Strategy Mining on University Students' Feedback

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ABSTRACT

Strategies can be mined by analyzing advices and recommendations from university students. Useful knowledge from text analysis surface potential new strategy, which can be used by university operators. Strategy in this context is defined as a plan of action or policy that gives direction. In the contact of students' feedback, outcomes of text mining can be presented as concept map where key concepts and sub concepts are linked and hence provide directions. However, these linked concepts are not final strategy but rather preliminary draft 'strategy' or 'direction' where fine-tuning is required. The analysis also presents clusters of concepts where themes that are closely interrelated are put into the same cluster so that different strategy can be formed on different issues. The feedback in this research consists of advice and recommendations of the university students in a yearly university survey. The text mining methodology used in this research entails text parsing, filtering, and topics and clustering of themes once these unstructured texts are pre-processed. This paper concludes by drawing several issues to the attention of the institute.

Keywords: Strategy, text mining, feedback, concept map.

I INTRODUCTION

Strategy is a set of actionable items that consist of policy and rules that provide direction for an organization. Strategy can be mined from advices and recommendations from students in a university. University students express themselves in many forms. Some pour out their unhappiness and dissatisfaction on social media platforms such as Facebook and Twitter. Some choose to file their complaints to the administrators ofthe universities. In order to obtain voices from these students, universities in Malaysia carry out survey periodically to collect their feedback and analyze them in order to listen to students' voices. Their voices in the form of unstructured text are analyzed and used so that draft strategies in the form of rules can be obtained. Analyzing unstructured text can be carried out using text analytics. In the text analysis, concepts and sub concepts, discussion topics and cluster of themes are highlighted by the process of text analysis. Some past research has provided evidence with respect to the research topic in this paper (Leeman-Munk, Wiebe & Lester 2014;Blikstein ,2011; Grant, 1991; Weber and Mateas, 2009). RELATED WORKS

Weber & Mateas (2009) presented a data mining approach to opponent modeling in strategy games. Expert gameplay is learned by applying machine learning techniques to large collections of game logs. This approach enables domain independent algorithms to acquire domain knowledge and perform opponent modeling. Machine learning algorithms are applied to the task of detecting an opponent's strategy before it is executed and predicting when an opponent will perform strategic actions. Their approach involves encoding game logs as a feature vector representation, where each feature describes a unit or building type is first produced. In their research, also compare representation to a state representation in perfect and imperfect information environments and the results show that representation has higher predictive capabilities and is more tolerant of noise. They also discuss how to incorporate data mining approach into a full game playing agent.

In Grant (1991) paper, he stated that strategy is defined as "the match an organization makes between its internal resources and skills and the opportunities and risks created by its external environment". In Leeman-Munk, Wiebe & Lester (2014) work, they pointed out that real-time formative assessment of student learning has become the subject of increasing attention. Students' textual responses to short answer questions offer a rich source of data for formative assessment. However, automatically analyzing textual constructed responses poses significant computational challenges, and the difficulty of generating accurate assessments is exacerbated by the disfluencies that occur prominently in elementary students' writing. With robust text analytics, there is the potential to accurately analyze students' text responses and predict students' future success. They presented WRITEEVAL, a hybrid text analytics method for analyzing student-composed text written in response to constructed response questions. Based on a model integrating a text similarity technique with a semantic analysis technique, WRITEEVAL performs well on responses written by fourth graders in response to short-text science questions. Further, it was found that WRITEEVAL's assessments correlate with summative analyses of student performance.

Ferguson & Shum (2011) pointed out that generic web analytics tend to focus on easily harvested quantitative data, Learning Analytics will often seek qualitative understanding of the context and meaning of this information. This is critical in the case of dialogue, which may be employed to share knowledge and jointly construct understandings, but which also involves many superficial exchanges. Previous studies have validated a particular pattern of "exploratory dialogue" in learning environments to signify sharing, challenge, evaluation and careful consideration by participants. This study investigates the use of sociocultural discourse analysis to analyze synchronous text chat during an online conference. Key words and phrases indicative of exploratory dialogue were identified in these exchanges, and peaks of exploratory dialogue were associated with periods set aside for discussion and keynote speakers. Fewer individuals posted at these times, but meaningful discussion outweighed trivial exchanges. If further analysis confirms the validity of these markers as learning analytics, they could be used by recommendation engines to support learners and teachers in locating dialogue exchanges where deeper learning appears to be taking place.

