outcomes
- Social Outcomes
- Wellbeing Outcomes

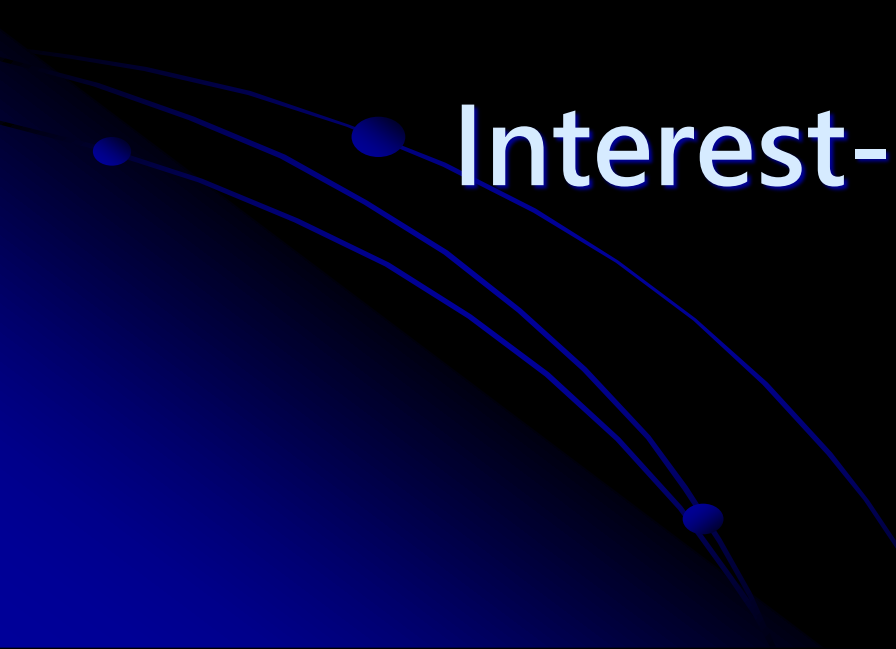
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Positive Feedback



How to ensure the input is both massive and high-quality?



Interest-Driven Co-Creator Theory
(IDC Theory)

Asian Education

Examination-Driven → Low Interest, Low Confidence

Interest-Driven Creator Theory (IDC)

(Asian Researcher Coauthors, 2018)

Taiwan

Tak-Wai Chan, National Central University
Chen-Chung Liu, National Central University
Ben Chang, National Central University
Calvin Liao, NTUNS
Fu-Yun Yu, National Cheng Kung University
Zhi-Hong Chen, National Taiwan Normal University

China

Ronghuai Huang, Beijing Normal University
Xiaoqing Gu, East China Normal University
Hercy Cheng, Central China Normal University

Hong Kong

Siu-Cheung Kong, The Education University of Hong Kong
Ronnel King, The Education University of Hong Kong
Minhong Wang, The University of Hong Kong

Australia

Jon Mason, Charles Darwin University

Singapore

Chee-Kit Looi, Nanyang Technological University
Lung-Hsiang Wong, Nanyang Technological University
Wenli Chen, Nanyang Technological University
Longkai Wu, Nanyang Technological University

Malaysia

Su Luan Wong, Universiti Putra Malaysia,

Korea

Heisawn Jeong, Hallym University, Republic of Korea
Hyo-Jeong So, Ewha Womans University

Japan

Hiroaki Ogata, Kyoto University

India

Sahana Murthy, Indian Institute of Technology 74

5 key elements of IDC Theory

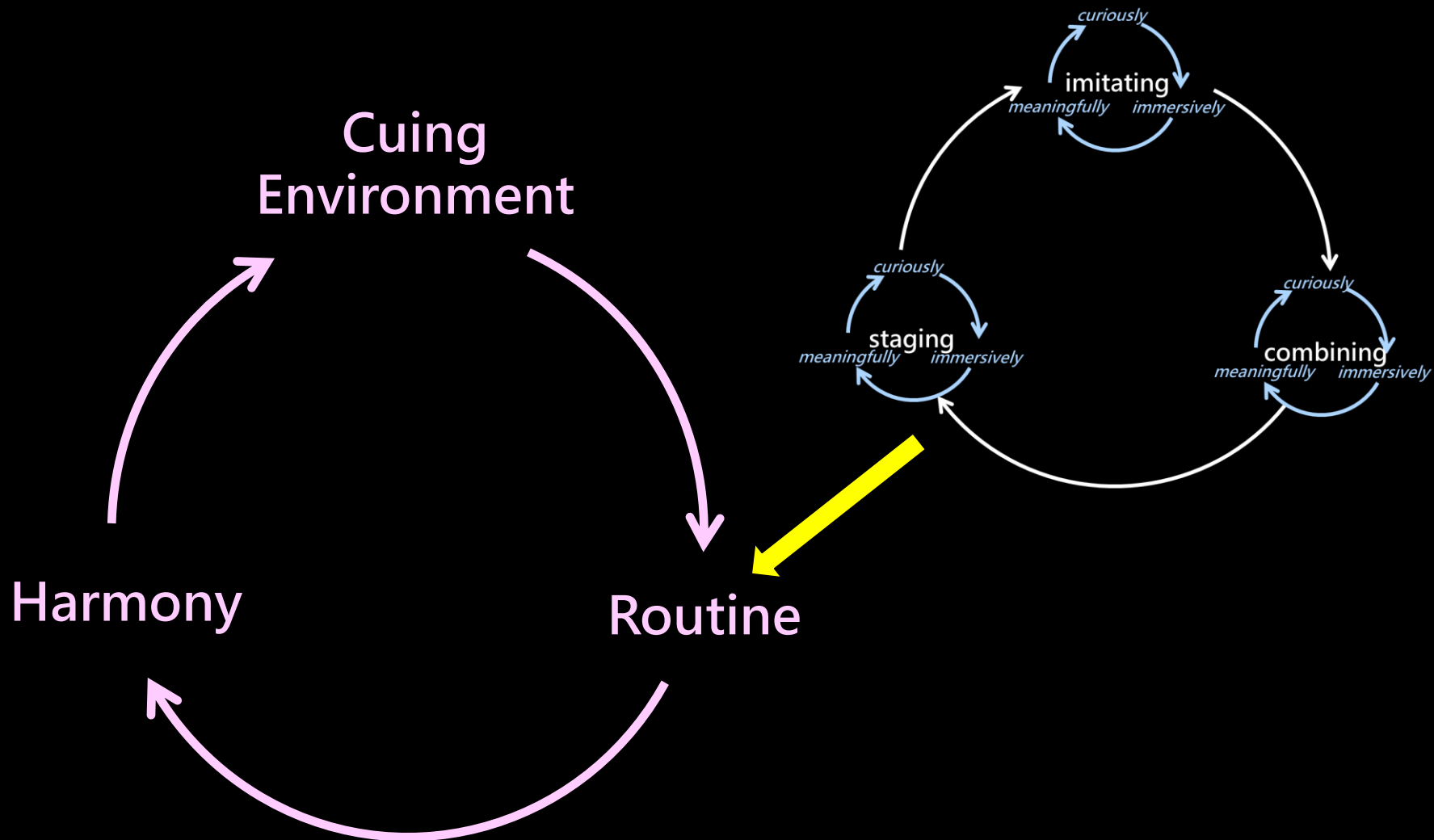
1. **Interest** *as mental representation*
 - learning as development of interest
2. **Creation** *as learning process*
 - how to design learning process as creation process
3. **Interest** *as learning strategy*
 - how to create (learn) with interest, not with pain, and hence to develop interest
4. **Habit** *as regular interest development*
 - how to develop habit and hence develop interest day-by-day
5. **Collaboration and Copresence** *as harmonious cultural development*
 - how to nurture societal harmony

