DonorsChoose

DonorsChoose.org receives hundreds of thousands of project proposals each year for classroom projects in need of funding. Right now, a large number of volunteers is needed to manually screen each submission before it's approved to be posted on the DonorsChoose.org website.

Next year, DonorsChoose.org expects to receive close to 500,000 project proposals. As a result, there are three main problems they need to solve:

- How to scale current manual processes and resources to screen 500,000 projects so that they can be posted as quickly and as efficiently as possible
- How to increase the consistency of project vetting across different volunteers to improve the experience for teachers
- How to focus volunteer time on the applications that need the most assistance

The goal of the competition is to predict whether or not a DonorsChoose.org project proposal submitted by a teacher will be approved, using the text of project descriptions as well as additional metadata about the project, teacher, and school. DonorsChoose.org can then use this information to identify projects most likely to need further review before approval.

About the DonorsChoose Data Set

The `train.csv` data set provided by DonorsChoose contains the following features:

Feature	**Description**
`project_id`	A unique identifier for the proposed project. **Example:** `p036502`
`project_title`	Title of the project. **Examples:** • `Art Will Make You Happy!` • `First Grade Fun`
`project_grade_category`	Grade level of students for which the project is targeted. One of the following enumerated values: • `Grades PreK-2` • `Grades 3-5` • `Grades 6-8` • `Grades 9-12`
`project_subject_categories`	One or more (comma-separated) subject categories for the project from the following enumerated list of values: • `Applied Learning` • `Care & Hunger` • `Health & Sports` • `History & Civics` • `Literacy & Language` • `Math & Science` • `Music & The Arts` • `Special Needs` • `Warmth` **Examples:** • `Music & The Arts` • `Literacy & Language, Math & Science`
`school_state`	State where school is located (Two-letter U.S. postal code). **Example:** `WY`
`project_subject_subcategories`	One or more (comma-separated) subject subcategories for the project. **Examples:** • `Literacy`

- `Literature & Writing, Social Sciences`

Feature	Description
`project_resource_summary`	An explanation of the resources needed for the project. **Example:** • `My students need hands on literacy materials to manage sensory needs!`
`project_essay_1`	First application essay*
`project_essay_2`	Second application essay*
`project_essay_3`	Third application essay*
`project_essay_4`	Fourth application essay*
`project_submitted_datetime`	Datetime when project application was submitted. **Example:** `2016-04-28 12:43:56.245`
`teacher_id`	A unique identifier for the teacher of the proposed project. **Example:** `bdf8baa8fedef6bfeec7ae4ff1c15c56`
`teacher_prefix`	Teacher's title. One of the following enumerated values: • `nan` • `Dr.` • `Mr.` • `Mrs.` • `Ms.` • `Teacher.`
`teacher_number_of_previously_posted_projects`	Number of project applications previously submitted by the same teacher. **Example:** `2`

* See the section **Notes on the Essay Data** for more details about these features.

Additionally, the `resources.csv` data set provides more data about the resources required for each project. Each line in this file represents a resource required by a project:

Feature	Description
`id`	A `project_id` value from the `train.csv` file. **Example:** `p036502`
`description`	Desciption of the resource. **Example:** `Tenor Saxophone Reeds, Box of 25`
`quantity`	Quantity of the resource required. **Example:** `3`
`price`	Price of the resource required. **Example:** `9.95`

Note: Many projects require multiple resources. The `id` value corresponds to a `project_id` in train.csv, so you use it as a key to retrieve all resources needed for a project:

The data set contains the following label (the value you will attempt to predict):

Label	Description
`project_is_approved`	A binary flag indicating whether DonorsChoose approved the project. A value of `0` indicates the project was not approved, and a value of `1` indicates the project was approved.

Notes on the Essay Data

Prior to May 17, 2016, the prompts for the essays were as follows:

- __project_essay_1:__ "Introduce us to your classroom"
- __project_essay_2:__ "Tell us more about your students"
- __project_essay_3:__ "Describe how your students will use the materials you're requesting"
- __project_essay_3:__ "Close by sharing why your project will make a difference"

Starting on May 17, 2016, the number of essays was reduced from 4 to 2, and the prompts for the first 2 essays were changed to the following:

- __project_essay_1:__ "Describe your students: What makes your students special? Specific details about their background, your neighborhood, and your school are all helpful."

your neighborhood, and your school are all helpful.

- __project_essay_2:__ "About your project: How will these materials make a difference in your students' learning and improve their school lives?"

  For all projects with project_submitted_datetime of 2016-05-17 and later, the values of project_essay_3 and project_essay_4 will be NaN.

In [1]:

```
%matplotlib inline
import warnings
warnings.filterwarnings("ignore")

import sqlite3
import pandas as pd
import numpy as np
import nltk
import string
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.feature_extraction.text import TfidfTransformer
from sklearn.feature_extraction.text import TfidfVectorizer

from sklearn.feature_extraction.text import CountVectorizer
from sklearn.metrics import confusion_matrix
from sklearn import metrics
from sklearn.metrics import roc_curve, auc
from nltk.stem.porter import PorterStemmer

import re
# Tutorial about Python regular expressions: https://pymotw.com/2/re/
import string
from nltk.corpus import stopwords
from nltk.stem import PorterStemmer
from nltk.stem.wordnet import WordNetLemmatizer

from gensim.models import Word2Vec
from gensim.models import KeyedVectors
import pickle

from tqdm import tqdm
import os

from plotly import plotly
import plotly.offline as offline
import plotly.graph_objs as go
offline.init_notebook_mode()
from collections import Counter
os.chdir('C:/Users/kingsubham27091995/Desktop/AppliedAiCouse/DonorsChoose')
```