II   PROBLEM STATEMENT AND OBJECTIVE

Formulating strategy for any organization has never been an easy thing to do. The Malaysia Ministry of Education has conducted a yearly university experience survey to both Malaysian and international students in order to understand their needs and areas of improvement. These surveys have generated a lot of data such as advices and recommendations in the form of unstructured text. However, due to skill, expertise and resources constraints by these universities and the ministry, these comments and feedback were not analyzed and looked at seriously using text analysis. More than often, the analysis is only carried out manually. Considering the amount of unstructured text that one needs to read and analyze, it is not efficient and productive. This research focuses on advice and recommendations provided by the students. The objective of this research is to analyze the feedback from all the students in the university to highlight key concerns and sub concepts. From the analysis of these key terms, important issues can be examined and strategies can be formed to resolve and improve the issues concerned. Text cluster and topics are used to exhibit themes from these unstructured texts. The advice and recommendations from students that are grouped can be used to form draft university strategy. This paper attempts to answer "Can advise

and recommendations from students are good to be used as draft strategy mined from their unstructured text?".

III   RESEARCH METHODOLOGY

An annual survey was carried out by a private university to obtain feedback on students' university lifestyle. Data collected was secondary and the feedbacks are in unstructured text format. The main participants for this research was students and all are asked to enter their feedback on a voluntarily basis. The total population of the university is the total population size for this research. Students name and private details are not expose in this research due to data privacy and confidentiality. Analysis of this research was carried out using SAS Eminer. Text mining node was used to analyze any corpus of documents or texts.Text parser breaks sentence into tokens or terms. The reasons of doing so are to eliminate unwanted noises from these sentences in order not to be processed further. Parsing activity output will be inputs into text filter. The text filter node were chosen to process keyterms based on dictionary used, multi-terms, stem words, stop-list and start-list definitions. In SAS EMiner, Text Cluster node will discover themes for each terms.Meanwhile the Text Topic node will discover themes but assign each document to zero or more of those themes. Text Cluster node is suited for documents that generally focus on a particular topic because when multiple concepts are present in a document, the chosen theme could be 'biased' (for lack of a better word). This allows analysis in the paper to examine key issues in the form of key terms from the students' feedback. Visual concept maps are used to link key concept (from the key term) to related sub concepts. Lastly, topics and clusters are highlighted by the text miner software.

IV   ANALYSIS AND DISCUSSION

In this section, key terms that are concept mined from the unstructured text are ranked using weight (or level of importance). All the concepts (or terms) will be grouped as topics and clusters of themes to be highlighted to the university operators for the formulation of strategy and hence improve quality of university students' experience. In this analysis, topics or themes and cluster of themes surfaced by the software will be discussed. In addition, each topic is examined closely in this section. Multiple themes surface from corpus of feedback (because each feedback is stored in an individual database cell) are grouped in each cluster. The outcomes of the text analysis are analyzed and explained in the following sections.

a. Advice Given to Junior Students

The feedback captured on advice given to junior students provide information on study, cost of living, attitude, living environment, saving tips and so on. From the feedback obtained, several issues arise. The following are several key terms that are important: "environment", "procrastinate", "journey", "institution", "program" and "result" (Figure. 1). Figure 2 illustrates key concepts and their relevant sub concepts visually. The thickness of the line that link between two terms (or concepts) indicate they are closely related. Once notices that "student" and "friendly" are linked by a bold and thick line. This allow one to drill down the actual feedback provided by the students to examine the actual issue on these two concepts. Other link that has thick bold line includes "student" – "different" – "country".