Learning a domain is viewed as developing
interest of the domain at different stages

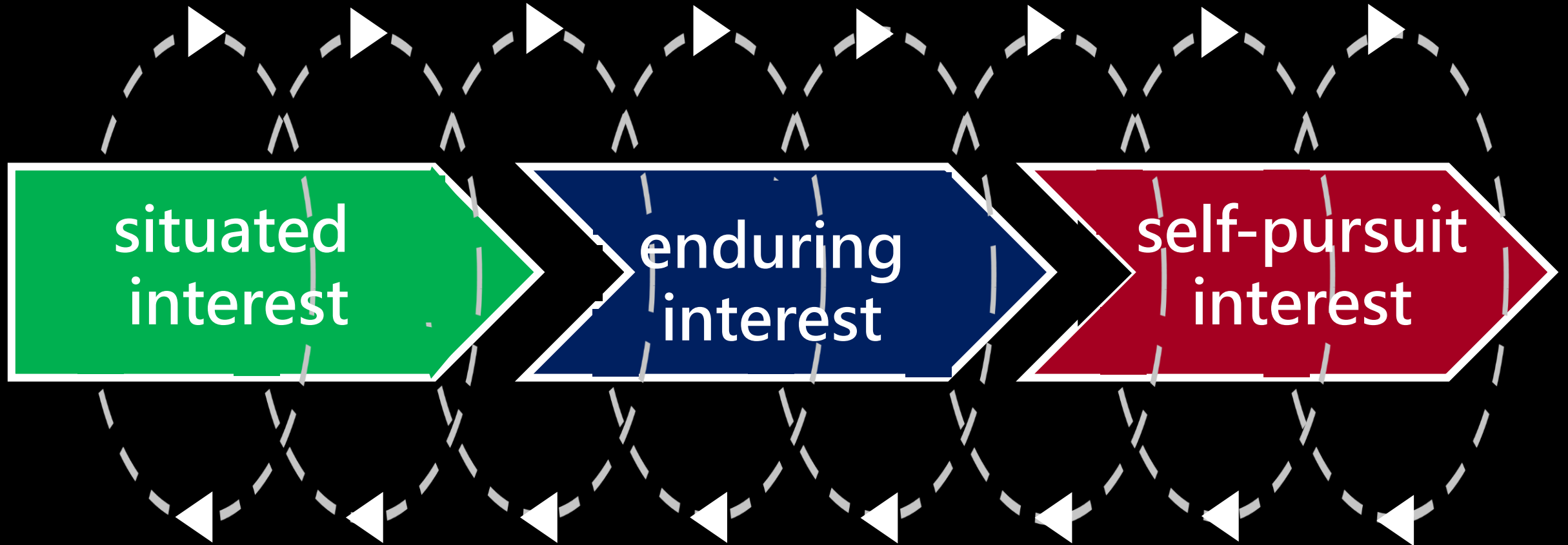


stages of interest development

habit loop / creation loop / interest loop



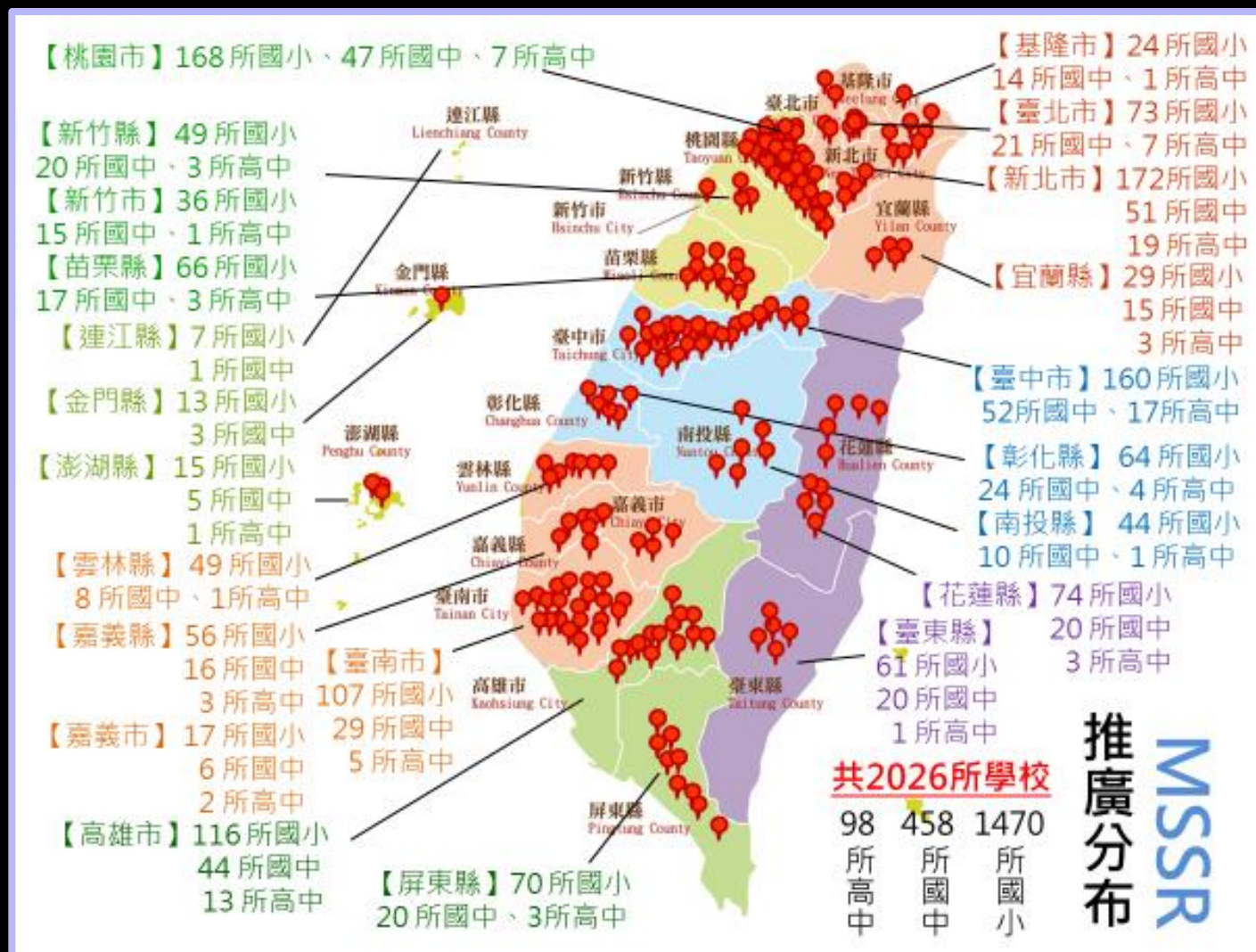
develop learning-interest of a domain with habit loop



stages of interest development

Today

2026 schools adopt IDC-Based Reading in Taiwan



IDC Mini Experimental Elementary School



IDC Mini Experimental Elementary School



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We may define

Seamless AI World

A **real world** that seamlessly connects and integrates all things,
including physical and virtual spaces and empowered by AI

More specifically,
Seamless AI World

is a world in which resource
can be *seamlessly* and *equitably* accessible, *AI-empowered* and *safe*!