1.1 Reading Data

In [2]:

```
project_data = pd.read_csv('train_data.csv',nrows=10000)
resource_data = pd.read_csv('resources.csv')
```

In [3]:

```
print("Number of data points in train data", project_data.shape)
print('-'*50)
print("The attributes of data :", project_data.columns.values)
```

```
Number of data points in train data (10000, 17)
--------------------------------------------------
The attributes of data : ['Unnamed: 0' 'id' 'teacher_id' 'teacher_prefix' 'school_state'
 'project_submitted_datetime' 'project_grade_category'
 'project_subject_categories' 'project_subject_subcategories'
 'project_title' 'project_essay_1' 'project_essay_2' 'project_essay_3'
 'project_essay_4' 'project_resource_summary'
 'teacher_number_of_previously_posted_projects' 'project_is_approved']
```

In [4]:

```
print("Number of data points in train data", resource_data.shape)
print(resource_data.columns.values)
resource_data.head(2)
```

```
Number of data points in train data (1541272, 4)
['id' 'description' 'quantity' 'price']
```

Out[4]:

	id	description	quantity	price
0	p233245	LC652 - Lakeshore Double-Space Mobile Drying Rack	1	149.00
1	p069063	Bouncy Bands for Desks (Blue support pipes)	3	14.95

Preprocessing of Project Grade Category

In [5]:

```
project_grade_category = []

for i in range(len(project_data)):
    a = project_data["project_grade_category"][i].replace(" ", "_")
    project_grade_category.append(a)
```

In [6]:

```
project_grade_category[0:5]
```

Out[6]:

```
['Grades_PreK-2', 'Grades_6-8', 'Grades_6-8', 'Grades_PreK-2', 'Grades_PreK-2']
```

In [7]:

```
project_data.drop(['project_grade_category'], axis=1, inplace=True)
```

In [8]:

```
project_data["project_grade_category"] = project_grade_category
```

In [9]:

```
project_data.head(5)
```

Out[9]:

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime	pro
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	Mrs.	IN	2016-12-05 13:43:57	Lite
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	Mr.	FL	2016-10-25 09:22:10	Hist Spo

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime	pro
2	21895	p182444	3465aaf82da834c0582ebd0ef8040ca0	Ms.	AZ	2016-08-31 12:03:56	Hea
3	45	p246581	f3cb9bffbba169bef1a77b243e620b60	Mrs.	KY	2016-10-06 21:16:17	Lite Scie
4	172407	p104768	be1f7507a41f8479dc06f047086a39ec	Mrs.	TX	2016-07-11 01:10:09	Mat

1.2 preprocessing of `project_subject_categories`

In [10]:

```
catogories = list(project_data['project_subject_categories'].values)
# remove special characters from list of strings python:
https://stackoverflow.com/a/47301924/4084039

# https://www.geeksforgeeks.org/removing-stop-words-nltk-python/
# https://stackoverflow.com/questions/23669024/how-to-strip-a-specific-word-from-a-string
# https://stackoverflow.com/questions/8270092/remove-all-whitespace-in-a-string-in-python
cat_list = []
for i in catogories:
    temp = ""
    # consider we have text like this "Math & Science, Warmth, Care & Hunger"
    for j in i.split(','): # it will split it in three parts ["Math & Science", "Warmth", "Care & H
unger"]
        if 'The' in j.split(): # this will split each of the catogory based on space "Math & Scienc
e"=> "Math","&", "Science"
            j=j.replace('The','') # if we have the words "The" we are going to replace it with ''(i
.e removing 'The')
        j = j.replace(' ','') # we are placeing all the ' '(space) with ''(empty) ex:"Math &
Science"=>"Math&Science"
        temp+=j.strip()+" " #" abc ".strip() will return "abc", remove the trailing spaces
        temp = temp.replace('&','_') # we are replacing the & value into
    cat_list.append(temp.strip())

project_data['clean_categories'] = cat_list
project_data.drop(['project_subject_categories'], axis=1, inplace=True)

from collections import Counter
my_counter = Counter()
for word in project_data['clean_categories'].values:
    my_counter.update(word.split())

cat_dict = dict(my_counter)
sorted_cat_dict = dict(sorted(cat_dict.items(), key=lambda kv: kv[1]))
```

1.3 preprocessing of `project_subject_subcategories`

In [11]:

```
sub_catogories = list(project_data['project_subject_subcategories'].values)
# remove special characters from list of strings python:
https://stackoverflow.com/a/47301924/4084039

# https://www.geeksforgeeks.org/removing-stop-words-nltk-python/
# https://stackoverflow.com/questions/23669024/how-to-strip-a-specific-word-from-a-string
# https://stackoverflow.com/questions/8270092/remove-all-whitespace-in-a-string-in-python

sub_cat_list = []
for i in sub_catogories:
    temp = ""
    # consider we have text like this "Math & Science, Warmth, Care & Hunger"
    for j in i.split(','): # it will split it in three parts ["Math & Science", "Warmth", "Care & H
unger"]
        if 'The' in j.split(): # this will split each of the catogory based on space "Math & Scienc
        if 'The' in j.split(): # this will split each of the catogory based on space "Math & Scienc
e"=> "Math","&", "Science"
            j=j.replace('The','') # if we have the words "The" we are going to replace it with ''(i
.e removing 'The')
        j = j.replace(' ','') # we are placeing all the ' '(space) with ''(empty) ex:"Math &
Science"=>"Math&Science"
        temp +=j.strip()+" "#" abc ".strip() will return "abc", remove the trailing spaces
        temp = temp.replace('&','_')
    sub_cat_list.append(temp.strip())

project_data['clean_subcategories'] = sub_cat_list
project_data.drop(['project_subject_subcategories'], axis=1, inplace=True)

# count of all the words in corpus python: https://stackoverflow.com/a/22898595/4084039
my_counter = Counter()
for word in project_data['clean_subcategories'].values:
    my_counter.update(word.split())

sub_cat_dict = dict(my_counter)
sorted_sub_cat_dict = dict(sorted(sub_cat_dict.items(), key=lambda kv: kv[1]))
```