TERM	FREQ	# DOCS	KEEP	WEIGHT ▼
environment	6	4	☑	0.76
procrastinate	5	4	☑	0.76
journey	5	4	☑	0.76
institution	5	4	☑	0.76
program	5	4	☑	0.76
result	5	4	☑	0.76

Figure. 1. Key terms based on Advice Feedback
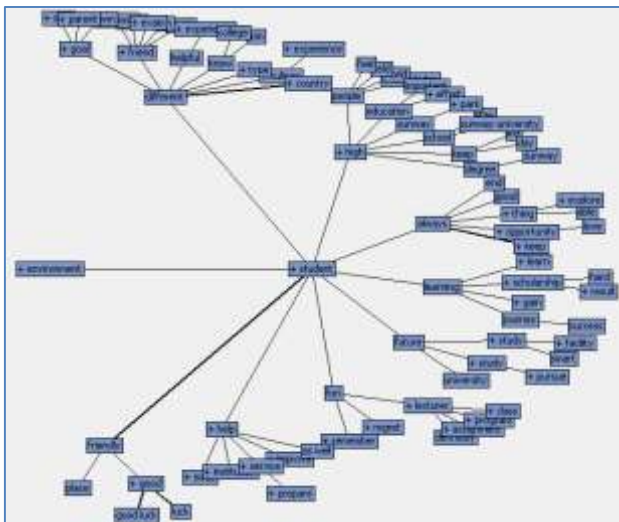
Figure. 2. Concept map for "Environment"

In Figure. 3, samples feedback on "Environment" are listed. This allows detail examination on the advice provided by the students hence formulating strategy becomes more accurate. The "journey" concept map is illustrated in Figure. 4.

> The overall experience in Sunway has been great as most of the lecturers are helpful and easy to approach. However, there should be more improvement on the environment of the entire campus
>
> In order to succeed, your desire for success should be greater than your fear of failure, you must refuse to be a captive of the environment in which you find yourself.
>
> Prepared your own packed food because the food is quite expensive due to the living cost. If he or she can afford it, then is fine. Computer service is first come first serve so be quick otherwise it will be taken by other students. Hope you can tolerant hot condition because the environment is pretty packed and crowded resulting a stuffy and uncomfortable environment.
>
> If you want to aces in your studies, go home and study as the school environments is not catering for student to do revision but more to socialize like a food court environment, that if you are going to study in Sunway University. Be involve in Student community :)

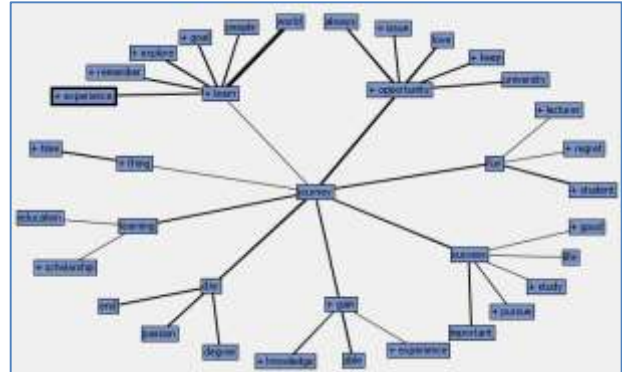Figure. 3. Samples feedback for "Environment" key term

Figure. 4. Concept map for "journey"

In Figure. 5, a sample of feedback were extracted. Based on the links that are highlighted in thick bold lines, a close examination can be carried out based on the concept links. For example, concept links for "journey" - "opportunity" - "university", "learn" - "world" and "learn" - "experience" can be further zoomed into the actual advice provided by their senior.

> Knowledge is one of the best gift anyone can give to themselves because with knowledge one is empowered to go out in the world and make something out of themselves and to give back to society. If you have the opportunity to study at a University and take up a course make good use of everything that is offered, that is your right, don't take things for granted (ie. always be humble, respect others point of view, show gratitude),persevere and keep going even when it gets tough because the fruits that you will yield at the end of the day will be worth every last sweat you poured into becoming the person you are. Work hard but remember to have fun. Apply the things you have learnt, don't just learn something because it is in the course syllabus or because you have to do it in order to finish the semester do it with a passion, gain something from what you are doing and use the knowledge you have gained in your everyday life because that is when you learn best. You learn best when you are able to apply what you have learnt to the world we live in. Don't ever stop learning, there is so much to explore, so much to gain, so much to do; always have a thirst for knowledge and you will never go hungry another day in your life. Make something your trade and give back to the world to the best of your ability, leave an everlasting mark on the world and a strong imprint in the people you come in contact with because that is what will be remembered by people you live behind when you time is up. Be the best you can ever be and share your ability and talents with the people around you as that is what will make you a rich person spiritually and you will always feel whole. Knowledge is power, now and forever. All the very best to all you students out there who will be embarking on this fulfilling journey, trust you will never regret
>
> Education should be a journey of fun learning! Everyone is capable of gaining a scholarship, as long as effort is put into what you do.
>
> Do your best and strive for success due to the hardship faced. Hopefully you manage to secure a good career prospects and it will brighten up your journey in future!

