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Does Cognitive Analytics Hold a Key to Solving Mena's Youth Unemployment Problem?

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Suggested shorter title:

Is CA the Key to Unlock Youth Unemployment in MENA?

Abstract. According to test scores, students in Middle East/North Africa (MENA) are at the bottom of nearly all international learning measurement tests. Regardless of test scores, youth in MENA (*i.e.* 15-24 year olds) are facing the highest rates of unemployment of any world region. Coupled with this, the world of work is changing dramatically. Employers' skill demands for 'new hires' are fading away and being replaced by self-employed entrepreneurs who must take responsibility for their own employment. Given the very high rates of youth unemployment, the limited skills of the majority of teachers in public education and that students must unlearn a system that was all they've experienced from childhood onward…is it feasible that cognitive analytics could address these complex requirements?

Extended Abstract. Not so long ago, researchers in educational methods, as well as pedagogy in tertiary education, focused on the linkages between taught skills and employability (Harvey and Askling 2003). But what does it mean today to be employable? Nearly two decades have passed, and employability is, perhaps arguably, less a goal of education than creating self-initiated employment—*i.e.* Entrepreneurship. Even the OECD has recently changed its reporting for the economic rate of small business impact from only those firms with 10-or-more employees, to now include those with just 1-to-9 employees. A major reason for this is that business development in a number of countries has begun to grow fastest in the 3-or fewer-employees category, especially during the first five years of operation. These new businesses will also require a different approach to leadership.

Rather than the long-held view of pyramid management structures where authority is at the top and responsibility flows downward as directives, a firm with just 1-to-9 employees suggests an enterprise where most employees are responsible for a specific aspect of the business (e.g., Marketing, Sales, Manufacturing, *et al*). Most likely they will be both the Manager as well as the primary specialist Worker for some time to come…at least until profits reach a level that hiring more staff isn't considered frivolous by the other Worker-Managers. But moving from educational systems that are only slowly beginning to adjust to what is already happening in existing enterprises will take time to develop the Worker-Managers. In MENA, this will take even longer. Public schools from kindergarten-through-twelfth grade, as well as many universities, are not preparing graduates for such independent working careers. In addition, there is a shortage of accredited universities and programmes in proportion to the possible numbers of students needing to attend.

Keywords: Cognitive Analytics; Education; Middle East/North Africa; MENA; Entrepreneurship; Training; Active Learning; Value Stream Mapping.

1 Introduction

1.1 What youth unemployment tells us in MENA

Presently the 15-24 year-olds in MENA are the highest number of unemployed youths in the world (Fig. 1 Worldwide youth unemployment).

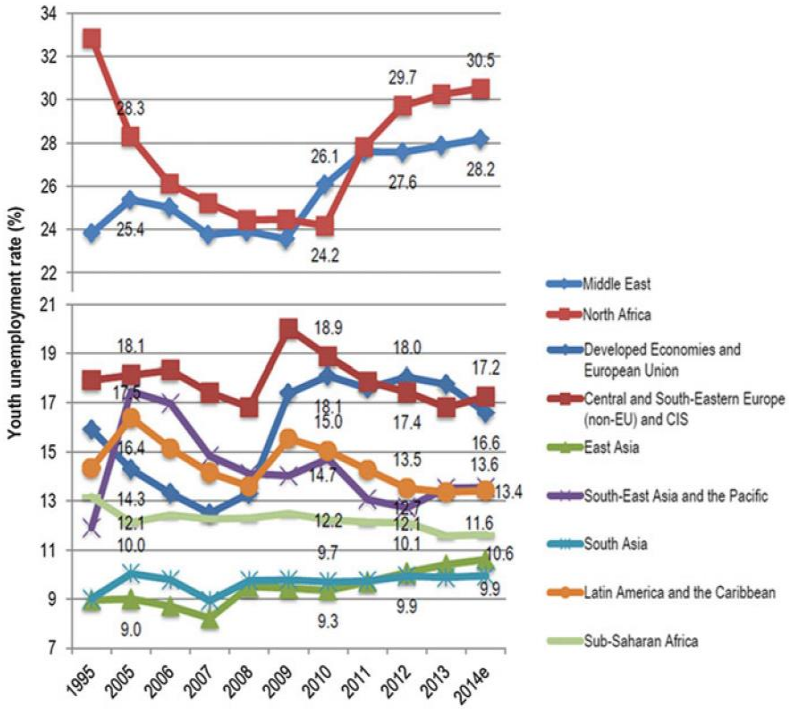


Fig. 1 Worldwide unemployment of youths.
Source: ILO, Trends Econometric Models, April 2015.

Generally speaking, when faced with the nearly 20-year chart (as in Fig. 1), most people's reaction to the upper section (i.e. MENA) that never drops below 24.2 per cent is likely be that governments haven't done their jobs very well. Especially considering that the lower section—non-MENA 'rest of the world'—never rises above 18.9 per cent in the same 20 years. Yet in the upper MENA section, three recent and significant rates are blended with the rest of the countries' rates: Tunisia's rate of youth unemployment in 2011 had reached 42.48 per cent, which was certainly a contributing cause of the Jasmine Revolution; in 2017 rates in Jordan reached 39.76 per cent (and a common concern, at the time, was whether or not it might lead to a revolution); but at the other end of the spectrum, Morocco in 1995 peaked at 38.39 per cent; dropped to 28.52 per cent in 1997, spiked at 33.65 per cent in 1998 but declined steadily each year and then stabilised at 17.96 per cent in 2017 (ILO and World Bank 2018). Yet, these three countries and their rates hold some lessons for the rest of MENA:

- Tunisia, prior to the Ben Ali government, had the best prepared youth in MENA in terms of training and matching their skills to future work requirements. This was an initiative of Drs. Mahmoud Messaadi and Habib Bourguiba, both of whom exhibited exceptional planning and implementation skills;
- Demonstrations in 2017 went on for months across Jordan before they turned violent in 2018. Youth unemployment was a concern but not nearly as significant an issue as the removal of bread price-subsidies and the sales tax/price increases that the Mulki government had instituted in order to fulfil the 2016

agreement with IMF for an Extended Fund Facility. When the Central Government instituted additional taxes on medicines, King Abdullah blocked that and the Mulki government resigned. It could be said that the people's trust in, and loyalty to, the King prevented a much more dangerous outcome. One of the important initiatives of King Hussein was his Seventh Discussion Paper, issued before the 2017 demonstrations began, that described what students should expect from their public education (" modern teaching methods should be adopted to encourage critical and deductive thinking, rather than rote learning. Moreover, these methods should combine theory and practice, field and classroom, as well as analysis and planning"), in addition to society's expectations of their Monarch ("Our people are our most valuable asset. Armed with a modern, quality education, Jordanians will become agents of change. To that end, we must ardently invest in education. It is the most rewarding investment, and I firmly believe that every Jordanian is entitled to an opportunity to pursue a good education, excel and realise his or her highest potential" (Abdullah II ibn Al Hussein 2017). King Abdullah's behaviour, as well as Queen Rania's philanthropic activities to further education in Jordan (e.g. Queen Rania Teacher Academy) have led to the population's high levels of trust and loyalty;

- For a long period of time in many international comparisons, Morocco tended to appear just above the bottom of most lists. But that is rapidly changing, due to two different factors. The first is Morocco is the *only* MENA country where young people will seriously consider a private sector job over a government position. (Although, Lebanon is rapidly approaching similar levels). This comes from the very smooth income tax system where jobs are expected to have a contract registered with the local authorities and the employer is required to deduct proper employee income tax and pay it directly to the Ministry of Finance. The other factor is that Morocco is undergoing a building boom and in some regions can't attract as many workers as needed, Tangier being an example. It's possible that the new high-speed train linking Casablanca to Tangier and its nearby ports may be a major driver. Both of these factors are likely to be characteristics of Innovation.