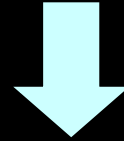
We value competition

- Competition drives progress, whether it is individual or group
- In real life, like sports or commerce, collaboration often goes with competition:
 - Inter-group competition while inner-group collaboration
- As long as the rules of the game are fair, competition is socially acceptable
- To maintain harmony, every competitor should psychologically prepare for the possibility of loss before undertaking a challenge. Furthermore, those who do lose should learn to accept their loss gracefully.
- In other words, if one has not psychologically prepared for the possibility of loss, one should not participate in a competition.

Seamless IDC Theory (SIDC Theory)

A theory that informs how to design
IDC learning in the Seamless AI World.

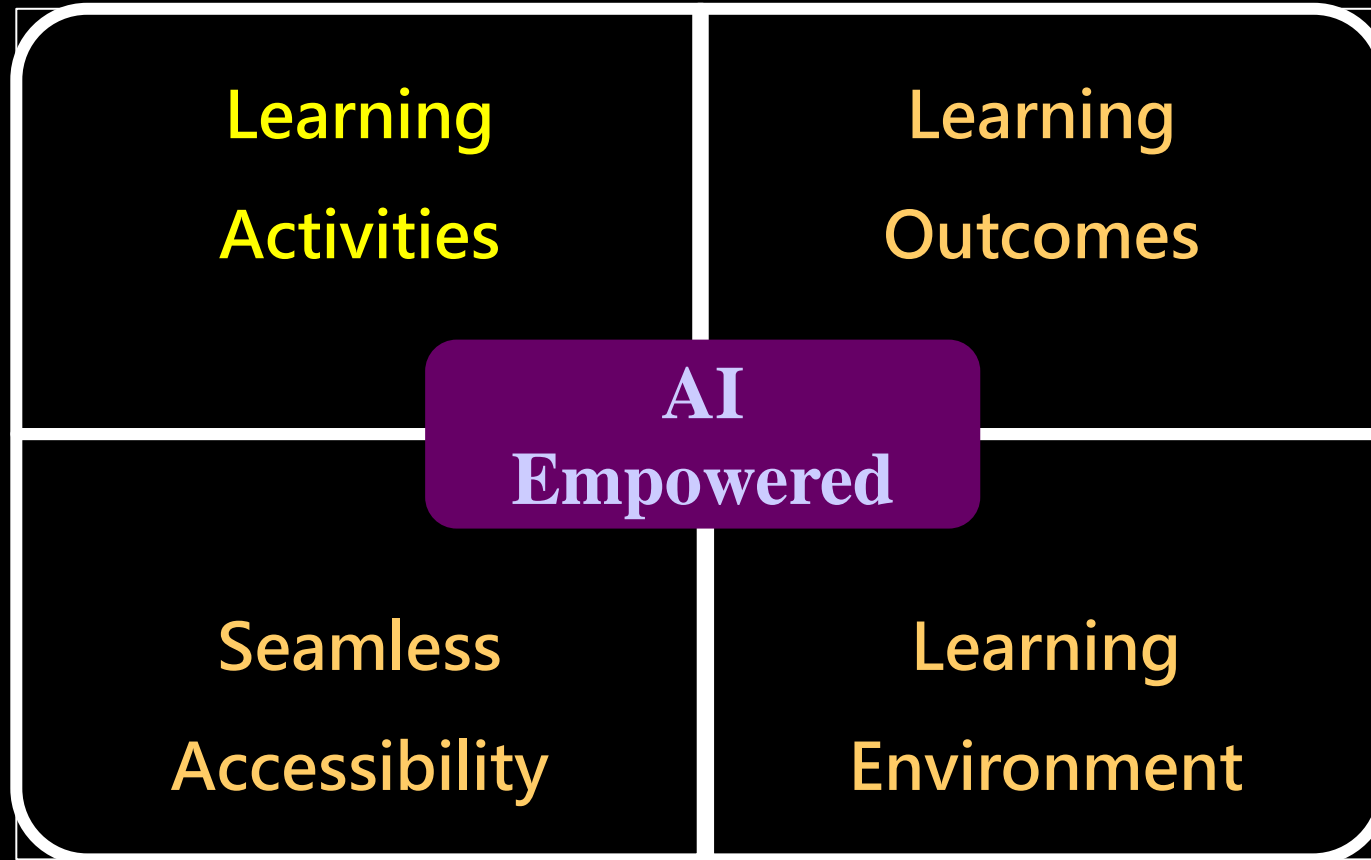
Seamless IDC Theory



Learning with
Harwell Values

**Seamless
AI World** →

Human Resources
Digital Resources
Digital Safety

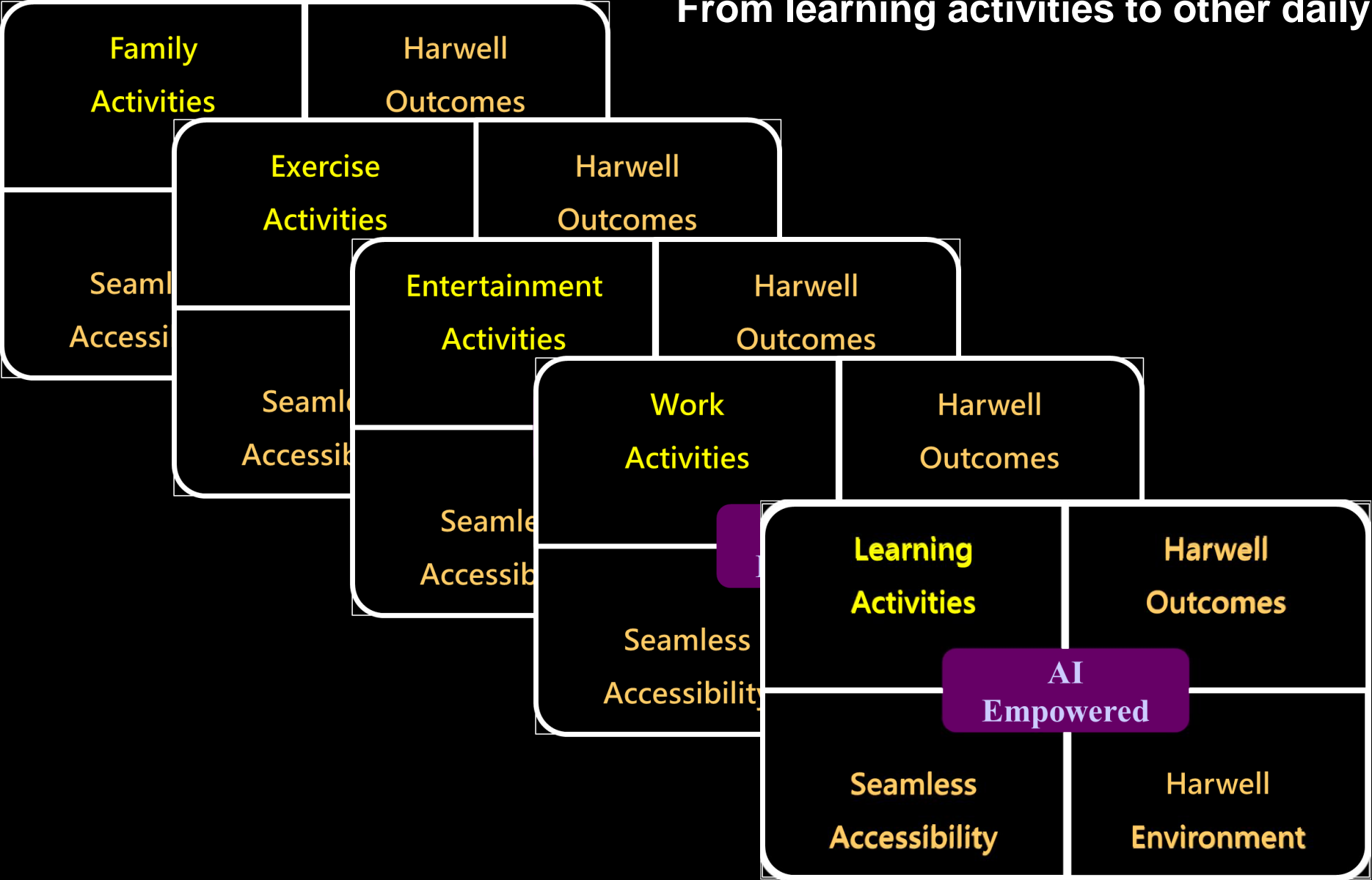


Attaining
Harwell

→ **The
Harwell
World**

Learning within
Harwell Environment

From learning activities to other daily activities



Outline

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More than 160 years ago, Dickens wrote in the first sentence of his “A Tale of Two Cities”:

**“It was the best of times, it was the worst of times,
it was the age of wisdom, it was the age of foolishness,
it was the epoch of belief, it was the epoch of incredulity,
it was the season of Light, it was the season of Darkness,
it was the spring of hope, it was the winter of despair...”**

What has happened in the last few years.....?

The world is on the brink of peril

- **The human lifespan is extended, but millions of people deceased in a short time before our eyes due to COVID-19**