Figure. 5. Samples feedback for "Journey" key term.

"Institution" is another key term that was highlighted by students. The concept map in Figure. 6 shows a snapshot of the linked concepts.
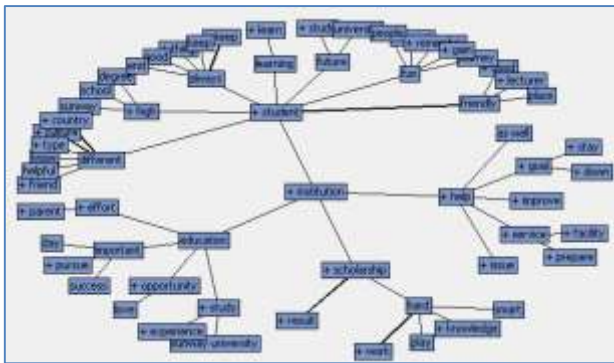
Figure. 6. Concept map for "Institution".

For example, "student" - "friendly", "institution" - "scholarship" - "result", "institution" - "scholarship" - "hard" - "work" highlights that senior advises junior to work hard to get scholarship and students need to be friendly to each other. Figure 7 displays a snapshot of feedbacks from students.

Choose an institution that can provide you with an international education and allow you to make contact with people from all around the world.

-Be objective in your comments and criticism. Giving subjective comments and simply saying "this is bad" without providing reasoning will not help our institution improve. -Help your student body, such as STACT and Student Council and believe in their ab

Find out the type of scholarships given throughout different institution in the country and aim to get it.

Figure. 7. Samples feedback for "Institution" key term.

Figure. 8 and 9 illustrates concept map and feedback on the concept "program".
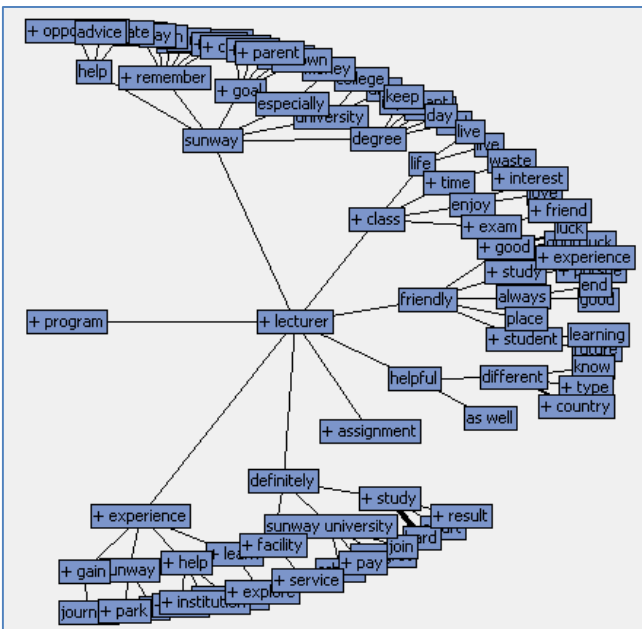
Figure. 8. Concept map for "program".

Sunway Psychology program is good and the lecturers are very well qualified as well. But the living expenses here is high.

Join this program if you like research and critical thinking

Scholarships should be given more to students from different previous programs, with the good results regardless or what previous program they took.

fill free to join this program as this will be many benefits for the future.

Figure. 9. Samples feedback for "program" key term.