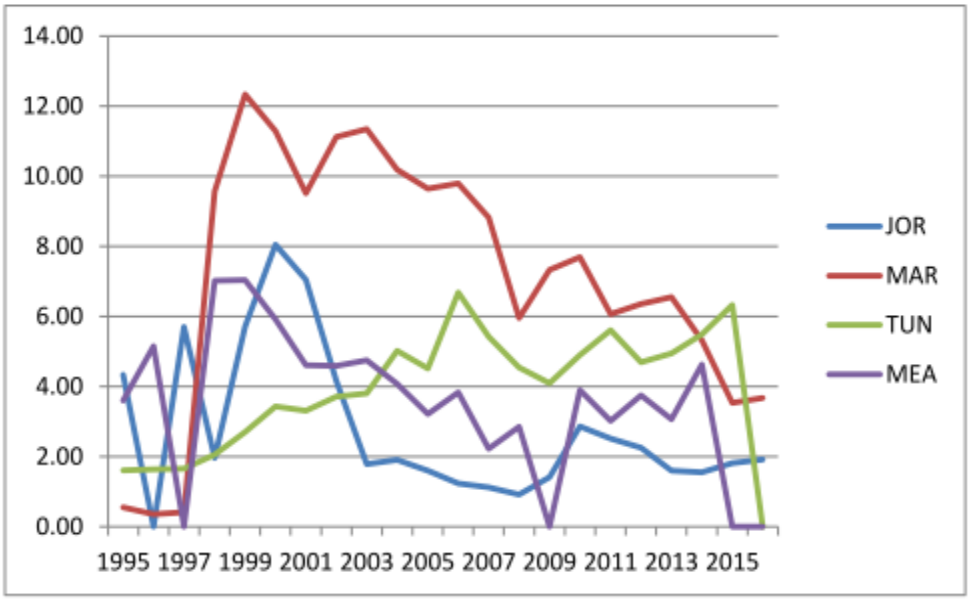


Fig. 2 Innovation-based products shipped. *Source*: United Nations and World Bank, 2018.

As Fig. 2 shows, Morocco in 1995 was off to a late start with design, manufacture and shipping of new innovative products. Tunisia already had a market as did Jordan and MENA overall (albeit Jordan and MENA appear to have had some reporting, or possibly planning, problems). Each of these examples warns us of how fragile the MENA economies are, but especially when high youth unemployment is factored in. The tipping point occurs when it seems to most of the population that there is no future left for youth (*i.e.*, the 15-24 year olds). But there are some

positive factors, too, that affect the youth unemployment rates. Even in the fragile MENA environment, there are lessons to be learned from the three examples: 1) Future success can be achieved through exceptional planning and implementation of matching future job requirements to educational training; 2) Leaders that create the best possible learning environment generate high levels of trust and loyalty through their concern for the youth population; 3) Even in adversity, Innovation can still win.

1.2 Employers' needs

In Western countries, universities, business organizations, various levels of government (from local to national) and even individual (usually large) businesses describe the needs of employers. This helps to inform students, as well as their parents and teachers, about the necessary skills and training that particular industries and occupations require. In addition, internships are undertaken to acquaint students with employer expectations and help the students to hone the most sought after skills for when they actually enter the job market. There is abundant literature to be found throughout Western countries that helps students, parents, educators and other planners to direct students in the most useful, and hopefully interesting, direction(s).

Very little literature exists, though, concerning employers' needs in MENA. What does exist has been written by international organizations (e.g., World Bank, World Economic Forum, as well as some of the multinational accounting firms). These are helpful, but not really a sufficient substitute for the employers' own perspectives. For example, just a quick search through Scholar Google turns up six pertinent entries on the first page (of more than 10); three of which reached 634 citations, 364 citations and 55 citations, respectively. Most likely the dearth of research concerning employer needs in MENA has to do with the traditional pattern of the government providing jobs. As in the former Soviet systems, if a government job required additional skills, training was provided on-the-job by some suitable level of the government.

Regardless, employer needs are very similar the world over. The article with 364 citations (University of Glasgow 2011) provides a good overview of what's expected. Key findings were identified as "Employers expect graduates to have technical and discipline competences from their degrees but require graduates also to demonstrate a range of broader skills and attributes that include team-working, communication, leadership, critical thinking, problem solving and managerial abilities". It's reasonable to expect graduates to have the technical and discipline competences that match the degrees pursued. But the rest of the expected skills may come as a shock to many, especially in MENA to learn that 'team-working, communication, leadership, critical thinking, problem solving and managerial abilities' are equally as important as competence in the graduated discipline. The majority of these skills are taught using Active Learning. Through a combination of: "1) *Collaborative learnin*g that refers to any instructional method where students work together in small groups to reach a common goal; the main emphasis is on student interaction to solve a problem rather individual efforts; 2) *Cooperative learning* can be defined as a structured form of group work where students pursue common goals while being assessed individually; 3) *Problem-based learning (PBL)* is an instructional method where relevant problems are introduced at the beginning of the instruction cycle and used to provide the context and motivation for the learning that follows. It is always active and usually (but not necessarily) collaborative or cooperative using the above definitions. PBL typically involves significant amounts of self-directed learning on the part of the students" (Prince 2004). The education system that King Abdullah described as his goal for Jordan's youth, (in Section 1.1), is most similar to Active Learning.

There is one other significant component of the University of Glasgow study, which the employers described as 'The importance of placements, internships and work-based learning'. "Perhaps above all, the literature and our own findings have overwhelmingly highlighted that employers, students, graduates and HEI [Higher Educational Institutions'] representatives value work-based learning (such as placements and internships) as particularly effective approaches to promote the employability of graduates. ..The importance of placements and internships has also been evidenced by longitudinal studies (e.g. Hall et al 2009)" (University of Glasgow 2011). A widely cited outcome in both the U.K. and U.S. supports the fact that graduates who have done an internship or work-based learning have more success finding suitable jobs after graduation.

1.3 When 'Employees' become the Entrepreneur

There is considerable evidence now in OECD countries that business structures are changing dramatically, and much more rapidly than even the OECD had initially recognized. Even after OECD had acknowledged that most new businesses were entrepreneurial start-ups, the organisation focused on ten employees or more, while countries such as Canada, were developing the largest share of their new businesses in the 1-to-9 employees category (Ministry of Industry Canada 2016; OECD 2018a). The trend now is toward 1-to-3 persons as the most likely number of people working in a new start-up, usually for about five years before other people are employed (OECD (2017). The Canadian statistics also compared new entrepreneurial formations to the educational backgrounds of these entrepreneurs. They found university graduates to be most likely to start small- to medium-size enterprises.