1.3 Text preprocessing

Cleaning Titles(Text Preprocessing)

In [12]:

```
# https://gist.github.com/sebleier/554280
# we are removing the words from the stop words list: 'no', 'nor', 'not'
stopwords= ['i', 'me', 'my', 'myself', 'we', 'our', 'ours', 'ourselves', 'you', "you're", "you've",
\
            "you'll", "you'd", 'your', 'yours', 'yourself', 'yourselves', 'he', 'him', 'his',
'himself', \
            'she', "she's", 'her', 'hers', 'herself', 'it', "it's", 'its', 'itself', 'they', 'them',
'their',\
            'theirs', 'themselves', 'what', 'which', 'who', 'whom', 'this', 'that', "that'll",
'these', 'those', \
            'am', 'is', 'are', 'was', 'were', 'be', 'been', 'being', 'have', 'has', 'had', 'having',
'do', 'does', \
            'did', 'doing', 'a', 'an', 'the', 'and', 'but', 'if', 'or', 'because', 'as', 'until', '
while', 'of', \
            'at', 'by', 'for', 'with', 'about', 'against', 'between', 'into', 'through', 'during',
'before', 'after',\
            'above', 'below', 'to', 'from', 'up', 'down', 'in', 'out', 'on', 'off', 'over', 'under'
, 'again', 'further',\
            'then', 'once', 'here', 'there', 'when', 'where', 'why', 'how', 'all', 'any', 'both', 'e
ach', 'few', 'more',\
            'most', 'other', 'some', 'such', 'only', 'own', 'same', 'so', 'than', 'too', 'very', \
            's', 't', 'can', 'will', 'just', 'don', "don't", 'should', "should've", 'now', 'd', 'll'
, 'm', 'o', 're', \
            've', 'y', 'ain', 'aren', "aren't", 'couldn', "couldn't", 'didn', "didn't", 'doesn', "do
esn't", 'hadn',\
            "hadn't", 'hasn', "hasn't", 'haven', "haven't", 'isn', "isn't", 'ma', 'mightn',
"mightn't", 'mustn',\
            "mustn't", 'needn', "needn't", 'shan', "shan't", 'shouldn', "shouldn't", 'wasn',
"wasn't", 'weren', "weren't", \
            'won', "won't", 'wouldn', "wouldn't"]
```

In [13]:

```
# https://stackoverflow.com/a/47091490/4084039
import re

def decontracted(phrase):
    # specific
    phrase = re.sub(r"won't", "will not", phrase)
    phrase = re.sub(r"can\'t", "can not", phrase)

    # general
    phrase = re.sub(r"n\'t", " not", phrase)
    phrase = re.sub(r"\'re", " are", phrase)
    phrase = re.sub(r"\'s", " is", phrase)
    phrase = re.sub(r"\'d", " would", phrase)
    phrase = re.sub(r"\'ll", " will", phrase)
    phrase = re.sub(r"\'t", " not", phrase)
    phrase = re.sub(r"\'ve", " have", phrase)
    phrase = re.sub(r"\'m", " am", phrase)
    return phrase
```

In [14]:

```
clean_titles = []

for titles in tqdm(project_data["project_title"]):
    title = decontracted(titles)
    title = title.replace('\\r', ' ')
    title = title.replace('\\"', ' ')
    title = title.replace('\\n', ' ')
    title = re.sub('[^A-Za-z0-9]+', ' ', title)
    title = ' '.join(f for f in title.split() if f not in stopwords)
    clean_titles.append(title.lower().strip())
```

```
100%|██████████████████████████████████| 10000/10000 [00:00<00:00, 20862.00it/s]
```

In [15]:

```
project_data["clean_titles"] = clean_titles
```

In [16]:

```
project_data.drop(['project_title'], axis=1, inplace=True)
```

Finding number of words in title and introducing it in a new column

- This can be used as Numerical Feature for Vectorisation

In [17]:

```
title_word_count = []
for a in project_data["clean_titles"] :
    b = len(a.split())
    title_word_count.append(b)
```

In [18]:

```
project_data["title_word_count"] = title_word_count
project_data.head(5)
```

Out[18]:

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime	pro
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	Mrs.	IN	2016-12-05 13:43:57	My Eng that
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	Mr.	FL	2016-10-25 09:22:10	Our arriv sch lea.
2	21895	p182444	3465aaf82da834c0582ebd0ef8040ca0	Ms.	AZ	2016-08-31 12:03:56	\r\n\ cha alwa th...
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	I wo unic

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime	pro
3	45	p246581	f3cb9bffbba169bef1a77b243e620b60	Mrs.	KY	2016-10-06 21:16:17	fille ESL
4	172407	p104768	be1f7507a41f8479dc06f047086a39ec	Mrs.	TX	2016-07-11 01:10:09	Our grad nex m...