Figure 10 illustrates the concept map for "result". Several key links include "study" – "life" – "enjoy", "result" – "hard" – "work" and "result" – "good" – "luck".
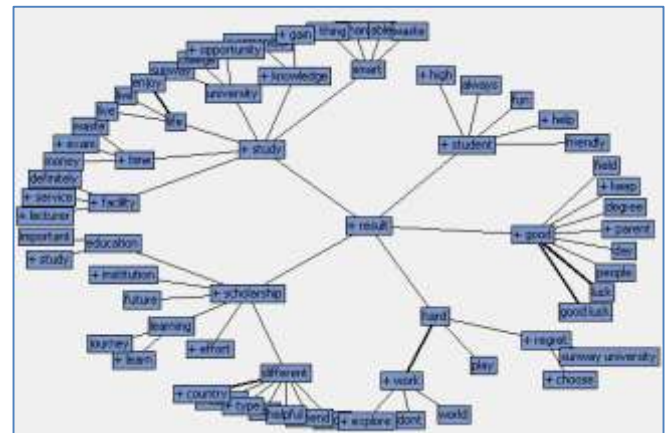

Figure. 10. Concept map for "result".

Figure 11a and 11b illustrate that each cluster is formed by a set of concepts or themes that are grouped in each cluster.

Figure. 11a. Cluster of themes.

For example, "money waste especially +time +assignment +knowledge +parent passion +want +remember degree well live dont education" illustrates one key strategy that consists of several major concepts highlighted by students.
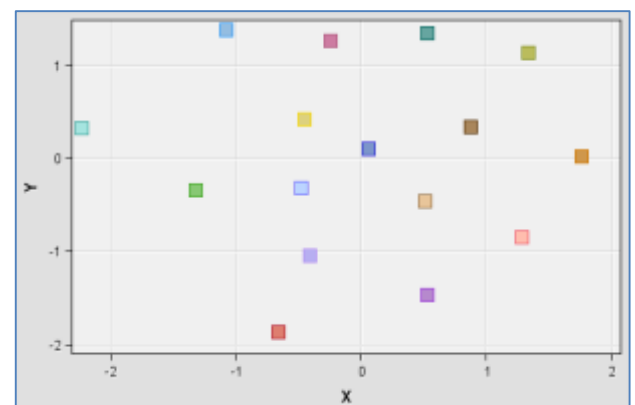

Figure. 11b. Cluster of themes.

As for topics on Advice, Figure 12 shows the top 20 topics of discussion highlighted by students.

```
life,enjoy,live,+full,live
+study,hard,smart,+scholarship,+full
good luck,luck,+good,play,job
sunway,+lecturer,+experience,better,+remember
different,+country,+culture,+friend,+type
sunway university,+lecturer,+good,join,+program
give up,+pay,work,smart,dont
+choose,wisely,+regret,+friend,enjoy
sunway,join,+park,+friend,+experience
success,+opportunity,important,help,hesitate
+learn,+thing,world,+knowledge,people
always,good,+good,give up,+procrastinate
+student,+help,+experience,future,+scholarship
+work,hard,play,fun,enjoy
+want,stay,+pursue,+stay,passion
school,stay,fun,+high,place
future,join,know,better,+prepare
hard,work,+help,+good,college
+hard,+friend,fun,+work,smart
money,waste,+time,waste,especially
+study,better,dont,+pursue,sunway university
+find,+good,food,enjoy,+environment
+scholarship,education,college,+result,+good
+time,+friend,know,+exam,college
university,+facility,enjoy,people,+service
```

Figure. 12. Topics discussed by students on "Advice".

b.   Recommendation from Students

This sections examine recommendation remark from the students. The text analysis highlights four (4) key terms that are of high concern by the students include "different", "person", "park", and "world" (Figure. 13).

TERM	FREQ	# DOCS	KEEP	WEIGHT ▼
different	6	4	☑	0.706
person	5	4	☑	0.705
park	5	4	☑	0.705
world	5	4	☑	0.705

Figure. 13. Key terms for "Recommendation" feedback.