- **Digitization enables all of us to connect and communicate, but we constantly quarrel over different beliefs**
- **Online games immerse players, but children's addiction may become a disaster**

The world is on the brink of peril (con't)

- **Artificial intelligence can improve human life, but it can also cause great harm to humanity**
- **The metaverse may represent a bright future world, but it may also signal a dark abyss to come**
- **We cheer for technological advancement, but worry about climate change, natural resource depletion, environmental pollution, wealth disparity and other problems**

More recently,
the rising frequency of global conflicts makes
such threats are even more ACUTE!

**More and more people
worry about the possibility of
a nuclear apocalypse and World War III**

**It is said that at the end of World War II,
a letter was found in a Nazi concentration camp.**

Dear Teachers:

I am a survivor of a concentration camp.

My eyes saw what no man should witness:

gas chambers built by learned engineers,

children poisoned by educated physicians,

infants killed by trained nurses,

women and babies shot and burned by high school and college graduates.

So, I am suspicious of education.

My request is: help your students become human.

Your efforts must never produce

learned monsters, skilled psychopaths, educated Eichmanns.

Reading, writing, arithmetic are important

only if they serve to make our children more human.

So, what is education?

- What is the meaning of going to school?
- What is the future of humankind?
- Can we live in harmony with the world around us?
- What role should education play in this turbulent world?

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Have you ever thought about:

What do you aspire to in your lifetime?

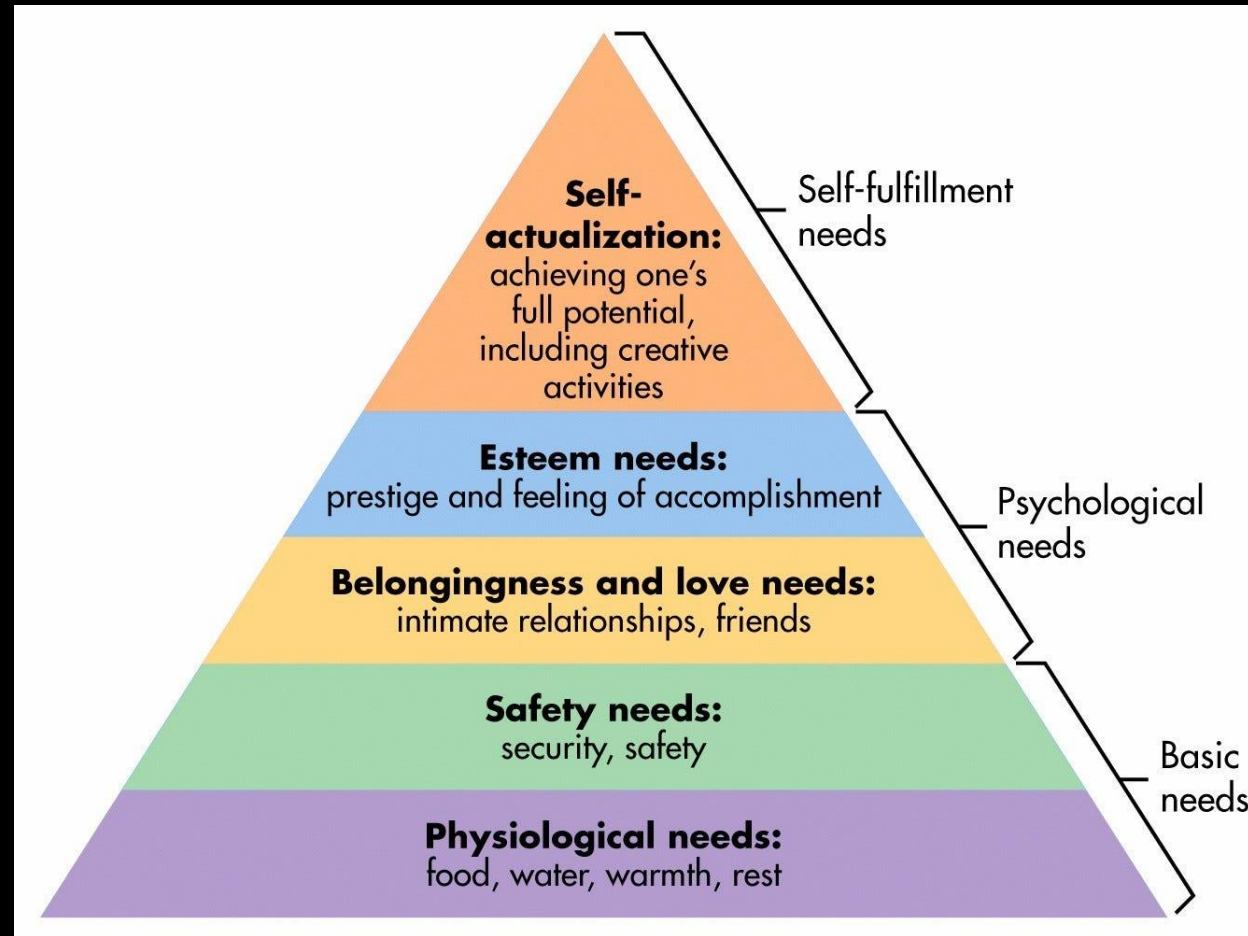
Please think about it for 10 seconds!