But employment in MENA is changing, too. Employers' skill demands for 'new hires' are fading away and being replaced by self-employed entrepreneurs who must take responsibility for their own employment, from defining their business niche and keeping their skill-sets up-to-date, learning to navigate through accountant's reports and legal contracts, in addition to marketing their product/service to potential new customers. As difficult as this will be for youth in MENA, the very limited number of accredited academic programmes to develop entrepreneurs will be an additional challenge.

In a review of academic backgrounds of successful and well-known entrepreneurs, it was found that nearly all had attended either AACSB-accredited Business schools and/or ABET-accredited Engineering programmes. Table 1 compares the likelihood of a student in Middle East/North Africa (MENA) in 2017 getting access in their home country to AACSB-accredited Business schools and/or ABET-accredited Engineering programmes with a North American student's chances. Lack of access to advanced education leaves young people in MENA even more disadvantaged than they already are today.

Table 1. 2017 Data indicating MENA student's potential access to AACSB/ABET vs. North American students' opportunities

Region	Total youth population (millions)	Youth population as share of national[a]	Total AACSB and ABET Programmes	AACSB	ABET	Student 'Chance' per Local Programme
MENA Total	**61.021**	**–**	**305**	**16**	**289**	**4.998279**
North Africa:	15.033	–	1	0	1	0.066520
Morocco	5.796	17.22%	1	0	1	0.172533
Algeria	6.422	15.95%	0	0	0	0.00
Libya	1.139	17.41%	0	0	0	0.00
Tunisia	1.676	15.05%	0	0	0	0.00
Eastern Mediterranean:	32.510	–	72	3	69	0.090306
Egypt	18.214	19.24%	18	1	17	0.988251
Lebanon	1.044	16.73%	32	2	30	30.651341
Syria	3.377	19.65%	0	0	0	0.00
Palestinian Territories: West Bank Gaza	 0.582 0.372	 21.56% 21.21%	9	0	9	9.433962
Jordan	1.647	20.12%	13	0	13	7.893139
Iraq	7.274	19.07%	0	0	0	0.00
GCC members:	7.682	–	232	13	219	30.200469
Kuwaiti only (immigrants = 69%)	0.429	15.16%	31	2	29	72.261072
Bahraini only (immigrants = 50%)	0.217	15.76%	13	1	12	59.907834
Qatari only (immigrants = 88%)	0.285	12.62%	12	1	11	42.105263
UAE: Emirati only: (immigrants = 85%)	0.802	13.53%	58	5	53	72.319201
Saudi Arabia only (35% immigrants)	5.308	18.85%	110	4	106	20.723436
Omani only (40% immigrants)	0.641	19.11%	8	0	8	12.480499
Yemen:	5.796	21.16%	0	0	0	0.00
North America:	49.440	–	3674[b]	539	3135	74.312298
Canada	4.285	12.12%	22	22	0	5.134189
US	43.613[c]	13.46%[c]	3652	517	3135	83.736501
US indigenous	1.800	21.46%	–	–	–	80.417502

Source: Author's own research.

1.4 Public education in MENA has not kept up with the modern world of work

Despite these changes already occurring in the world of work, public education has not kept up. MENA's public education system has seen little change since the 1950s. It's remained dependent on memorization, no classroom discussion, nor opportunity for self-reflection—and rarely, if ever, a chance to ask a question. While the 'output' from this system may have been suitable for government positions in the past, it is terribly in need of reform. (This is especially true in a region where a number of countries have availed themselves of IMF loans only to find that creating further government positions is forbidden in the IMF loan system). Given the very high rates of youth unemployment, the inadequate skill sets of the majority of teachers in public education to teach and that students must unlearn a system that was all they've experienced from childhood onward…is it feasible that cognitive analytics could address these complex requirements?

E-learning as a method of 'distance education' is known to be sufficient when the student cohort has a fairly good grasp of how to manage their own learning progress and goals. But the majority of young people needing to be retrained in MENA do not have the self-confidence to self-assess and correctly adjust their own trajectory. Very close observation is needed to help university-age students as they attempt to readjust their thinking. There are several specific behaviours displayed: With male students, acting out/being disruptive is one example; more often their behaviour seems unusually shy. This is almost always the initial behaviour of female students but when asked about group work or presentations, the females usually explain that they have an opinion but aren't able to express

it. The "not being able to express themselves" is mostly a euphemism for not feeling worthy of taking classroom time to express their ('lowly') opinion. With careful nurturing, these students begin to get over the experiences of their past education in about six to eight weeks. By the end of one semester they are performing well. But the initial steps have to be managed very carefully and above all to avoid pushing them to do more than they are emotionally ready to try.

Experiments with E-learning/Distance education have not been productive. If anything, the students who need the most attention and most careful help tend to disappear into the background—as though they weren't even involved. In essence, though, this is likely to be their level of non-interaction that represents their past attempts to just get through the system of memorization, not drawing attention to one's self and hoping to just pass the course.

It's not impossible to solve these training issues in classrooms of 25 to 30 students, especially where at least 5 or 6 students can help as mentors. Presently, though, there are more than 61 million young people in MENA who need to be retrained. Their teachers also need retraining to stop perpetuating the problem. With the magnitude of numbers who need retraining, this is an application that needs automation. There are some cues that can be observed in the classroom and appear to be possible to implement via cognitive analytics (CA). In particular, there are eye patterns that initially indicate the student is aware and/or thinking of course material that engages them. Sometimes it relates to a sense of curiosity, other times it has to do with how quickly the students can suggest a possible answer on a pop quiz, etc. Sometimes it relates to exercises handed out based on use of Lean Value Stream Mapping (VSM). The students see VSM as a kind of game, aren't usually familiar with the technique, and each step is unique; *i.e.*, not something to be memorized. Also, sometimes there can be more than one correct answer. There can also be times that a proponent of one approach needs to convince other team members why that particular approach should be adopted. But the sign of recognition is always a momentary flash in either one or both eyes.

Looking through various CA applications available on the Internet, there are a number of advertising applications that might be similar to what's needed to replicate the classroom experience, or might at least be adaptable. From a topical perspective of CA, there are two areas that might be appropriate for this specific application:

1) Change management and leadership in the digital transformation initiatives focusing on continuous improvement and radical change/digital disruption;

2) Organizational change and governance aspects in the digital disruption process.

1.5 Research Questions

In MENA, the problem of youth unemployment remains intractable; *given that the requirements of a job are shifting 'from employee to entrepreneur', how will this impact MENA's youth? Are they prepared? If not, does Cognitive Analytics offer a solution that more rapidly prepares MENA's youth for the coming transition to entrepreneurs?* Discourse analysis, Comparative analysis and Benchmarking are used to address the Research Questions; Kaizen and Lean Value Stream Analysis were used to test Findings in classrooms.

2 Comparison of International Educational Results

2.1 Differences in education begin at an early age

TIMSS and PIRLS testing. *Trends in International Mathematics and Science Study* (TIMSS) and *Progress in International Reading Literacy Study* (PIRLS) are mathematics, science and reading tests administered to 4^{th} and 8^{th} graders every four and five years across the world. The goal of the exams is to provide a comparable set of measurable educational standards that can be accessed by educators across the world.