Figure. 14 illustrates the concept map for "different". Links that connect several important key concepts are "good" - "sunway university", "good" - "lecturer", "different" - "student" - "sunway university", "different" - "people" - "world".
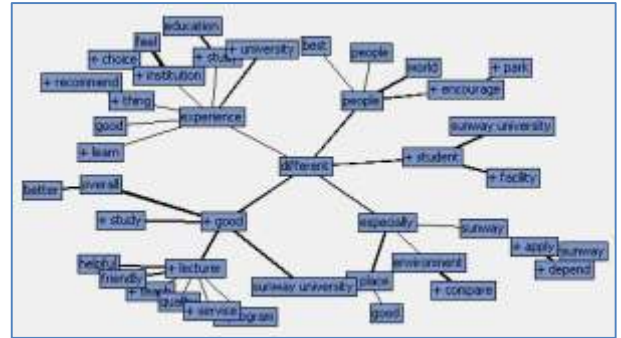
Figure. 14. Concept map for "Different".

Figure 15 displays sample feedbacks for "different".

Figure. 15. Samples feedback for "Different" key term.

Figure. 16 illustrates concept map for "Park" concept.

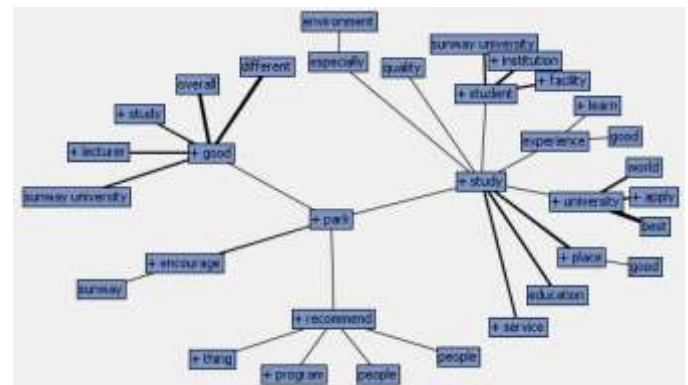**Figure. 16. Concept map for "Park".**

Samples of feedback on "Park" are presented in Figure. 17.

Figure. 17. Samples feedback for "Park" key term.

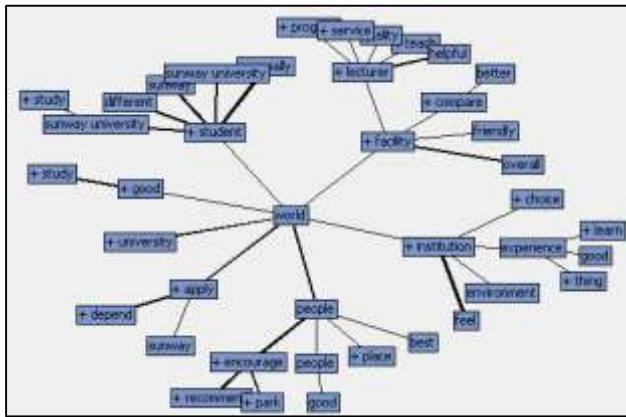Figure. 18 illustrates the concept map for "World".

Figure. 18. Concept map for "World".

Some links that connect important concepts are "world" - "student" - "sunway university", "world" - "institution" - "feel", "world" - "people" - "encourage" where samples feedback are illustrated in Figure 19.

The institution is already overcrowded, and some of the facilities are just unusable. The road connecting the institution to the outside world is like the surface of the moon.

I have been impressed with Sunway University even before I applied to study here. For one, the generosity of the University and the JCF in providing scholarships to deserving students have always attracted my attention. Not only does this provide many students with opportunities for good education, it helps lighten the burden of many students who find it difficult to afford tuition fees. The collaboration between Sun-U and many esteemed institutions around the world including Lancaster University, Victoria University and Le Cordon Bleu also impressed me and many of my peers.

Figure. 19. Samples feedback for "World" key term.

In Fig. 19, the concept map for "Improvement" is illustrated. The "Improvement" concept is found to have stronger link to "park" – "car" – "space" where Fig. 20 illustrates sample feedback on the "Improvement" concept.