Most of us are ordinary people, perhaps we can ask

**What do most people aspire to
throughout their lives?**

The same answer: happiness, wealth, health.....?

Perhaps we can associate the question to: **Maslow's hierarchy of needs**



Adopted from <https://medium.com/re-write/maslows-hierarchy-of-needs-9ead9a46cb14>

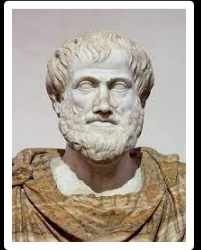
The question also leads us to the concepts:

- **Happiness**

- the absence of pain and the pursuit of pleasure...

- **Eudaimonia (Aristotle)**

- living a virtuous life, reaching one's full potential, and doing what is worth doing...



- **Wellbeing**

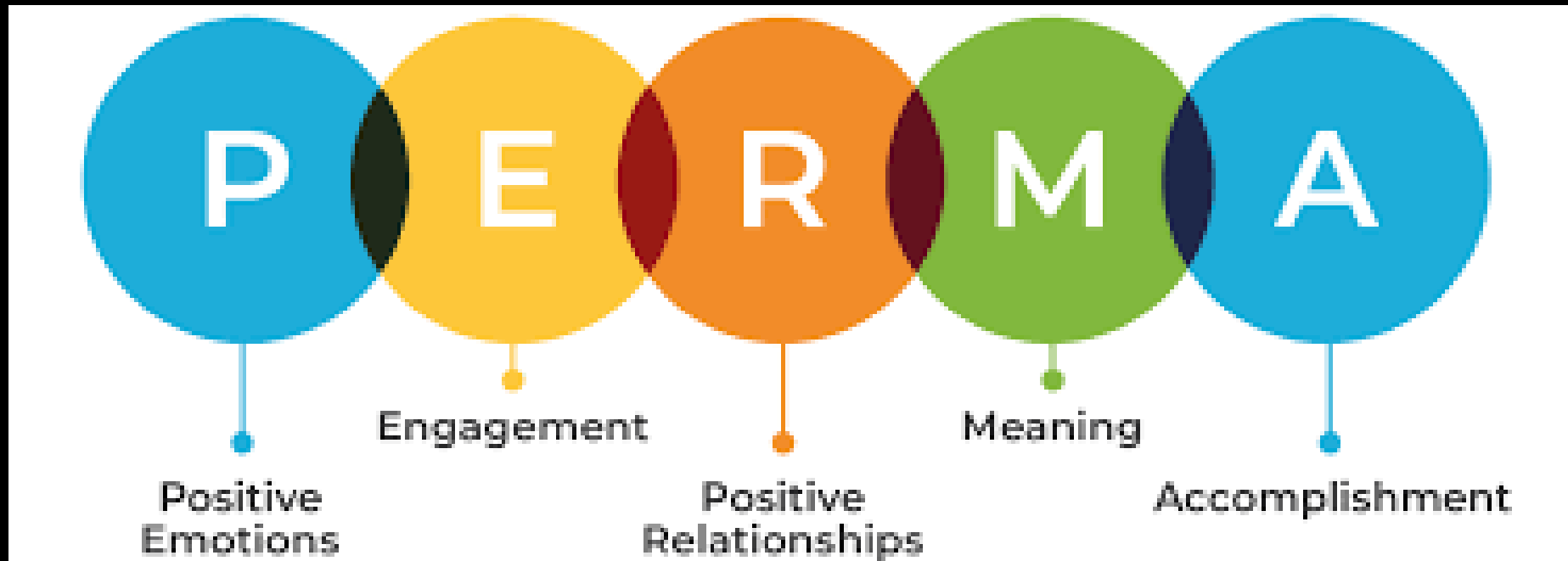
- modern name for eudaimonia
- experience of various aspects of a good life

- **Flourishing (Seligman, etc.)**

- modern name for eudaimonia, mostly adopted by positive psychologists
- experience of positive emotions, positive psychological functioning, and positive social functioning
- fulfillment of one's potentials and capabilities