Combining 4 Essays into 1 Essay Feature

In [19]:

```
# merge two column text dataframe:
project_data["essay"] = project_data["project_essay_1"].map(str) +\
                        project_data["project_essay_2"].map(str) + \
                        project_data["project_essay_3"].map(str) + \
                        project_data["project_essay_4"].map(str)
```

In [20]:

```
# printing some random reviews
print(project_data['essay'].values[0])
print("="*50)
print(project_data['essay'].values[150])
print("="*50)
print(project_data['essay'].values[1000])
print("="*50)
```

```
My students are English learners that are working on English as their second or third languages. W
e are a melting pot of refugees, immigrants, and native-born Americans bringing the gift of langua
ge to our school. \r\n\r\n We have over 24 languages represented in our English Learner program wi
th students at every level of mastery.  We also have over 40 countries represented with the
families within our school.  Each student brings a wealth of knowledge and experiences to us that
open our eyes to new cultures, beliefs, and respect.\"The limits of your language are the limits o
f your world.\"-Ludwig Wittgenstein  Our English learner's have a strong support system at home th
at begs for more resources.  Many times our parents are learning to read and speak English along s
ide of their children.  Sometimes this creates barriers for parents to be able to help their child
learn phonetics, letter recognition, and other reading skills.\r\n\r\nBy providing these dvd's and
players, students are able to continue their mastery of the English language even if no one at hom
e is able to assist.  All families with students within the Level 1 proficiency status, will be a
offered to be a part of this program.  These educational videos will be specially chosen by the En
glish Learner Teacher and will be sent home regularly to watch.  The videos are to help the child
develop early reading skills.\r\n\r\nParents that do not have access to a dvd player will have the
opportunity to check out a dvd player to use for the year.  The plan is to use these videos and ed
ucational dvd's for the years to come for other EL students.\r\nnannan
==================================================
The 51 fifth grade students that will cycle through my classroom this year all love learning, at l
east most of the time. At our school, 97.3% of the students receive free or reduced price lunch. O
f the 560 students, 97.3% are minority students. \r\nThe school has a vibrant community that loves
to get together and celebrate. Around Halloween there is a whole school parade to show off the bea
utiful costumes that students wear. On Cinco de Mayo we put on a big festival with crafts made by
the students, dances, and games. At the end of the year the school hosts a carnival to celebrate t
he hard work put in during the school year, with a dunk tank being the most popular activity.My st
udents will use these five brightly colored Hokki stools in place of regular, stationary, 4-legged
chairs. As I will only have a total of ten in the classroom and not enough for each student to hav
e an individual one, they will be used in a variety of ways. During independent reading time they
will be used as special chairs students will each use on occasion. I will utilize them in place of
chairs at my small group tables during math and reading times. The rest of the day they will be us
ed by the students who need the highest amount of movement in their life in order to stay focused
on school.\r\n\r\nWhenever asked what the classroom is missing, my students always say more Hokki
Stools. They can't get their fill of the 5 stools we already have. When the students are sitting i
n group with me on the Hokki Stools, they are always moving, but at the same time doing their
work. Anytime the students get to pick where they can sit, the Hokki Stools are the first to be ta
ken. There are always students who head over to the kidney table to get one of the stools who are
disappointed as there are not enough of them. \r\n\r\nWe ask a lot of students to sit for 7 hours
a day. The Hokki stools will be a compromise that allow my students to do desk work and move at th
e same time. These stools will help students to meet their 60 minutes a day of movement by
allowing them to activate their core muscles for balance while they sit. For many of my students,
these chairs will take away the barrier that exists in schools for a child who can't sit
still.nannan
==================================================
How do you remember your days of school? Was it in a sterile environment with plain walls, rows of
```

```
desks, and a teacher in front of the room? A typical day in our room is nothing like that. I work
hard to create a warm inviting themed room for my students look forward to coming to each day.\r\n
\r\nMy class is made up of 28 wonderfully unique boys and girls of mixed races in
Arkansas.\r\nThey attend a Title I school, which means there is a high enough percentage of free a
nd reduced-price lunch to qualify. Our school is an \"open classroom\" concept, which is very uniq
ue as there are no walls separating the classrooms. These 9 and 10 year-old students are very eage
r learners; they are like sponges, absorbing all the information and experiences and keep on wanti
ng more.With these resources such as the comfy red throw pillows and the whimsical nautical hangin
g decor and the blue fish nets, I will be able to help create the mood in our classroom setting to
be one of a themed nautical environment. Creating a classroom environment is very important in the
success in each and every child's education. The nautical photo props will be used with each child
as they step foot into our classroom for the first time on Meet the Teacher evening. I'll take pic
tures of each child with them, have them developed, and then hung in our classroom ready for their
first day of 4th grade.  This kind gesture will set the tone before even the first day of school!
The nautical thank you cards will be used throughout the year by the students as they create thank
you cards to their team groups.\r\n\r\nYour generous donations will help me to help make our
classroom a fun, inviting, learning environment from day one.\r\n\r\nIt costs lost of money out of
my own pocket on resources to get our classroom ready. Please consider helping with this project t
o make our new school year a very successful one. Thank you!nannan
==================================================
```

Cleaning Essays(Text Preprocessing)

In [21]:

```
clean_essay = []

for ess in tqdm(project_data["essay"]):
    ess = decontracted(ess)
    ess = ess.replace('\\r', ' ')
    ess = ess.replace('\\"', ' ')
    ess = ess.replace('\\n', ' ')
    ess = re.sub('[^A-Za-z0-9]+', ' ', ess)
    ess = ' '.join(f for f in ess.split() if f not in stopwords)
    clean_essay.append(ess.lower().strip())
```

```
100%|████████████████████████████████████| 10000/10000 [00:10<00:00, 974.97it/s]
```

In [22]:

```
project_data["clean_essays"] = clean_essay
```

In [23]:

```
project_data.drop(['essay'], axis=1, inplace=True)
```

Finding number of words in title and introducing it in a new column

- This can be used as Numerical Feature for Vectorisation

In [24]:

```
essay_word_count = []
for ess in project_data["clean_essays"] :
    c = len(ess.split())
    essay_word_count.append(c)
```