The International Association for the Evaluation of Educational Achievement (IEA) headquartered in Hamburg, Germany and Amsterdam in the Netherlands, and Lynch School of Education at Boston College. The IEA is responsible for developing the tests. "TIMSS testing began in 1995, is repeated every four years and by 2015 had collected more than 20 years of trends; PIRLS began in 2001 and is administered every five years, making 2016 its fourth assessment. IEA lists the benefits of the testing as:

- Measuring the effectiveness of their educational systems in a global context
- Identifying gaps in learning resources and opportunities
- Pinpointing any areas of weakness and stimulating curriculum reform
- Measuring the impact of new educational initiatives
- Training researchers and teachers in assessment and evaluation."(TIMSS 2015 Assessment Frameworks. 2015).

4th Grade Mathematics Achievement 2015. In total, 41 countries were measured. Of those, nine countries from the Middle East/North Africa (MENA) participated: Bahrain, Iran, Jordan, Kuwait, Morocco, Oman, Qatar, Saudi Arabia and United Arab Emirates. Median: A score of 500 represented the *median* benchmark. Highest scores: The highest category included the criteria of "Can apply understanding and knowledge in a variety of relatively complex situations and explain their reasoning". The five most successful countries, all from Southeast Asia achieved the following *average* scores: Singapore (618), Hong Kong (615), Korea (608), Taipei (597) and Japan (593); which were followed by *average* scores from Northern Ireland (570), Russia (564), Norway (549), Ireland (547) and England (546) to comprise the rest of the 'top 10'. Second highest scores: A larger number of countries (36 per cent) were able to score within a range of 550 to 625, indicating students "Can apply knowledge and understanding to solve problems". What needs to be noted here is that *average* scores per country appear beside the country's name. But the distribution of scores is a much wider range and in terms of student capabilities, the criteria for each category becomes easier to achieve as the range descends. But a particular point of note is the dramatic difference between the Southeast Asia scores and the next highest grouping: there is a difference of 23 points between Japan and Northern Ireland and an even greater 48 points between Singapore and Northern Ireland.

The Below median category: 75 per cent of the students scored above the lowest parameter of 400 but just below the median, at 475. The capability associated with this score range considers that the student "Can apply basic mathematical knowledge in simple situations". This is in contrast to the capability associated with the Lowest scores: Some of the U.A.E. students were able to meet this parameter, but roughly half fell into the lowest category—along with all the other MENA countries who had taken the tests (*i.e*., Qatar, Oman, Bahrain, Iran, Saudi Arabia, Morocco, Jordan, Kuwait; in ranked order from highest listed first to lowest). Just one MENA country, U.A.E., managed to get into the 'Below Median' category; the remaining eight not only fell into the 'Below 400' category, they were mostly clustered at the very lowest scores of all countries that participated (TIMSS 2015 Assessment Frameworks. 2015). The somewhat surprising results are that no MENA country was able to score above the worldwide median. In addition, while the TIMSS experts were surprised by the rather great difference in earned points between South East Asia and Western Countries (a range of 23 to 48 points), the difference between South East Asia and the MENA countries was much greater—a range of 156 points between Singapore and the highest scoring U.A.E., but a range of 268 points between Singapore and MENA's lowest scores in Kuwait.

*8th Grade Mathematics Achievement 2015***.** In total 11 MENA countries participated in the tests. In many cases students who were tested in 4^{th} grade would also have been tested four years later in 8^{th} grade. It's clear from the analyses of the tests each four years that the educators' goal is to determine whether or not the overall student body is performing better each time; and by allusion, to whether or not the teaching methods/actions improved. As Table 2 shows, five MENA scores improved and two additional countries were added. It should be noted that even Singapore, the highest scoring country worldwide, improved in the 8^{th} grade tests, as well.

4th Grade Science Achievement 2015. In Science scores 500 was again the median. The same grouping of 'top ten' countries was repeated for the Science scores, even in the same order: Singapore, Korea, Japan, Russia, Hong Kong, Taipei, Finland, Kazakhstan, Poland and the U.S. But none of the MENA countries had scored as well as they had in the Mathematics scores. All were below the median, but Bahrain (at 459) achieved a higher score than U.A.E. (that tied with Georgia at 451). The rest in descending order were Qatar (436), Oman (431), Iran (421), Saudi Arabia (390), Morocco (352) and Kuwait (337). Except for Indonesia (397), all of the MENA scores were among the very lowest recorded amongst all students tested.

8th Grade Science Achievement 2015. Science scores for 8^{th} grade students was an area where students from MENA did their best. This is especially interesting because it was a more difficult area for other students. In general, this topic was the most difficult for the non-MENA students. In the 8^{th} grade mathematics scores, the non-MENA students were able to increase their scores from 23 to 48 points, compared to their 4^{th} grade scores. This range was considered quite significant in the TIMSS write-up. However, the range of improvement for MENA countries between 4^{th} grade science and 8^{th} grade science was much more significant: It ranged from 21 to 74 points difference between the 4^{th} grade scores and the 8^{th} grade. Only one finding of this type was found in the 4^{th} grade vs. 8^{th} grade math scores. This was a 39 point improvement in Kuwait's 5-year span. Likewise, the biggest improvement in 8^{th} grade vs. 4^{th} grade science scores was a 74-point improvement by Kuwait. But four or five other MENA countries also showed significant improvement when 8^{th} grade scores for science were compared with 4^{th} grade (Table 2, column 5). While there is a risk that tests may have been graded differently than for the tests in the preceding 5 years, it seems possible that teaching style may have changed. This should be investigated further to understand whether or not there might be something significant that was overlooked and could be shared with the other MENA countries.

4th Grade Reading Results 2016. In general, the PIRLS reading scores are higher than the 4th Grade Math or Science. Exceptions are Bahrain, Morocco (but only in comparison to math scores), Oman and U.A.E. (just slightly below math and science); Egypt did not participate in the 4th grade math and science but its score of 330 for reading would certainly be very low. Neither Lebanon nor Jordan participated in the reading tests.

Table 2. TIMSS and PIRLS test results for 2015/2016

Country	Avg. 4th Grade Math	Avg. 8th Grade Math	Avg. 4th Grade Science	Avg. 8th Grade Science	Avg. 4th Grade Reading
Highest >600	*S'pore 618*	*S'pore 621*	*S'pore 590*	*S'pore 597*	*Russia 581*
7					*S'pore 576*
Median	**500**	**500**	**500**	**500**	**500**
Bahrain	451	454+3	459	466	446
Egypt	No score	392	No score	371	330
Iran	431	436+5	421	456(+35)	428
Jordan	388	386	No score	426	No score
Kuwait	353	392(+39)	337	411(+74)	393
Lebanon	No score	442	No score	398	No score
Morocco	377	384+7	352	393(+41)	358
Oman	425	403	431	455(+24)	418
Qatar	439	437	436	457(+21)	442
Saudi Arabia	383	368	390	396	430
U.A.E.	452	465+13	451	477(+26)	450
11 countries	*9 countries*	*11 countries*	*8 countries*	*11 countries*	*9 countries*

Source: TIMSS and PIRLS. 2015 and 2016.

While there are some 'bright spots' among the scores seen in Table 2, it cannot be overlooked that in nearly all cases, MENA countries were at the very bottom of each set of TIMSS and PIRLS tests.