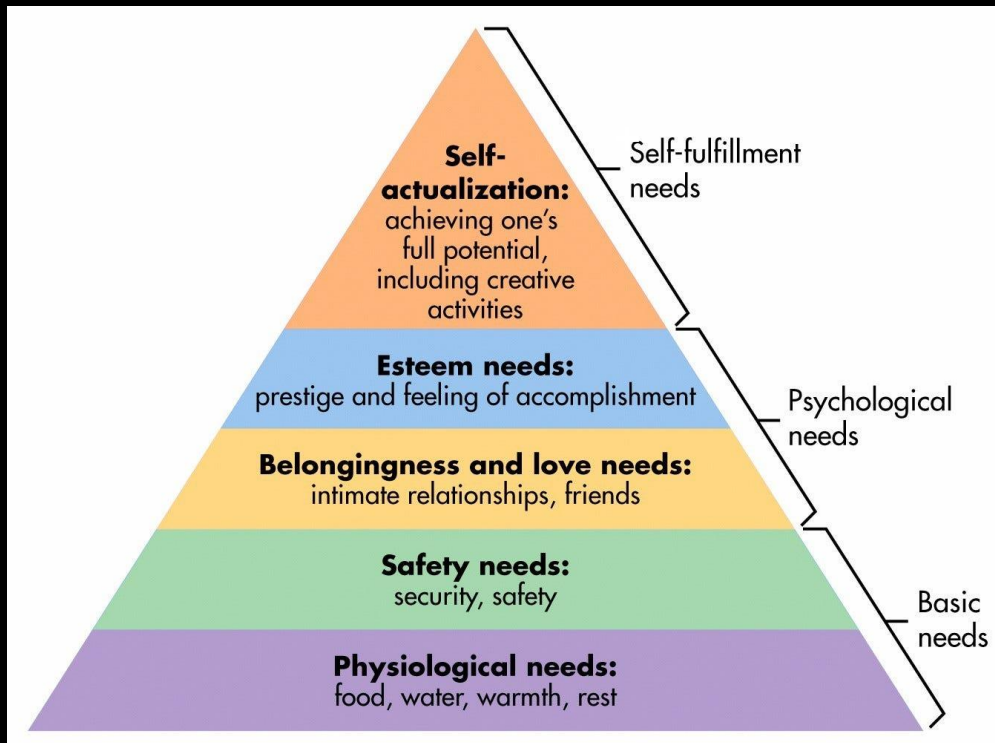
Seligman's PERMA Model



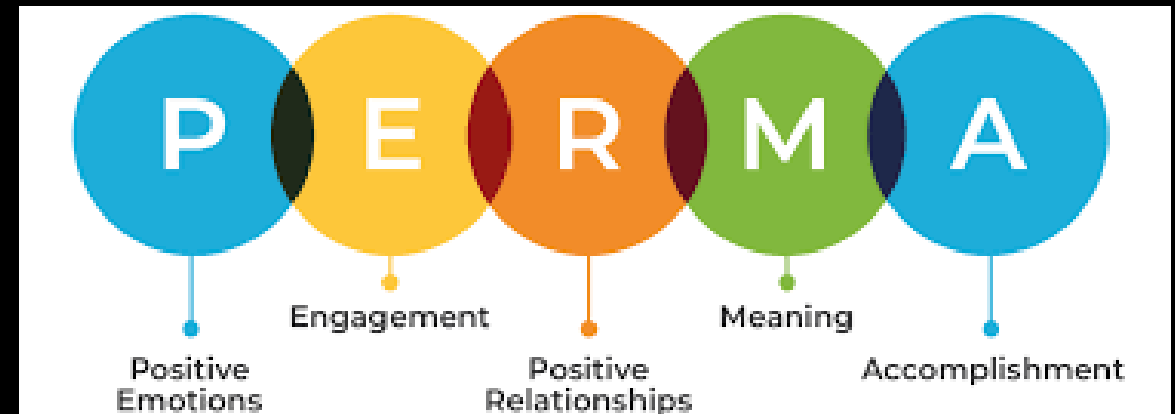
Seligman argues that these 5 elements are both ***measurable and teachable***, making the PERMA Model a practical framework.

Let us adopt **'wellbeing'** in our discussion
because it is a **broad term**
encompassing various aspects of a good life.

Furthmore, let's take 'wellbeing' as



+



**What do most people aspire
in their whole life?**

The answer: wellbeing

Now, two concerns with education:

Wellbeing in Education?

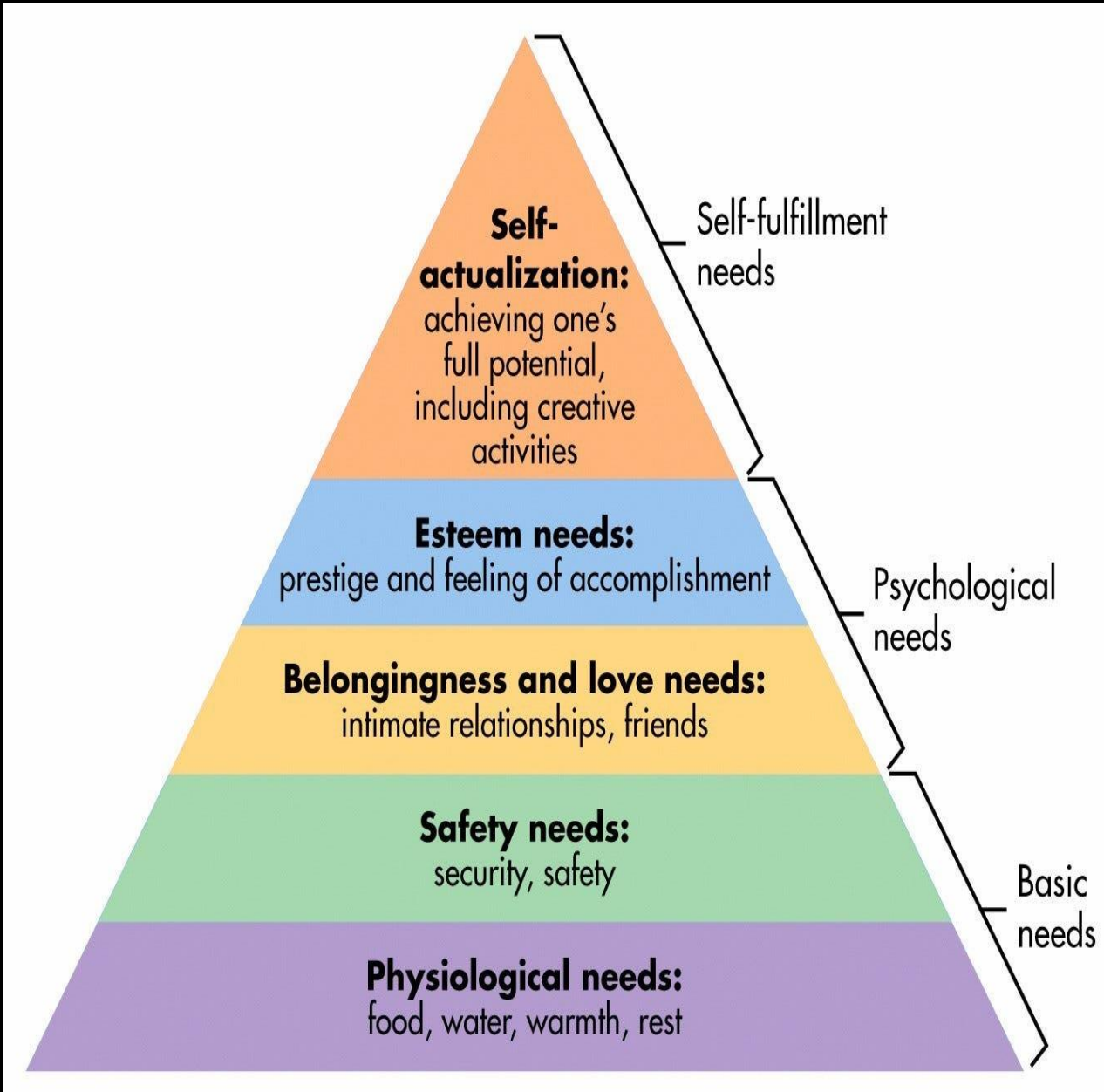
Can we attain wellbeing through education?

Education for Wellbeing?

Is education for the purpose of achieving wellbeing?

UNESCO's documents on wellbeing *especially during Covid-19*

- UNESCO Strategy on Education for Health and Well-Being: Contributing to the Sustainable Development Goals (2023)
- Education for Health and Well-Being Thematic Paper (2022)
- Supporting Learning Recovery One Year into COVID-19 - The Global Education Coalition in Action (2021)
- Prioritizing Health and Well-Being Now and When Schools Reopen (2020)
- Nurturing the Social and Emotional Wellbeing of Children and Young People During Crises (2020)
- Global Education Monitoring (GEM) Report 2020
- UNESCO Strategy on Education for Health and Well-Being (2016)



**We need a shared
Global Educational Goal
to lead our global endeavor!**

**Can education help
resolve these problems?**

GLOBAL SCALE

*pandemic, climate change,
wars, food, etc.*

**Unfortunately,
human basic needs are at stake!**

However

**If there is no harmony,
there is no wellbeing!**

Reflection?

- Have we ever thought about our educational goal at a higher-level manner?
- If not, are we sure that we fully understand the position of our research's contribution to the future education?
- Or do we just let the ever-advancing technology guide our research?