In [25]:

```
project_data["essay_word_count"] = essay_word_count
project_data.head(5)
```

Out[25]:

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime	pro

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime	pro
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	Mrs.	IN	2016-12-05 13:43:57	My Eng that
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	Mr.	FL	2016-10-25 09:22:10	Our arri sch lea.
2	21895	p182444	3465aaf82da834c0582ebd0ef8040ca0	Ms.	AZ	2016-08-31 12:03:56	\r\n\ cha alw th...
3	45	p246581	f3cb9bffbba169bef1a77b243e620b60	Mrs.	KY	2016-10-06 21:16:17	I wo unic fille ESL
4	172407	p104768	be1f7507a41f8479dc06f047086a39ec	Mrs.	TX	2016-07-11 01:10:09	Our grac nex m...

Calculating Sentiment Scores for the Essays Feature

In [26]:

```
import nltk
from nltk.sentiment.vader import SentimentIntensityAnalyzer
```

In [27]:

```
nltk.download('vader_lexicon')
```

```
[nltk_data] Downloading package vader_lexicon to
[nltk_data]     C:\Users\kingsubham27091995\AppData\Roaming\nltk_data.
[nltk_data]     ..
[nltk_data]   Package vader_lexicon is already up-to-date!
```

Out[27]:

```
True
```

In [28]:

```
analyser = SentimentIntensityAnalyzer()
```

In [29]:

```
## http://t-redactyl.io/blog/2017/04/using-vader-to-handle-sentiment-analysis-with-social-media-te
xt.html
neg = []
pos = []
neu = []
compound = []

for a in tqdm(project_data["clean_essays"]) :
    b = analyser.polarity_scores(a)['neg']
    c = analyser.polarity_scores(a)['pos']
    d = analyser.polarity_scores(a)['neu']
    e = analyser.polarity_scores(a)['compound']
    neg.append(b)
    pos.append(c)
    neu.append(d)
    compound.append(e)
```

```
100%|████████████████████████████████████████| 10000/10000 [01:51<00:00, 95.89it/s]
```

In [30]:

```
project_data["pos"] = pos
project_data["neg"] = neg
project_data["neu"] = neu
project_data["compound"] = compound

project_data.head(5)
```

Out[30]:

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime	pro
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	Mrs.	IN	2016-12-05 13:43:57	My Eng that
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	Mr.	FL	2016-10-25 09:22:10	Our arri sch lea.
2	21895	p182444	3465aaf82da834c0582ebd0ef8040ca0	Ms.	AZ	2016-08-31 12:03:56	\r\n\ cha alw th...
3	45	p246581	f3cb9bffbba169bef1a77b243e620b60	Mrs.	KY	2016-10-06 21:16:17	I wc unic fille ESL
4	172407	p104768	be1f7507a41f8479dc06f047086a39ec	Mrs.	TX	2016-07-11 01:10:09	Our grad nex m...

5 rows × 24 columns

1.5 Preparing data for models

In [31]:

```
project_data.columns
```

Out[31]:

```
Index(['Unnamed: 0', 'id', 'teacher_id', 'teacher_prefix', 'school_state',
       'project_submitted_datetime', 'project_essay_1', 'project_essay_2',
       'project_essay_3', 'project_essay_4', 'project_resource_summary',
       'teacher_number_of_previously_posted_projects', 'project_is_approved',
       'project_grade_category', 'clean_categories', 'clean_subcategories',
       'clean_titles', 'title_word_count', 'clean_essays', 'essay_word_count',
       'pos', 'neg', 'neu', 'compound'],
      dtype='object')
```

we are going to consider

```
- school_state : categorical data
- clean_categories : categorical data
- clean_subcategories : categorical data
- project_grade_category : categorical data
- teacher_prefix : categorical data

- project_title : text data
- text : text data
- project_resource_summary: text data (optinal)

- quantity : numerical (optinal)
- teacher_number_of_previously_posted_projects : numerical
- price : numerical
```

1.5.1 Vectorizing Categorical data

- https://www.appliedaicourse.com/course/applied-ai-course-online/lessons/handling-categorical-and-numerical-features/

One Hot Encoding of Clean_Categories

In [32]:

```
# we use count vectorizer to convert the values into one
from sklearn.feature_extraction.text import CountVectorizer
vectorizer = CountVectorizer(vocabulary=list(sorted_cat_dict.keys()), lowercase=False, binary=True
)
categories_one_hot = vectorizer.fit_transform(project_data['clean_categories'].values)
print(vectorizer.get_feature_names())
print("Shape of matrix after one hot encodig ",categories_one_hot.shape)
```

```
['Warmth', 'Care_Hunger', 'History_Civics', 'Music_Arts', 'AppliedLearning', 'SpecialNeeds',
'Health_Sports', 'Math_Science', 'Literacy_Language']
Shape of matrix after one hot encodig  (10000, 9)
```