2.2 Differences in educational performance increase with age

PISA Testing of 15-year olds. Programme for International Student Assessment (PISA) testing is an OECD initiative. Fewer countries across MENA participate in PISA tests compared with TIMSS and PIRLS tests. From North Africa, only Algeria and Tunisia are included while in Middle East, Jordan, Lebanon, Qatar and U.A.E. participate. However, 64 countries/economies participate in the PISA testing. OECD describes the programme goals as "PISA assesses the extent to which 15-year-old students, near the end of their compulsory education, have acquired key knowledge and skills that are essential for full participation in modern societies. The triennial assessment focuses on the core school subjects of reading, mathematics and science. Students' proficiency in an innovative domain is also assessed. The assessment does not just ascertain whether students can reproduce knowledge; it also examines how well students can extrapolate from what they have learnt and can apply that knowledge in unfamiliar settings, both in and outside of school. This approach reflects the fact that modern economies reward individuals not for what they know, but for what they can do with what they know" (OECD 2018: 12).

In the 2015 programme, a new topic of Collaborative Problem-Solving results was added. In general, it was found that female students did better at this (*i.e.*, student groups of three or more students working together to solve a problem). It should be remembered though, that within a similar age group, male students usually perform better in

STEM subjects. By their early twenties, there is less difference between female and male students' STEM performance. It might be that similar age-based changes in brain development could impact male students' scores in Collaborative Problem-Solving in a similar manner. With the exception of the Collaborative Problem-Solving, the three main test domains are very similar to TIMSS and PIRLS testing (Table 3: Definitions of the three main PISA test domains).

Table 3. Definitions of the three main PISA test domains

Reading literacy: The capacity to understand, use, reflect-upon and engage with written texts in order to achieve one's goals and to develop one's knowledge and potential, and to participate in society.
Mathematical literacy: An individual's capacity to formulate, employ, and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena. It assists individuals to recognise the role that mathematics plays in the world and to make the well-founded judgments and decisions needed by constructive, engaged and reflective citizens.
Scientific literacy: The ability to engage with science-related issues, and with the ideas of science, as a reflective citizen. A scientifically literate person is willing to engage in reasoned discourse about science and technology which requires the competencies to explain phenomena scientifically, evaluate and design scientific enquiry, and interpret data and evidence scientifically.

Source: OECD 2018: 17.

Reading test results 2015. As with PIRLS, Singapore emerged as the highest scoring country (535) in terms of reading results. It was followed closely by Canada and Hong Kong, tied at 527 points. These scores, along with some 22 others that scored 498 as the lowest level, were rated "*significantly higher* than the OECD average." Russia, which had scored so highly in PIRLS, received a score of 495 but with the notation that it (along with the U.S., Spain, Switzerland, China, Taipei) "was *not statistically significantly* lower than the OECD average". All of the MENA countries were considered "statistically *significantly* below the OECD average". U.A.E., Jordan and Qatar had the best reading scores in MENA. Although, Dubai independently of the other parts of U.A.E. achieved a score of 475, while Abu Dhabi only achieved 419. Cumulatively, U.A.E. achieved a national score of 434. As with the PIRLS scores, though, the rest of the MENA countries were at the very bottom of OECD reading scores, along with Dominican Republic, Former Yugoslav Republic of Macedonia (FYROM) and Kosovo.

Mathematics test results 2015. Once again, Singapore achieved the highest score (564). Again, the next nearest scores were very similar to TIMSS: Hong Kong earned a score of 548; Macao earned 544, Taipei achieved 542 and Japan—the first OECD country appearing in the rankings, achieved 532, with China close behind at 531 points. U.A.E. achieved MENA's highest score (427), yet this was still designated as 'statistically *significantly* below the OECD average". Qatar was 14th from the bottom at 402; Lebanon finished at eleventh from the bottom; followed by Jordan at seventh from last place; and finally Tunisia at fourth from last and Algeria at next to last place.

Science test results 2015. Once again, Singapore outscores all other countries. But in science, Japan (the highest ranked OECD country) receives the second highest score, at 538. Despite the very good score for Japan, it is 18 points lower than Singapore. This begins to show how really hard Singapore worked to achieve such consistently high scores—in both PISA and TIMSS/PIRLS. Also once again, all of the MENA countries are within the range of

'statistically *significantly* below the OECD average'—although Russia is included, as well.

What is especially interesting is that all of the MENA countries, except Lebanon, scored higher in Science than in other subjects. This was the same result on Table 4. It raises a question as to whether or not Science might be taught differently than Reading and Math in MENA; and whether there might be something different in the way Math or Science is taught in Lebanon

Table 4. PISA test results 2015 with highest scores noted

Country	Avg. 15 yr-old Reading	Avg. 15 yr-old Math	Avg. 15 yr-old Science
Highest score:	*S'pore 535*	*S'pore 564*	*S'pore 556*
6 countries			
MENA:			
Algeria	350	360	376
Jordan	408	380	409
Lebanon	347	396	386
Qatar	402	402	418
Tunisia	361	367	386
U.A.E.	434	427	437

Source: OECD 2016: 67, 149, 177.

Collaborative Problem-Solving results 2015. The 2015 assessment was the first time that Collaborative Problem-Solving (CPS) had been attempted in OECD's PISA testing. The general parameters based on four levels of proficiency were described in the following excerpt:

Proficiency at Level 4. "Students … can successfully carry out complicated problem-solving tasks with high collaboration complexity. They maintain an awareness of group dynamics and ensure that team members act in accordance with their agreed-upon roles, while simultaneously monitoring progress towards a solution of the given problem. They take initiative and perform actions or make requests to overcome obstacles and to resolve disagreements and conflicts. Students ... at Level 4 are … 'top performers'." The only MENA countries that participated in the Collaborative Problem-solving testing were Tunisia and the U.A.E. Tunisia was the lowest performer of all participating countries. As a result it was possible for the OECD to adopt Tunisia as an indicator of how significant it was to have Level 4 participants in any of the Collaborative teams. E.g., "in two OECD countries and in seven partner countries, fewer than 1 in 100 students perform at Level 4; and in Tunisia, fewer than 1 in 1 000 students performs at this level". (640 score points or more).

Proficiency at Level 3. "Students ... can complete tasks with either complex problem-solving requirements or complex collaboration demands. They can recognise information needed to solve a problem, request it from the appropriate team member, and identify when the provided information is incorrect. These students can perform multi-step tasks that require integrating multiple pieces of information. Level 3 was the most common proficiency level in 10 of the 51 countries/economies with adjudicated data from the collaborative problem-solving assessment. By contrast, in two OECD countries and five partner countries, fewer than one in ten students performs at Level 3 or higher. In Tunisia, fewer than one in 100 students can successfully complete a Level 3 item". (540 to less than 640 score points).

Proficiency at Level 2. "Students proficient at Level 2 … can contribute to a collaborative effort to solve a problem

of medium difficulty. They can communicate with team members about the actions to be performed and they can volunteer information not specifically requested by another team member. … over 85% of 15-year-olds are proficient at Level 2 or higher; in a further seven countries/economies–Australia, Canada, Denmark, Estonia, Finland, New Zealand and Chinese Taipei–over 80% of 15-year-olds achieve this level of competence. … However, in two OECD countries and eight partner countries, a majority of students cannot complete Level 2 items successfully". (440 to less than 540 score points).

