Using the Gartner Hype Cycle to Evaluate the Adoption of Emerging Technology Trends in Higher Education – 2013 to 2016

Tania Prinsloo[1*], JP van Deventer[1]

[1]University of Pretoria, Pretoria, South Africa
tania.prinsloo@up.ac.za
phil.vandeventer@up.ac.za

Abstract. The landscape of higher education is changing, with more techno-savvy students entering these institutions. The aim of this paper is to identify the trends of the Gartner Hype Cycles for Emerging Technologies for 2013 and 2016 and to compare the rate of adoption by higher education institutions worldwide. The research approach is a quantitative meta-analysis. Results indicate that higher education institutions are slow to adopt emerging technologies and rather adopt technologies once they have become common in the everyday lives of people. A possible solution is to find innovative and cheaper ways of incorporating the emerging trends in higher education.

Keywords. Gartner's Hype Cycle, Emerging Technologies, Higher Education.

1 Introduction

Higher education is changing rapidly due to globalization and increasing internationalization [2]. The student entering higher education today is technologically much further advanced than five years ago [4]. Technology is not only embedded in their everyday lives, but also part of their higher education experience [5]. The landscape of higher education is adapting to new technologies and trends, with institutions implementing new technologies to attract students [2]. Technology adoption, however, is different for diverse technologies [1]. The aim of this article is to compare the rate of adoption of emerging technologies by higher education institutions from 2013 to 2016, to the Gartner Hype Cycle for Emerging Technologies, to determine if universities are staying ahead or lagging behind.

2 Background

Roy Amara is quoted as saying "we tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run" [3]. Higher education institutions need to position themselves to remain competitive in the technological do-

main. One way of measuring the performance of these institutions is by comparing them to Gartner's Hype Cycle for Emerging Technologies.

2.1 The Gartner Hype Cycle

The Gartner Hype Cycle is a graphical representation of the newest emerging technology trends worldwide and is published annually from 1995 [7]. The hype cycle starts with the overenthusiastic adopters, through five phases, until the new technology finds its use in the market [13]. Figure 1 illustrates the hype curve.

Fig. 1. The Gartner Hype Cycle Curve [13]

The five phases of the hype curve are described by Lajoie and Bridges [12].

2.2 Gartner's Hype Cycles for Emerging Technologies: 2013 to 2016

The 2013 and 2016 hype cycles are shown and elaborated on in this section to be able to look forward and backward regarding technology adoption in higher education institutions.

The 2013 Hype Cycle for Emerging Technologies
Figure 3 below describes the Hype Cycle for Emerging Technologies in 2013 [9].

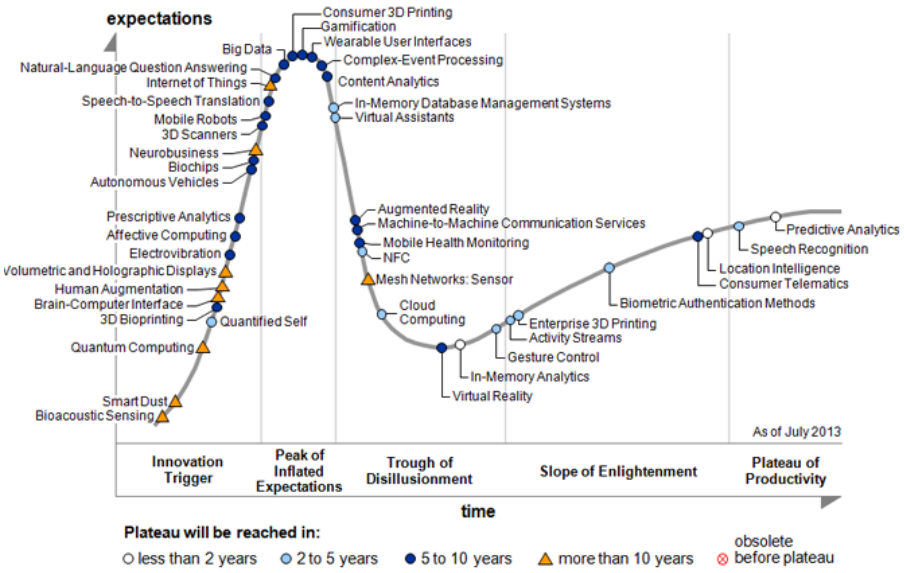

Fig. 2. Hype Cycle for Emerging Technologies, 2013 [9]

The 2016 Hype Cycle for Emerging Technologies

Figure 3 below describes the Hype Cycle for Emerging Technologies in 2016 [10].