Remember

Designing future education
is
designing the future world

We are powerful, but we must be responsible and careful!

Also remember

- The education we impart today will determine the destiny of all humans in the years to come.
- In 20 years or so, today's school students will be in their 30's or 40's and emerge as the pillars of our society.

Thus, if we ask again:

**What do most people aspire
in their whole life?**

a possible answer: Harmony & Wellbeing (Harwell)

This is also the essence of humanity!

Harmony

- **Oxford Dictionary (meaning):**
 - Agreement of feeling or sentiment; peaceableness, concord.
 - Combination or adaptation of parts, elements, or related things, so as to form a consistent and orderly whole; agreement, accord, congruity
- **Webster Dictionary (synonyms) :**
 - Balance, coherence, concinnity, consonancy, orchestration, proportion, symmetry, symphony, unity

Three types of harmony

- **Individual harmony (with self)**

- a state of peace, balance, and contentment within oneself
- involving the alignment of thoughts, emotions, and actions, hence leading to a sense of inner peace and stability
- an essential part of living a fulfilled and meaningful life

- **Social harmony (with society)**

- peaceful coexistence and mutual respect among individuals within a community or society
- involving goodwill among people
- building of supportive, cooperative relationships that promote understanding and belonging

- **Environmental harmony (with nature)**

- the balanced and sustainable relationship between humans and the natural environment
- involving living in a way that respects and preserves the natural world
- ensuring natural resources available for future generations and helping prevent environmental crises
- essence for the health of the planet and the survival of all its inhabitants

UNESCO's 17 SDGs

*essentially about **Equity & Environment***



- Societal Harmony

- **Equity**

- Environmental Harmony

- **Environment**

UNESCO's documents on harmony

- Sustainable Tourism in Harmony with Nature, People, and Spirituality (2020)
- UNESCO and Biodiversity: Creating Harmony (2020)
- Ecohydrology: Engineering Harmony for a Sustainable World (2015)
- Recipes for Harmony (2015)
- For a World of Harmony (2011)
- Man and Nature: Living in Harmony (2009)
- etc.

Harmony implies inclusiveness!

Harmony doesn't mean pursuit of conformity.

Just the opposite, pursuit of conformity leads to disharmony.

Harmony

```
graph TD; A[Harmony] --> B[Humanity Harmony]; A --> C[Environmental Harmony]
```

Humanity
Harmony

Environmental
Harmony

For Humanity Harmony

- **individual harmony**
 - *inner peace, satisfaction, balance, coherence, ...*
- **Family Harmony**
 - *love, care, modeling, parental respect, ...*
- **Societal Harmony**
 - *compassion, equity, inclusiveness, integrity, ...*
- **Global Harmony**
 - *Intersocietal compassion, intersocietal equity, SDGs, global citizenship (UNESCO), global competence (OECD), ...*

Harmony

Humanity Harmony

- *Individual Harmony*
 - *inner peace, balance, coherence, satisfaction, ...*
- *Family Harmony*
 - *love, care, modeling, parental respect, ...*
- *Societal Harmony*
 - *compassion, equity, inclusiveness, collaboration, integrity, ...*
- *Global Harmony*
 - *intersocietal compassion, intersocietal equity, SDGs, global citizenship (UNESCO), global competence (OECD), ...*

Environmental Harmony

- *Global Warming*
- *Natural Disasters*
- *Earth Resource Exhaustion*
- *Starvation*
- *Extinction of Species*
- *.....*

from Local to Global

Traditionally, our concern for harmony is from
personal → family → societal → global

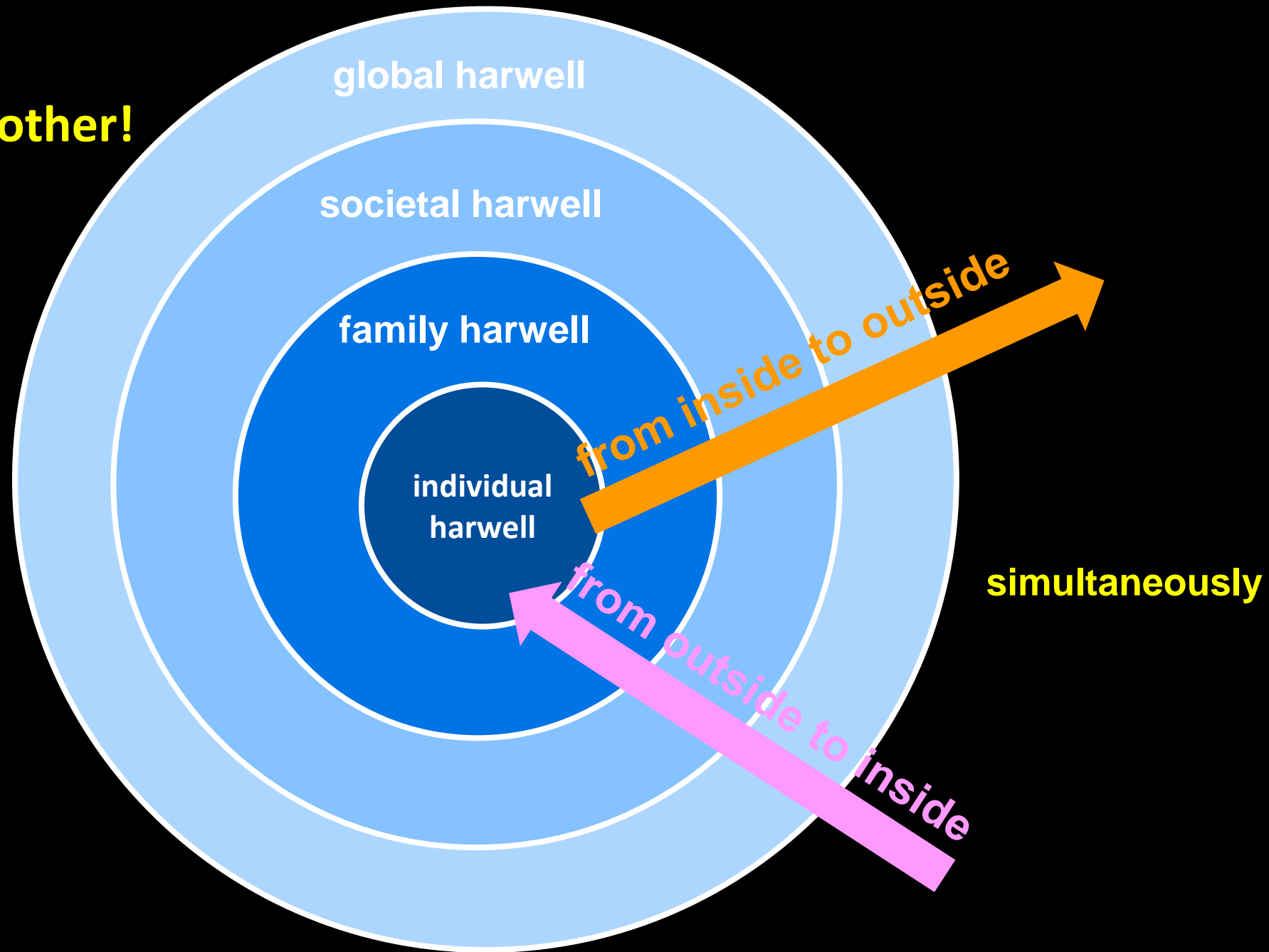
Same for wellbeing, our concern is from
personal → family → societal → global

from Global to Local

Because the world is getting smaller and smaller (due to the internet) and for many other reasons, our concern should also be

global → societal → family → individual

**Going both ways
mutually enhance
the development of each other!**



'Global Compassion' as an example

- **'Compassion'** (or empathy) is an important element of harmony.
- It is a sentiment mainly directed towards others, defined as “a strong feeling of sympathy and sadness for the suffering or bad luck of others and a wish to help them” (Cambridge Dictionary).
- We are well-aware and have 'compassion' for individuals, but not many of us realize that from a global perspective, we also need to extend compassion to other societies or cultures.