Proficiency at Level 1. "Students proficient at Level 1 can complete tasks with low problem difficulty and limited collaboration complexity. They tend to focus on their individual role within the group, but with support from team members. When working on a simple problem, these students can help find a solution to the problem. … Across OECD countries, 94% of students reach this level of collaborative problem-solving proficiency. However, in Tunisia, almost one in four students (25%) fails to reach this level of proficiency". (340 to less than 440 score points). Although not part of tests, there is also a level below Level 1.

Proficiency below Level 1. "The PISA 2015 collaborative problem-solving assessment was not designed to assess either elementary collaboration skills or elementary problem-solving skills. Hence, there were insufficient items to fully describe performance that fell below Level 1 on the collaborative problem-solving scale. Across OECD countries, 6% of students score below Level 1 on the proficiency scale. Between one in 50 students and one in 100 students in Estonia, Hong Kong (China), Japan, Korea and Singapore score below Level 1" (OECD. 2017: p. 73-76).

3 Findings

***Collaborative Problem-solving scores for MENA countries*:**

1) Tunisia was 382; within the band of Level 1;
2) U.A.E. was 435; also within the band of Level 1 but near to the top.

Beginnings of Field Research:
Comments regarding the MENA scores on TIMSS.PIRLS, PISA Reading, Mathematics, Science and Collaborative Problem-solving scores:

1) As previously mentioned, there may be a difference in teaching methods in place for Science as the MENA scores are considerably higher than other scores. Associated with this is whether or not Mathematics and/or Science is being taught differently in Lebanon. Both of these issues should be investigated more carefully.

2) While teaching MBA students at (a school), nearly all students were from either: the former USSR, its bloc countries, former Yugoslavia or other Balkan countries. In all there were around 90 Eastern European students. There were also a very much smaller number of students from Western Europe or North America. I was teaching all classes as teams with discussions. While some pop-quizzes were handed out (to check that reading assignments were being read), there was no memorization and focus was on case studies. Yet the Eastern students were constantly asking about the texts to be memorized. Then one of the Western European students told me that the Eastern students were worried they were going to be asked for bribes in order to pass the memorization exams they were expecting!

3) Classes with a total cohort of 75 to 80 students (at a university in Middle East) were puzzled about why we were forming teams. When I first started to push students to attempt to answer questions in classroom discussions, other students became worried and said that we shouldn't do that and could get in trouble! (I checked further within

the administration and learned there wasn't such a rule). But a number of teachers were only lecturing, handing out copies and telling the students to memorize them and not to disturb class with any questions. When I first raised the issue with the Dean, he recounted his own experience of five years in Engineering School in one of the Gulf States. He was very proud to have got the degree and been hired by an international automotive company. But on his first day at work, he couldn't perform any useful task and felt embarrassed. From then on, he removed the degree from his CV. (Things did improve for him; he stayed with the company and even obtained his PhD through them).

4) Then I didn't think about memorization again until I began teaching in (a university in North Africa). By then I was very used to hearing stories from students, and also their parents, about how badly the students (more than 200 in my courses) had been taught and how unrealistic some of the memorization assignments were. One example was a teacher that handed out more than 300 slides and told the students they would be responsible for memorizing all slides for their Final Exam. No questions were allowed in the classes, and certainly no discussion. This was a leading (school) and families were being asked for large tuition fees so that their students would benefit from the school, graduate and go on to successful and solid careers. As I was teaching Operations Management, Supply Chain Management and Quality Management, each of which included Value Stream Mapping (VSM), it occurred to me to try it in the Entrepreneurship classes, too. Entrepreneurship and Operations Management were both required courses for all students so it was a good mixture of students to see what would happen if we focused more on using pictorial symbols to express ideas or possibilities—or even strategies. VSM has its roots in Kaizen and was initially adopted so that factory workers with a wide variety of skills, education and sometimes dissimilar languages would all be able to pick up the same document and understand the issues diagrammed on it.

4 Field research

4.1 "*Learning to See*" (Rother and Shook 1998) was selected as a text book (and was the same one used in the other courses that required VSM). Courses were divided into teams of five or six students; to the extent possible, at least one student experienced in VSM was assigned to each team. During each class session more steps were shown in how to document/draw aspects of existing business cases under study in the semester(s). The students seemed to enjoy extra time spent on VSM. In one of the Supply Chain courses, the teams began creating (in the evening or on weekends) their own mock questions of what they thought I might choose to use on exams and post them to Face Book and seeing which of their colleague teams could get the right answer. I was very surprised to see they had turned the tools into a game and were spending their spare time on it! Another positive aspect I observed was a young student in one of the Entrepreneurship courses seemed to become more confident about speaking out in front of the older students in the course. It's likely that (at least) an unintended, but positive outcome, could be that VSM takes the pressure off students worrying about all the memorization. In Operations Management I require the teams to find a company that they want to assist during the semester. It's much easier for the teams to remember where they leave off studying the business while they spend a week or more away from the business. Documenting what they've seen makes it easier for the students, as well as the business owner/managers, to discuss the pertinent topics at the next scheduled meeting.

Another potential advantage could be that VSM could be used as a form of communication with students who might not be able to express themselves otherwise. This could also be done after transmitting answers/documents back to the teacher or school or team. The one aspect that isn't addressed—but is extremely important in classroom settings is for the teacher to notice when students' eyes begin to "light up"—this could be an aspect that CA brings into the setting that has not been included in other distance learning systems. On the other side of the argument, it's extremely important that this isn't overlooked, which is an advantage of working with the class in person. Sometimes, the student recognizes that something 'new' entered their thinking and they want to talk about it after class; another positive aspect about meeting in person.

5 Conclusion

This paper explores whether or not a particular aspect of Cognitive Analytics (which is currently more frequently seen in marketing/advertising applications) could be applied to the very enormous problem of educating both unemployed youth across MENA as well as providing more useful training for other young people—and their teachers—to adopt an education system that is directed more at entrepreneurial work skills. Without using tools that enhance their ability to create businesses and earn a living, it's not reasonable to think that MENA's 60+ million young people (plus the very high numbers of already unemployed) are somehow going to achieve their expectations of future success. It should be clear that a future based on the educational approaches that were put in place across MENA some 50 to 70 years ago aren't suited to the teaching tasks required now. Modernization is urgently needed.

Even the current approach of most governments in MENA of teaching small cohorts of the best and most promising students entrepreneurial skills in hope of them becoming the next Sergey Brin (Google/Alphabet), Mark Zuckerberg (Face Book) or Steve Jobs (Apple) is likely to already be too late. Creating a huge employer that generates work for many others isn't likely when we look at the OECD data that shows that one-to-three persons is the most likely entrepreneurial configuration. The possibility that one of these huge companies might be created exists, but it shouldn't be considered the goal. At the same time, focus must also be on teachers needing to be retrained to teach using Active Learning rather than relying on ineffective methods (e.g., rote memorization) for a modern world of work.

Section 5.1 gives a very brief introduction to VSM. As can be seen, though, there is nothing about VSM that relates to memorization. It's more like a game that encourages users at more advanced levels to play and compete to produce the best, or most elegant suggestions for improvement. Production as well as Process improvement (such as restaurant staff management, online service offerings, etc.). VSM's roots go back to the work of Bell Labs statisticians and adaptation of their work (from the 1930s onward) by significant academics, such as Dr. Walter Shewhart and his student, Dr. W. Edwards Deming. It was Deming that brought the statistics-based systems to 1950s Japan where these systems were merged with the work of the Japanese Union of Scientists and Engineers (JUSE) to re-orient accuracy (based on Kaizen) as a critical requirement for industrial quality control and workplace worker performance. The end result was to rebuild Japan's manufacturing industry and to get the country back to export capability, which was achieved in roughly 10 years, but continued to improve to rates that hadn't been experienced before by Japan.