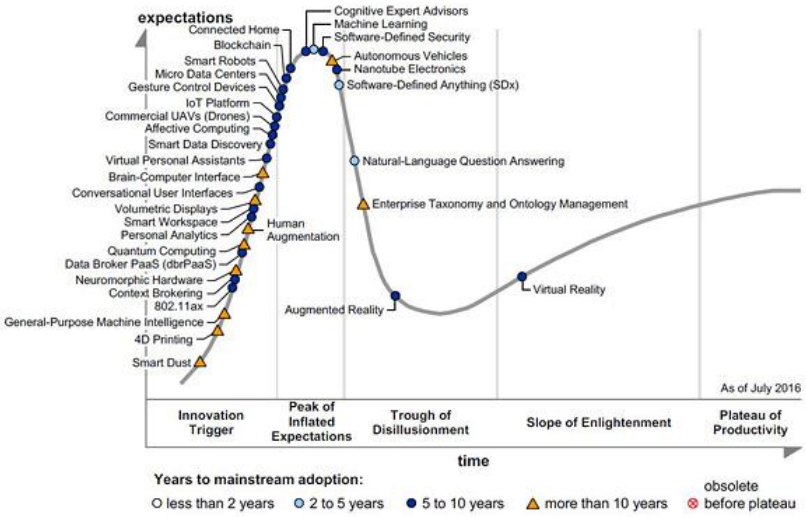

Fig. 3. Hype Cycle for Emerging Technologies, 2016 [10]

3 Research Question

The main research question asked in this paper is: to what extend is higher education incorporating emerging technology trends compared to Gartner's Hype Cycle for Emerging Technologies?
The secondary questions are:

- How many trends identified in the 2013 Hype Cycle for Emerging Technologies have been adopted by higher education institutions from 2013 to 2016?
- How many trends identified in the 2016 Hype Cycle for Emerging Technologies have been adopted by higher education institutions from 2013 to 2016?

4 Research Methodology

The research methodology is a quantitative meta-analysis. Meta-analysis is used to synthesize quantitative information from related studies and produce results that summarize a whole body of research [6]. The selection criteria for the data gathering was:

4.1 Identify the Study and Inclusions

- To perform a specific Google Scholar search that included the words "tertiary institution" or "tertiary institutions" or "higher education" and the "keyword/s" identified in both the 2013 and 2016 Gartner Hype Cycles of Emerging Technologies [8, 10]. The dates were limited to 2013 to 2016. The search criteria had to be very specific, only searching for the term "education", for example, would lead to incorrect results.
- To identify the same keywords from the Hype Cycles in the proceedings of the International Symposium on Emerging Technologies for Education (SETE) of 2016.
- To then give the total score of results from the two sets of data above in the Total column.
- To also perform a general Google Scholar search with only the keywords from the Hype Cycles from 2013 to 2016 to see if the trends identified have been researched at all in scholarly literature and to what extent.

4.2 Exclusions

The keywords had to be present in the results exactly as they are referred to by Gartner, limiting the possible number of search results. This was done because of time- and resource constraints.

4.3 Abstract the Data from the Study

All the data was then summarized in two tables, Table 1 and 2.

4.4 Analyze the Data Statistically

A graph was plotted to identify the adoption of the trends by higher education institutions for the results of both the Hype Curves of 2013 and 2016.

5 Results

5.1 Main Findings

Gartner's Hype Cycle 2013
The keyword meta-analysis of the Gartner Hype Cycle for Emerging Technologies for 2013 is shown in Table 1 below.

Table 1. Keyword meta-analysis of the Gartner Hype Cycle for Emerging Technologies of 2013 [8]