‘Global Compassion’ as an example (con’t)

- In the future, ‘inter-family compassion’ and ‘inter-society compassion’ should be well-defined and promoted, not only for the general public but also for leaders or statesmen from different societies or states.
- Thus, ‘global compassion’ should encompass interpersonal, inter-family, and inter-society compassion.
- By the same reason, we should extend the definition of wellbeing to global wellbeing.

Why 'from Global to Local' is important?

- Edward Wilson (1978) put forward: human nature constitutes Heredity, Development, **Aggression**, Sex, **Altruism**, and Religion
- We inherit *aggression* from our ancient ancestors possibly because they robbed resources from others for survival, and more resources for even better survival
- Individual aggression aims for individual survival; tribal aggression for tribal survival
- Human selfishness may originate from our inherited aggression, which may lead to conflicts among individuals and societies

Why 'from Global to Local' is important? (con't)

While the progress of technology improves human wellbeing,
the reduction of aggression and the increase in altruism represent
the most significant advancements of human civilization.

*This may also explain why
Global Harwell should be our shared global educational goal!*

Thus, **Global Harwell** refers to harmony and wellbeing from both global and local perspectives.

From here on, 'Global Harwell' and 'Harwell' will be used interchangeably.

Harmony & Wellbeing (Harwell)

Harmony

Humanity

- Individual Harmony
- Family Harmony
- Societal Harmony
- Global Harmony

Environment

- Climate Change
- Natural Disasters
- Starvation
- Biodiversity
- Fossil Fuels Depletion
-

Wellbeing

- Accomplishment
- Meaning
- Engagement
- Positive Relationship
- Positive Emotion
- Financial Security
- Health

Harmony VS Wellbeing

To most people (non-academia):

Harmony is more associated with social relationship and environment

Wellbeing is more associated with individuals

Note that

no global harmony

→ no societal harmony

→ no family harmony

→ no individual harmony

→ no individual wellbeing

Also, note that

If most people aspire to achieve Harwell throughout their lives, then

- **the primary purpose of creating knowledge** is to help people attain Harwell
- **the very reason of existence of technology** is to help people attain Harwell
- Hence, **the purpose of education** is also to help students attain Harwell

More reasons why 'global' is important

- When we move into the digital future
 - The world is getting **smaller and smaller**: people interact across the globe so closely, yet they are situated so far away
 - Any important idea or practice will spread worldwide rapidly
- We want students of the **whole world** to enjoy an education full of Harwell and sustain it in their subsequent lives

Given all the deliberations above,
Global Harwell is what the majority of people aspire to throughout their lives
and captures, across different cultures, the core values of humanity.

Global Harwell
perhaps can serve as a candidate for
our shared global educational goal!

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How to achieve Global Harwell?

Researchers and practitioners in our field have long been focusing on **how** students learn and **what** they learn, but not **why** they learn.

But *why people learn* is the paramount objective of education for human beings and is the only way to help humans become truly civilized.

Future-Ready Learner: **GH-PISA**

- **Global Harweller**: a person who practices Global Harwell as personal value or life objective
- **Polymath**: a person who has interests and expertise in a wide range of disciplines, particularly in the humanities domain
- **Interest-Driven Co-Creator**: a person who, driven by their interests, pursues new knowledge and creates habitually
- **Sportsman**: a person who plays sport well and habitually
- **Aestheticist**: a person who is devoted to esthetics and pursues beauty and art

How to proceed?

A possible approach to spreading the thoughts and initiating actions

1. Awareness

Build global and local awareness of the goal

2. Model sites

Establish experimental and model sites in various countries and regions

3. Global educational park

Create a 'global educational park' by closely connecting these sites via technology, and

4. Dissemination

spread out the principles of global education and initiate actions for practice

**But what is the role of technology
in the big AI era?**

**AI companion not only passing the Turing Test,
but also emulating humans in various and subtle ways**

Digital Resemblance

Intellectual

Emotion

Social Relationship

Value System

.....

**We cannot distinguish the AI companion we are interacting is
a real human or artificial human (virtual or robotic)**

No doubt, AI will outperform human beings in many domains and in various aspects.

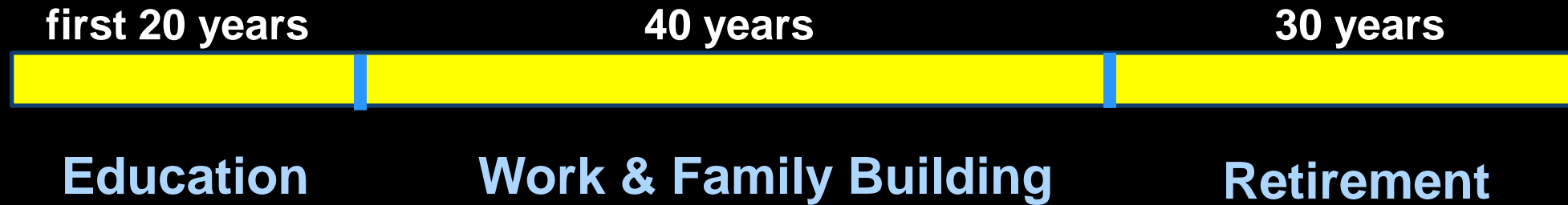
We shall interact with multiple **SUPER** artificial humans, virtual or robotic, as companions.

Can we design these AI companions to nurture our students with Global Harwell as their value and goal?

Yes, we definitely can.

This is the most significant and fruitful research on AI companions for the future, and it presents a big challenge as well!

Major purposes of one's life at different stages



The first 20 formative years of a person's character and value system will carry on for the rest of their lives.

Thus, if **all students in the world** have built Global Harwell as their value system and goal in this formative period, then the world will become a Harwell world.

The greatness of education

- As Mandela once stated:

"Education is the most powerful weapon you can use to change the world."

- EDUCATION could be the **only** and **most effective** means to save the world
- Moreover, if we succeed to a substantial degree, we and our next generation perhaps can enjoy a Harwell World, peaceful and flourishing

I hope this talk stimulates thoughts about

- What is education?
- What is educational goal?
- Would a shared educational goal worldwide exist?
- Should Global Harwell be our shared global educational goal?
- Could such a goal be attained?
- Could education and technology help attain an ideal future world or make our world much better in the long run?