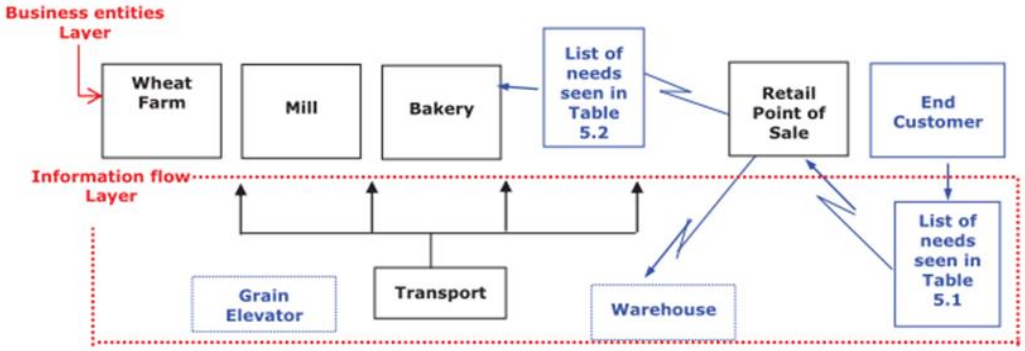
Whether teaching in the classroom or via distance-learning systems, class numbers still need to remain in the '25-30 students' category. For the most part, public schools across MENA do not have the number of classrooms required to meet the need. In addition, there are many communities across MENA that do not have adequate roads/transportation to get all the children to a school every day. Therefore, it will become a necessity for distance learning to be incorporated rather than waiting to develop more school classrooms. Incorporating Cognitive Analytics tools/applications will be a necessity, as well.

5.1 Some examples of VSM for those not acquainted with it

5.1.1 First example (Figure 5.8)

In VSM and Kaizen, the starting point is *always* the End Customer. All the drawings start from the end and carefully work back to the beginning. In Figure 5.8, the red designation on the upper left indicates the Business Entities Layer. It's useful as a starting point because nearly all business (and economics) students recognize the value stream (or Porter's Value Chain). The jagged blue arrows entering/leaving the box titled Retail Point of Sale are indications of electronic communications going toward the Retail Point of Sale (POS) or outbound from it. The Bakery is the last point of product preparation before it goes into storage or out to a shop. Likewise, a Mill needs to supply a Bakery, and a Wheat Farm needs to supply the Mill.

Figure 5.8
Layered view of VS: Business entities with start of information flow



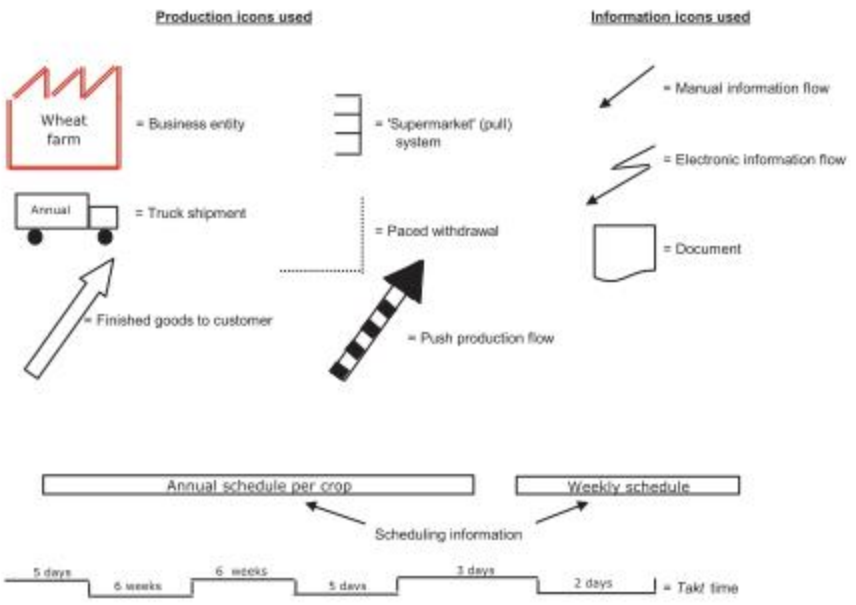
Source: Compiled from author's own research.

As Figure 5.8 shows, the End customer's needs are initially collected by the Retailer who in turn transmits that information – along with the Retailer's own set of needs (Table 5.2) – to the Baker and the Warehouse.

5.1.2 Second example (Figure 5.9)

Figure. 5.9 shows examples of some of the most used icons in VSM. Whether or not a process flow is pulled toward the customer or pushed is a key issue in VSM and Kaizen. The icon with three jagged teeth is frequently used to represent the most significant business entities in the diagrams.

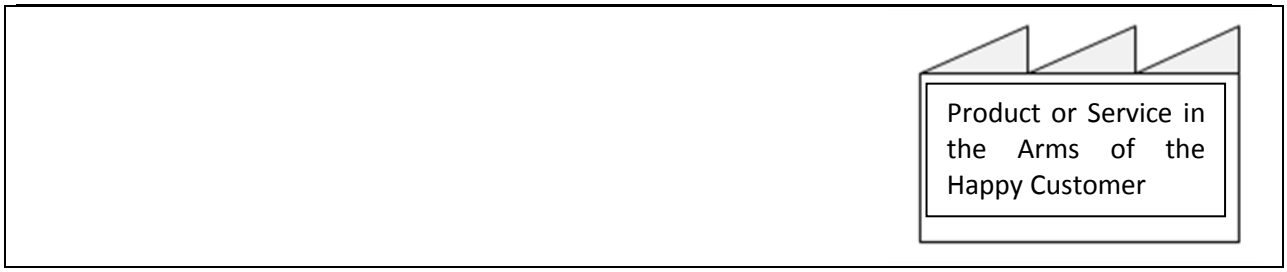
Figure 5.9
VSM icons



Source: Compiled from author's own research.