Figure. 20 and 21 show the themes generated by the text miner presented by the text cluster. In the text cluster, "+teach +thing +recommend sunway different good people +encourage +good education experience +lecturer" has a much higher weight which means this cluster and all the feedback in this cluster is a more important set of concepts.
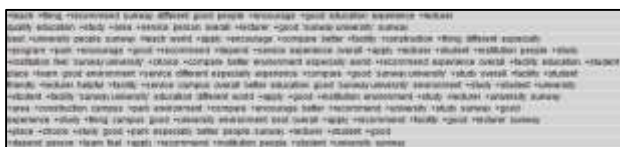

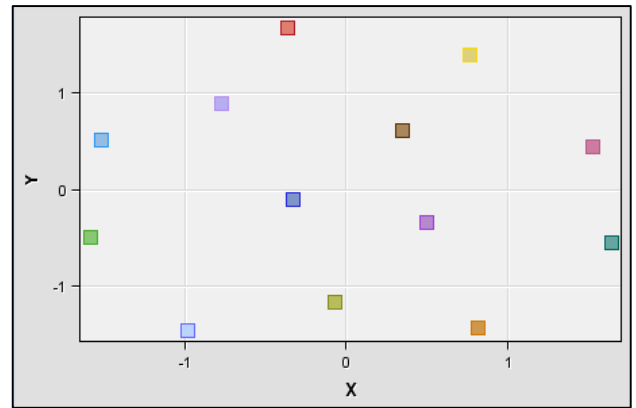**Figure. 20. Cluster of themes.**

Figure. 21. Cluster of themes.

Figure 21 demonstrates that all the clusters are clearly independent of each other. Figure. 22 illustrates a list of topics produced by the text topics function of the text miner software. Topic one consists of "+place +study +park +lecturer people", for example, has the highest weight which is the most talk about topic among students. For strategy formulation, it is easier and effective with the right topic being surfaced and highlighted to the university operator.

| +place,+study,+park,+lecturer,people |
| +student,different,especially,+learn,sunway |
| +apply,+depend,sunway,+student,+study |
| person,+learn,+depend,quality,people |
| +lecturer,+teach,sunway,+good,+university |
| sunway,best,+university,overall,people |
| +institution,world,+apply,+university,feel |
| +encourage,+park,people,+recommend,+good |
| good,sunway,people,+thing,+recommend |
| +study,education,quality,+area,+place |
| +facility,+university,+good,overall,better |
| campus,better,+thing,+study,helpful |
| +choice,better,+institution,+learn,+depend |
| overall,quality,+good,education,+study |
| sunway university,+recommend,+service,quality,better |
| friendly,helpful,+lecturer,+learn,overall |
| people,education,different,world,best |
| environment,+compare,+institution,+area,+service |
| +program,+recommend,+depend,+park,overall |
| place,+compare,+service,different,helpful |
| +area,+construction,+learn,+park,education |
| sunway university,+recommend,education,friendly,+good |
| experience,+learn,+university,+study,overall |
| feel,+compare,better,+thing,education |
| good,+learn,+thing,+lecturer,especially |

Figure. 22. Topics discussed by students on "Recommendation".

V DISCUSSION AND CONCLUSION

The number of advice and recommendations remarks from students are large and to do a comprehensive analysis manually will not be very effective and accurate. The use of text miner to analyze unstructured text to highlight new knowledge, new direction and strategies is a new approach in the process of strategy finding. In this paper, several

potential strategies based on the key concepts can be derived:

- "park" – "car" – "space" can be interpreted as "car park space is not sufficient"

- "world" - "student" - "sunway university" is "students in sunway university is from worldwide"

- "world" - "institution" - "feel" is interpreted as "it feels like world institution"

- "good" - "lecturer" is interpreted as "good lecturer in sunway university"

- "different" - "people" - "world" is interpreted as "different type of people from the world"

"result" – "hard" – "work" is interpreted as "to get result must work hard"Strategy can be deriving by simply looking at the relationship between two key terms from the text mining output. When the term park; car and space are link closely it means students complaints about not having enough car park space, hence the management of the universities should take note of how to manage and provide more space to solve this problem.

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