One Hot Encoding of Clean_Sub_Categories

In [33]:

```
# we use count vectorizer to convert the values into one
vectorizer = CountVectorizer(vocabulary=list(sorted_sub_cat_dict.keys()), lowercase=False, binary=
True)
sub_categories_one_hot = vectorizer.fit_transform(project_data['clean_subcategories'].values)
print(vectorizer.get_feature_names())
print("Shape of matrix after one hot encodig ",sub_categories_one_hot.shape)
```

```
['Economics', 'FinancialLiteracy', 'CommunityService', 'ForeignLanguages', 'ParentInvolvement', 'E
xtracurricular', 'Civics_Government', 'NutritionEducation', 'Warmth', 'Care_Hunger',
'SocialSciences', 'CharacterEducation', 'PerformingArts', 'TeamSports', 'Other',
'College_CareerPrep', 'Music', 'History_Geography', 'ESL', 'Health_LifeScience',
'EarlyDevelopment', 'Gym_Fitness', 'EnvironmentalScience', 'VisualArts', 'Health_Wellness',
'AppliedSciences', 'SpecialNeeds', 'Literature_Writing', 'Mathematics', 'Literacy']
Shape of matrix after one hot encodig  (10000, 30)
```

One-Hot-Encoding for School-State

In [34]:

```
from collections import Counter
my_counter = Counter()
for word in project_data['school_state'].values:
    my_counter.update(str(word).split())
```

In [35]:

```
school_state_dict = dict(my_counter)
sorted_school_state_dict = dict(sorted(school_state_dict.items(), key=lambda kv: kv[1]))
# we use count vectorizer to convert the values into one hot encoded features
# for STATE
vectorizer = CountVectorizer(vocabulary=list(sorted_school_state_dict.keys()), lowercase=False, bi
nary=True)
vectorizer.fit(project_data['school_state'].values)
print(vectorizer.get_feature_names())


school_state_one_hot = vectorizer.transform(project_data['school_state'].values)
print("Shape of matrix after one hot encoding ",school_state_one_hot.shape)
```

```
['VT', 'WY', 'ND', 'MT', 'NH', 'DE', 'SD', 'RI', 'NE', 'AK', 'NM', 'ME', 'DC', 'HI', 'WV', 'ID', 'I
A', 'KS', 'AR', 'MN', 'MS', 'OR', 'CO', 'KY', 'NV', 'MD', 'AL', 'TN', 'CT', 'WI', 'UT', 'VA', 'WA',
'MA', 'NJ', 'AZ', 'LA', 'OK', 'IN', 'MO', 'OH', 'PA', 'MI', 'GA', 'SC', 'IL', 'NC', 'FL', 'TX', 'NY
', 'CA']
Shape of matrix after one hot encoding  (10000, 51)
```

One-Hot-Encoding for Project_Grade_Category

In [36]:

```
from collections import Counter
my_counter = Counter()
for word in project_data['project_grade_category'].values:
    my_counter.update(str(word).split())
```

In [37]:

```
project_grade_category_dict = dict(my_counter)
sorted_project_grade_category_dict = dict(sorted(project_grade_category_dict.items(), key=lambda
kv: kv[1]))
```

In [38]:

```
# we use count vectorizer to convert the values into one hot encoded features
# for Project_Grade_Category
vectorizer = CountVectorizer(vocabulary=list(sorted_project_grade_category_dict.keys()), lowercase
=False, binary=True)
vectorizer.fit(project_data['project_grade_category'].values)
print(vectorizer.get_feature_names())


project_grade_category_one_hot =
vectorizer.transform(project_data['project_grade_category'].values)
print("Shape of matrix after one hot encoding ",project_grade_category_one_hot.shape)
```

```
['Grades_9-12', 'Grades_6-8', 'Grades_3-5', 'Grades_PreK-2']
Shape of matrix after one hot encoding  (10000, 4)
```

One-Hot_encoding for Teacher_Prefix

In [51]:

```
project_data['teacher_prefix']=project_data['teacher_prefix'].fillna("")
```

In [52]:

```
from collections import Counter
my_counter = Counter()
for word in project_data['teacher_prefix'].values:
    my_counter.update(str(word).split())
```

In [53]:

```
teacher_prefix_dict = dict(my_counter)
sorted_teacher_prefix_dict = dict(sorted(teacher_prefix_dict.items(), key=lambda kv: kv[1]))
```

In [ ]:

```
## ValueError: np.nan is an invalid document, expected byte or unicode string.
## The link below explains h0w to tackle such discrepancies.
## https://stackoverflow.com/questions/39303912/tfidfvectorizer-in-scikit-learn-valueerror-np-nan-
is-an-invalid-document/39308809#39308809

vectorizer = CountVectorizer(vocabulary=list(sorted_teacher_prefix_dict.keys()), lowercase=False,
binary=True)
vectorizer.fit(project_data['teacher_prefix'].values.astype("U"))

teacher_prefix_one_hot = vectorizer.transform(project_data['teacher_prefix'].values.astype("U"))

print(vectorizer.get_feature_names())

print("Shape of matrix after one hot encoding ",teacher_prefix_one_hot.shape)
```

1.5.2 Vectorizing Text data

1.5.2.1 Bag of words

Project Essays

In [55]:

```
# We are considering only the words which appeared in at least 10 documents(rows or projects).
vectorizer = CountVectorizer(min_df=10)
text_bow = vectorizer.fit_transform(project_data["clean_essays"])
print("Shape of matrix after one hot encoding ",text_bow.shape)
```

```
Shape of matrix after one hot encoding  (10000, 6213)
```

Project Titles

In [56]:

```
# Similarly you can vectorize for title also
# We are considering only the words which appeared in at least 10 documents(rows or projects).
vectorizer = CountVectorizer(min_df=10)
title_bow = vectorizer.fit_transform(project_data["clean_titles"])
print("Shape of matrix after one hot encodig ",title_bow.shape)
print("Number of unique words :" ,title_bow.shape[1])
```

```
Shape of matrix after one hot encodig  (10000, 671)
Number of unique words : 671
```