5.1.3 Third example (Customer Diagram 5.10)

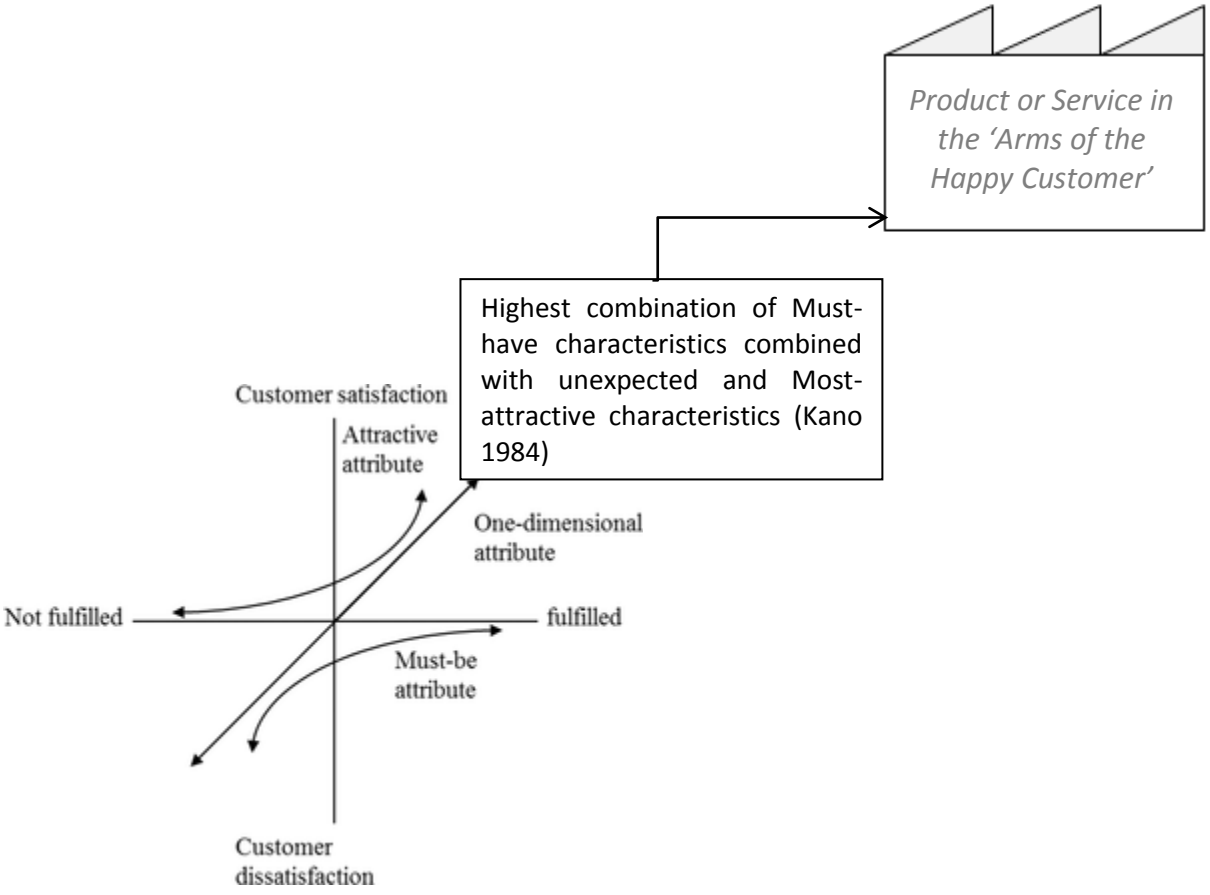
The Customer Diagram is also referred to as 'In the Arms of the Happy Customer' and it is a key element in Kaizen. To provide this product or service is the raison d'être that the entire business exists. It always appears in the upper right side of Kaizen diagrams. In Kaizen product/service planning, work begins at the Customer Diagram, and works toward the left up the value stream chain. (**Customer Diagram 5.10**)



5.1.4 Fourth example (Fig. 5.11 Kano model of Customer 'pulling' the product/service)

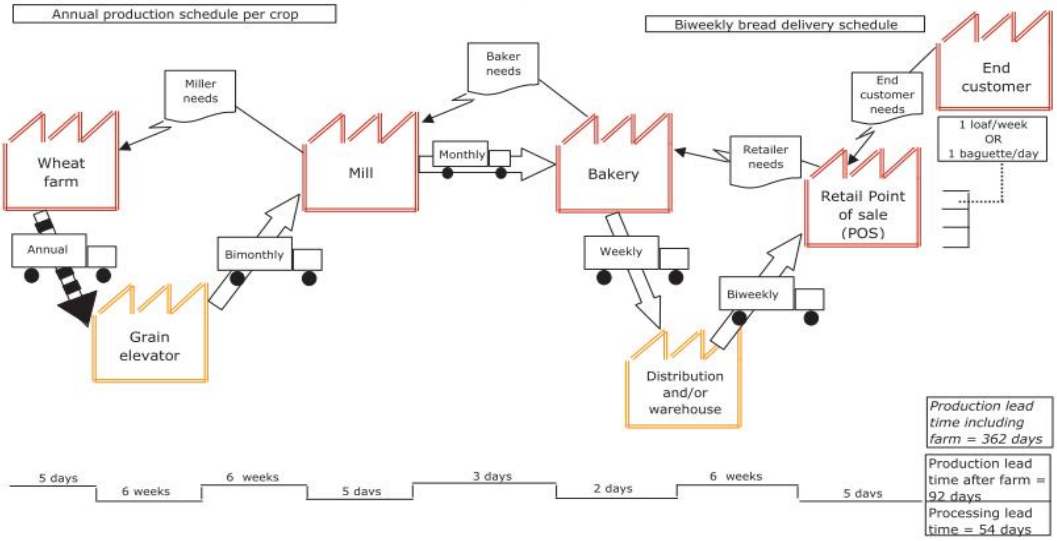
The Kano model of Customer's 'Must Have's' vs. 'Most Attractive' characteristics joined in the same diagram. An informed customer's perspective that is determined by "Who produces a good or service that *at least* meets my expectations? Or, preferably, who can surprise me and perform *even better* than I expected?"

Kaizen model of Customer 'pulling' product/service



Source: Authors' own work based on combination of Kaizen and Kano models.

Figure 5.10
VSM overview diagram for bread VC



Source: Compiled from author's own research.

5.1.5 Fifth example (An upper-layer VSM diagram of the product value chain in bread production).

The VSM diagram shows a more detailed view of the business first seen in Section 5.1.1. This depiction is the upper-most layer of the value stream for bread production. As the diagram shows, all the entities with jagged-teeth and red outline are critical to the business, especially the End customer (shown on the right-hand side). The two entities with jagged-teeth and orange outline are also critical to the business but in this case are owned by other companies, as indicated by the change in colour. Starting with the End customer we see that the typical customer pulls either one loaf of (sandwich) bread per week OR one baguette per day from the shelf of retail stores. By doing this, the customers have advised the Retailer (POS) what their needs are. The Retailer, in turn, orders inventory from the Bakery. The Bakery delivers the Distributor/Warehouse stock once each week; the Distributor delivers two deliveries per week to the Retailer. The Bakery also informs the Miller of monthly flour delivery requirements. This activates deliveries from the Grain elevator(s) twice each month to the Mill. At the same time, the Miller and the Grain elevator alert the Grower of their rate of wheat consumption for the coming season or year. At the top left-side of the diagram, the Annual Production schedule is labelled; on the top right-side the Bi-weekly delivery schedule is labelled. Both of these schedules must fit together to keep production running at optimal rates so that Quality is best possible optimization although Profitability is also considered. (In Kaizen, Quality always trumps Profitability). The line at the bottom of the diagram (with numbers of days and weeks and referred to as 'takt time') relates to the scheduled time required for each production element from the Wheat farm to the Arms of the customer. As the sums in the lower right-hand side of the diagram show, it takes 362 days per annum to provide bread to the customer (based on the configuration seen in the model, which includes growing and harvesting wheat). The Production lead time required (post-farm) is 92 days and the Processing time for the various process elements is 54 days. A likely first attempt at improvement would be for the 'consultant' (or student) to consider alternative approaches to improve upon the 92 and 54 days. Generally speaking, the easiest elements to improve are the ones closest to the End Customer. These often carry the highest potential for increased sales impact, so this is a good first project for the student.

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