Keyword from Hype Cycle	2013	2014	2015	2016	SETE 2016	Total	Total General Google Scholar Results
On the Rise							
Bioacoustic Sensing	0	0	0	0	0	0	20
Smart Dust	0	0	0	0	1	1	2 820
Quantum Computing	1	0	0	0	0	1	16 300
3D Bioprinting	0	0	0	0	0	0	2 200
Brain-computer Interface	1	0	0	0	0	1	17 100
Human Augmentation	0	1	0	0	1	1	595
Volumetric and Holographic Display	1	0	1	0	0	2	4
Electrovibration	0	0	0	0	0	0	456
Affective Computing	0	0	0	0	0	0	13 400
Prescriptive Analytics	0	0	0	0	0	0	1 400
Autonomous Vehicles	1	0	0	0	0	0	16 500
Biochip	0	0	0	0	0	0	15 900
Neurobusiness	0	0	0	0	0	0	61
At the Peak							
3D Scanners	1	0	0	0	0	1	4 100
Mobile Robots	0	0	0	0	0	0	21 000
Speech-to-Speech Translation	0	0	0	0	0	0	1 400
Internet of Things (IoT)	2	0	0	1	0	3	46 900
Natural-Language Question Answering	0	1	0	0	0	1	702
Big Data	0	4	3	4	1	11	61 400
Consumer 3D Printing	0	0	0	0	0	0	216
Gamification	0	3	2	3	1	6	16 200
Wearable User Interfaces	0	0	0	0	0	0	85
Complex-Event Processing	0	0	0	0	0	0	6 630

Keyword from Hype Cycle	2013	2014	2015	2016	SETE 2016	Total	Total General Google Scholar Results
Content Analytics	0	0	0	0	0	0	1 040
Sliding Into the Trough							
In-Memory Database Management Systems	0	0	0	0	0	0	110
Virtual Assistants	0	1	0	0	0	1	950
Augmented Reality	0	1	2	3	1	7	27 100
Machine-to-Machine Communication Services	0	0	0	0	0	0	35
Mobile Health Monitoring	0	0	0	0	0	0	1 350
Near-Field Technology (NFC)	0	0	1	1	0	2	318
Mesh Networks: Sensor	0	0	0	0	0	0	55
Cloud Computing	4	3	8	9	0	24	74 400
Virtual Reality	7	6	5	7	0	27	82 500
In-Memory Analytics	0	0	0	0	0	0	554
Gesture Control	0	0	0	0	0	0	4 850
Climbing the Slope							
Active Streams	0	0	0	0	0	0	556
Enterprise 3D Printing	0	0	0	0	0	0	54
Biometric Authentication Methods	0	0	0	0	0	0	447
Consumer Telematics	0	0	0	0	0	0	96
Location Intelligence	0	0	0	0	0	0	654
Entering the Plateau							
Speech Recognition	3	1	1	1	1	7	29 400
Predictive Analytics	0	1	0	0	0	1	16 500

It can be noted that “Cloud Computing” and “Virtual Reality” had the highest scores. Results for “Cloud Computing” at higher education institutions showed an upward trend, while the results for “Virtual Reality” remained mostly the same annually. The only other result worth mentioning was that of “Big Data”, with a total score of 11 over the four study year period. Figure 4 below graphically illustrates how the hype curve trends have been adopted by higher education institutions, with the peak at the third phase and not the second, as with the typical Gartner Hype Curve. There was not enough data to do the analysis annually, so the results were totaled.

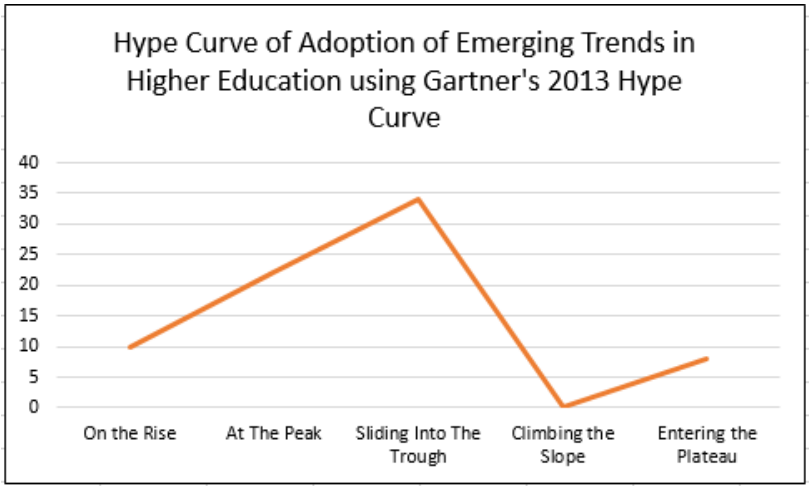

Fig. 4. The Hype Curve of Emerging Trends in Higher Education from 2013 to 2016 based on Gartner's Hype Cycle for Emerging Technologies of 2013

Gartner's Hype Cycle 2016

The keyword meta-analysis of the Gartner Hype Cycle for Emerging Technologies for 2016 is shown in Table 2 below.