1.5.2.2 TFIDF vectorizer

Project Essays

In [57]:

```
from sklearn.feature_extraction.text import TfidfVectorizer
vectorizer = TfidfVectorizer(min_df=10)
text_tfidf = vectorizer.fit_transform(project_data["clean_essays"])
print("Shape of matrix after one hot encodig ",text_tfidf.shape)
```

```
Shape of matrix after one hot encodig  (10000, 6213)
```

Project Titles

In [58]:

```
# Similarly you can vectorize for title also
from sklearn.feature_extraction.text import TfidfVectorizer
vectorizer = TfidfVectorizer(min_df=10)
title_tfidf = vectorizer.fit_transform(project_data["clean_titles"])
print("Shape of matrix after one hot encodig ",title_tfidf.shape)
```

```
Shape of matrix after one hot encodig  (10000, 671)
```

1.5.2.3 Using Pretrained Models: Avg W2V

In [59]:

```
'''
# Reading glove vectors in python: https://stackoverflow.com/a/38230349/4084039
def loadGloveModel(gloveFile):
    print ("Loading Glove Model")
    f = open(gloveFile,'r', encoding="utf8")
    model = {}
    for line in tqdm(f):
        splitLine = line.split()
        word = splitLine[0]
        embedding = np.array([float(val) for val in splitLine[1:]])
        model[word] = embedding
    print ("Done.",len(model)," words loaded!")
    return model
model = loadGloveModel('glove.42B.300d.txt')

# ============================
Output:

Loading Glove Model
1917495it [06:32, 4879.69it/s]
Done. 1917495  words loaded!

# ============================

words = []
for i in preproced_texts:
    words.extend(i.split(' '))

for i in preproced_titles:
    words.extend(i.split(' '))
print("all the words in the coupus", len(words))
words = set(words)
print("the unique words in the coupus", len(words))

inter_words = set(model.keys()).intersection(words)
print("The number of words that are present in both glove vectors and our coupus", \
      len(inter_words),"(",np.round(len(inter_words)/len(words)*100,3),"%)")

words_courpus = {}
words_glove = set(model.keys())
for i in words:
    if i in words_glove:
        words_courpus[i] = model[i]
print("word 2 vec length", len(words_courpus))


# stronging variables into pickle files python: http://www.jessicayung.com/how-to-use-pickle-to-sa
ve-and-load-variables-in-python/

import pickle
with open('glove_vectors', 'wb') as f:
    pickle.dump(words_courpus, f)


'''
```

```
Out[59]:
```

```
'\n# Reading glove vectors in python: https://stackoverflow.com/a/38230349/4084039\ndef
loadGloveModel(gloveFile):\n    print ("Loading Glove Model")\n    f = open(gloveFile,\'r\',
encoding="utf8")\n    model = {}\n    for line in tqdm(f):\n        splitLine = line.split()\n
word = splitLine[0]\n        embedding = np.array([float(val) for val in splitLine[1:]])\n        m
odel[word] = embedding\n    print ("Done.",len(model)," words loaded!")\n    return model\nmodel =
loadGloveModel(\'glove.42B.300d.txt\')\n\n# ============================\nOutput:\n    \nLoading G
love Model\n1917495it [06:32, 4879.69it/s]\nDone. 1917495  words loaded!\n\n#
============================\n\nwords = []\nfor i in preproced_texts:\n    words.extend(i.split(\'
\'))\n\nfor i in preproced_titles:\n    words.extend(i.split(\' \'))\nprint("all the words in the
coupus", len(words))\nwords = set(words)\nprint("the unique words in the coupus",
len(words))\n\ninter_words = set(model.keys()).intersection(words)\nprint("The number of words tha
t are present in both glove vectors and our coupus",       len(inter_words),"
(",np.round(len(inter_words)/len(words)*100,3),"%)")\n\nwords_courpus = {}\nwords_glove =
set(model.keys())\nfor i in words:\n    if i in words_glove:\n        words_courpus[i] = model[i]\r
print("word 2 vec length", len(words_courpus))\n\n\n# stronging variables into pickle files python
: http://www.jessicayung.com/how-to-use-pickle-to-save-and-load-variables-in-python/\n\nimport pic
kle\nwith open(\'glove_vectors\', \'wb\') as f:\n    pickle.dump(words_courpus, f)\n\n\n'
```

```
In [63]:
```

```python
# stronging variables into pickle files python: http://www.jessicayung.com/how-to-use-pickle-to-sa
ve-and-load-variables-in-python/
# make sure you have the glove_vectors file
with open('glove_vectors', 'rb') as f:
    model = pickle.load(f)
    glove_words =  set(model.keys())
```

Project Essays

```
In [64]:
```

```python
# average Word2Vec
# compute average word2vec for each review.
avg_w2v_vectors = []; # the avg-w2v for each sentence/review is stored in this list
for sentence in tqdm(project_data["clean_essays"]): # for each review/sentence
    vector = np.zeros(300) # as word vectors are of zero length
    cnt_words =0; # num of words with a valid vector in the sentence/review
    for word in sentence.split(): # for each word in a review/sentence
        if word in glove_words:
            vector += model[word]
            cnt_words += 1
    if cnt_words != 0:
        vector /= cnt_words
    avg_w2v_vectors.append(vector)

print(len(avg_w2v_vectors))
print(len(avg_w2v_vectors[0]))
```

```
100%|██████████████████████████████████| 10000/10000 [00:05<00:00, 1892.42it/s]
```

```
10000
300
```