Table 2. Keyword meta-analysis of the Gartner Hype Cycle for Emerging Technologies of 2016 [10].

Keyword from Hype Cycle	2013	2014	2015	2016	SETE 2016	Total	Total General Google Scholar Results
On the Rise - 2016							
Smart Dust	0	0	0	0	1	1	2 820
4D Printing	0	0	0	0	0	0	559
General-Purpose Machine Intelligence	0	0	0	0	0	0	1
802.11ax - Next generation wireless local area networks	0	0	0	0	0	0	1 680
Context Brokering	0	0	0	0	0	0	29
Neuromorphic Hardware	0	0	0	0	0	0	1 120
Data Broker PaaS (dbrPaaS)	0	0	0	0	0	0	1
Quantum Computing	1	0	0	0	0	1	16 300
Human Augmentation	0	1	0	0	1	1	595
Personal Analytics	0	0	0	0	0	0	478
Smart Workspace	0	0	0	0	0	0	38
Volumetric Displays	0	0	0	0	0	0	732

Keyword from Hype Cycle	2013	2014	2015	2016	SEIE 2016	Total	Total General Google Scholar Results
Conversational User Interfaces	0	0	0	0	0	0	41
Brain-Computer Interface	0	0	0	0	0	0	16 800
Virtual Personal Assistants	0	0	0	0	0	0	156
Smart Data Discovery	0	0	0	0	0	0	20
Affective Computing	0	0	0	0	0	0	13 500
Commercial UAVs (Drones)	0	0	0	0	0	0	19 800
IoT Platform	0	0	0	0	0	0	1 940
At the Peak							
Gesture Control Devices	0	0	0	0	0	0	34
Micro Data Centers	0	0	0	0	0	0	151
Smart Robots	0	0	0	0	0	0	426
Blockchain	0	0	0	0	0	0	4 700
Connected Home	0	0	0	0	0	0	2 260
Cognitive Expert Advisors	0	0	0	0	0	0	2
Machine Learning	0	0	0	0	1	1	262 000
Software-Defined Security	0	0	0	0	0	0	131
Autonomous Vehicles	0	0	0	0	0	0	16 600
Nanotube Electronics	0	0	0	0	0	0	1 230
Software-Defined Anything (SDx)	0	0	0	0	0	0	51
Sliding Into the Trough							
Natural Language Question answering	0	0	0	0	0	0	702
Enterprise Taxonomy and Ontology Management	0	0	0	0	0	0	1
Augmented Reality	0	1	2	3	1	7	27 100
Climbing the Slope							
Virtual Reality	7	6	5	7	0	27	82 500
Entering the Plateau							
None identified							

"Virtual Reality" was once again the top scorer, followed by "Augmented Reality". Only four of the other keywords scored once, namely "Smart Dust", "Quantum Computing", "Human Augmentation" and "Machine Learning". Figure 5 below show the how the hype curve trends have been adopted by higher education institutions based on Gartner's Hype Curve for Emerging Technologies for 2016.

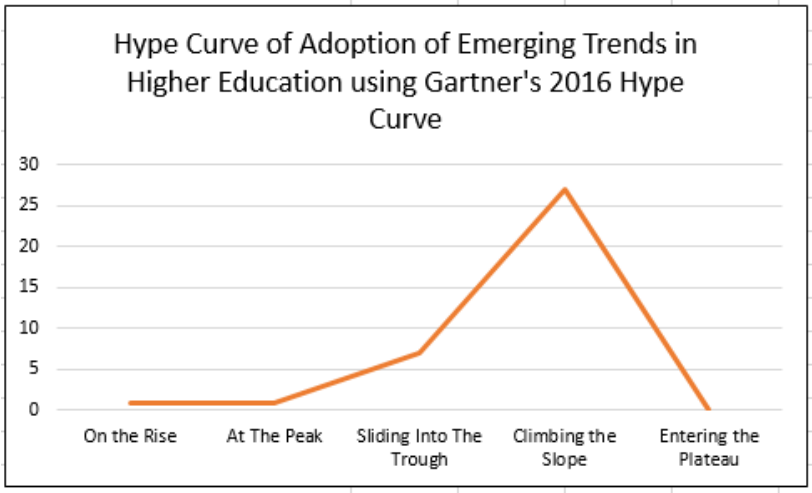

Fig. 5. The Hype Curve of Emerging Trends in Higher Education from 2013 to 2016 based on Gartner's Hype Cycle for Emerging Technologies of 2013

It can be seen from Figure 5 the graph looks almost the opposite of the Gartner Hype Curve, with the scores climbing in the third phase and peaking in the fourth phase. Again, the results were grouped and totaled for the four-year period.

5.2 Discussion

It is evident from Figure 4 and 5 that higher education institutions did not adopt the newest emerging technology trends. The 2013 Hype Curve begins to resemble the Gartner Hype Cycle for Emerging Technologies for 2013, but the peak is only at the third phase and not the second phase. "Virtual Reality" and "Cloud Computing" are most adopted in both the specific Google Scholar search as well as only the keywords themselves. The 2016 Hype Curve scores only on the third and fourth phases of the Gartner Hype Cycle for Emerging Technologies for 2016, with "Machine Learning" popular in the general keyword search, but only mentioned once in the specific keyword search. The results indicate that higher education institutions tend to adopt the technologies only once they reached maturity.

6 Conclusion and Future Research

It is concluded that only a handful of trends from both the 2013 and 2016 Gartner Hype Cycle for Emerging Technologies were adopted by higher education institutions. Possible reasons include budget constraints; taking a more conservative approach to new technologies; and adopting trends after they had proved to have wide acceptance. Bill Gates adapted the quotation of Roy Amara and said "we always overestimate the change that will occur in the next two years and underestimate the

change that will occur in the next ten. Don't let yourself be lulled into inaction" [11]. As higher education institutions, it is our role and responsibility to expose students to new technologies, however, time and resources may be limited. We should not lose sight of the trends, but rather focus on innovative and less expensive ways of incorporating the trends into tertiary institutions. Future research could include to update the findings annually based on the new Hype Cycles published and also to include the context of the keywords, not only the exact keywords to obtain a broader picture.

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References

1. Aldunate R, Nussbaum M (2013) Teacher adoption of technology. Computers in Human Behavior, 29(3), 519-524
2. Altbach PG, Reisberg L, Rumbley LE (2009) Trends in global higher education: Tracking an academic revolution: UNESCO Pub.; Sense
3. Almara R (n.d.) Amara's Law. http://www.pcmag.com/encyclopedia/term/37701/amara-s-law
4. Borokhovski E, Bernard RM, Tamim RM, Schmid RF, Sokolovskaya A (2016) Technology-supported student interaction in post-secondary education: A meta-analysis of designed versus contextual treatments. Computers & Education, 96, 15-28
5. Dahlstrom E, Walker J, Dziuban C (2013) ECAR study of undergraduate students and information technology. Retrieved from https://library.educause.edu/~/media/files/library/2014/10/ers1406.pdf
6. Egger M, Smith GD (1997) Meta-Analysis. Potentials and promise. BMJ: British Medical Journal, 315(7119), 1371
7. Fenn J, Raskino M (2008) Mastering the hype cycle: how to choose the right innovation at the right time: Harvard Business Press
8. Gartner Inc (2013a) Gartner's Hype Cycle Special Report for 2013. Retrieved from https://www.gartner.com/doc/2574916?ref=SiteSearch&sthkw=Gartner%27s%20Hype%20Cycle%20Special%20Report%20for%202013&fnl=search&srcId=1-3478922254
9. Gartner Inc (2013b) Gartner's 2013 Hype Cycle for Emerging Technologies maps out evolving relationship between humans and machines. Retrieved from http://www.gartner.com/newsroom/id/2575515
10. Gartner Inc (2016) Gartner's 2016 Hype Cycle for Emerging Technologies Identifies Three Key Trends That Organizations Must Track to Gain Competitive Advantage. Retrieved from http://www.gartner.com/newsroom/id/3412017
11. Gates, B (n.d.) Bill Gates Quotes BrainyQuote. Retrieved from https://www.brainyquote.com/quotes/quotes/b/billgates404193.html
12. Lajoie, EW, Bridges L (2014) Innovation decisions: Using the Gartner Hype Cycle. Library Leadership & Management, 28(4)
13. Linden A, Fenn J (2003) Understanding Gartner's hype cycles. Strategic Analysis Report Nº R-20-1971. Gartner, Inc