Project Titles

```
In [65]:
```

```python
# Similarly you can vectorize for title also
# average Word2Vec
# compute average word2vec for each review.
avg_w2v_title_vectors = []; # the avg-w2v for each sentence/review is stored in this list
for sentence in tqdm(project_data["clean_titles"]): # for each review/sentence
    vector = np.zeros(300) # as word vectors are of zero length
    cnt_words =0; # num of words with a valid vector in the sentence/review
    for word in sentence.split(): # for each word in a review/sentence
        if word in glove_words:
            vector += model[word]
            cnt_words += 1
    if cnt_words != 0:
        vector /= cnt_words
    avg_w2v_title_vectors.append(vector)

print(len(avg_w2v_title_vectors))
print(len(avg_w2v_title_vectors[0]))
```

```
100%|██████████████████████████████████████████| 10000/10000 [00:00<00:00, 43100.55it/s]
```

```
10000
300
```

1.5.2.3 Using Pretrained Models: TFIDF weighted W2V

Project Essays

In [66]:

```
# S = ["abc def pqr", "def def def abc", "pqr pqr def"]
tfidf_model = TfidfVectorizer()
tfidf_model.fit(project_data["clean_essays"])
# we are converting a dictionary with word as a key, and the idf as a value
dictionary = dict(zip(tfidf_model.get_feature_names(), list(tfidf_model.idf_)))
tfidf_words = set(tfidf_model.get_feature_names())
```

In [67]:

```
# average Word2Vec
# compute average word2vec for each review.
tfidf_w2v_vectors = []; # the avg-w2v for each sentence/review is stored in this list
for sentence in tqdm(project_data["clean_essays"]): # for each review/sentence
    vector = np.zeros(300) # as word vectors are of zero length
    tf_idf_weight =0; # num of words with a valid vector in the sentence/review
    for word in sentence.split(): # for each word in a review/sentence
        if (word in glove_words) and (word in tfidf_words):
            vec = model[word] # getting the vector for each word
            # here we are multiplying idf value(dictionary[word]) and the tf
value((sentence.count(word)/len(sentence.split())))
            tf_idf = dictionary[word]*(sentence.count(word)/len(sentence.split())) # getting the tf
idf value for each word
            vector += (vec * tf_idf) # calculating tfidf weighted w2v
            tf_idf_weight += tf_idf
    if tf_idf_weight != 0:
        vector /= tf_idf_weight
    tfidf_w2v_vectors.append(vector)

print(len(tfidf_w2v_vectors))
print(len(tfidf_w2v_vectors[0]))
```

```
100%|██████████████████████████████████████████| 10000/10000 [00:32<00:00, 312.24it/s]
```

```
10000
300
```

Project Titles

In [68]:

```
# S = ["abc def pqr", "def def def abc", "pqr pqr def"]
tfidf_model = TfidfVectorizer()
tfidf_model.fit(project_data["clean_titles"])
# we are converting a dictionary with word as a key, and the idf as a value
dictionary = dict(zip(tfidf_model.get_feature_names(), list(tfidf_model.idf_)))
tfidf_words = set(tfidf_model.get_feature_names())
```

In [69]:

```
# Similarly you can vectorize for title also
# average Word2Vec
# compute average word2vec for each review.
tfidf_w2v_title_vectors = []; # the avg-w2v for each sentence/review is stored in this list
for sentence in tqdm(project_data["clean_titles"]): # for each review/sentence
    vector = np.zeros(300) # as word vectors are of zero length
    tf_idf_weight =0; # num of words with a valid vector in the sentence/review
    for word in sentence.split(): # for each word in a review/sentence
        if (word in glove_words) and (word in tfidf_words):
            vec = model[word] # getting the vector for each word
            # here we are multiplying idf value(dictionary[word]) and the tf
value((sentence.count(word)/len(sentence.split())))
            tf_idf = dictionary[word]*(sentence.count(word)/len(sentence.split())) # getting the tf
idf value for each word
            vector += (vec * tf_idf) # calculating tfidf weighted w2v
            tf_idf_weight += tf_idf
    if tf_idf_weight != 0:
        vector /= tf_idf_weight
    tfidf_w2v_title_vectors.append(vector)

print(len(tfidf_w2v_title_vectors))
print(len(tfidf_w2v_title_vectors[0]))
```

```
100%|████████████████████████████████████| 10000/10000 [00:00<00:00, 19878.09it/s]
```

```
10000
300
```

1.5.3 Vectorizing Numerical features

In [60]:

```
price_data = resource_data.groupby('id').agg({'price':'sum', 'quantity':'sum'}).reset_index()
project_data = pd.merge(project_data, price_data, on='id', how='left')
```

Price

In [61]:

```
# check this one: https://www.youtube.com/watch?v=0HOqOcln3Z4&t=530s
# standardization sklearn: https://scikit-
learn.org/stable/modules/generated/sklearn.preprocessing.StandardScaler.html
from sklearn.preprocessing import StandardScaler

# price_standardized = standardScalar.fit(project_data['price'].values)
# this will rise the error
# ValueError: Expected 2D array, got 1D array instead: array=[725.05 213.03 329.   ... 399.   287.
73   5.5 ].
# Reshape your data either using array.reshape(-1, 1)

price_scalar = StandardScaler()
price_scalar.fit(project_data['price'].values.reshape(-1,1)) # finding the mean and standard
deviation of this data
print(f"Mean : {price_scalar.mean_[0]}, Standard deviation : {np.sqrt(price_scalar.var_[0])}")

# Now standardize the data with above maen and variance.
price_standardized = price_scalar.transform(project_data['price'].values.reshape(-1, 1))
```

```
Mean : 297.35772799999995, Standard deviation : 391.10985036728243
```

In [62]:

```
price_standardized
```

Out[62]:

```
array([[-0.36500673],
       [ 0.004199  ],
       [ 0.56120364],
       ...,
       [ 0.1434182 ],
       [ 0.07834697],
       [-0.21750341]])
```

Quantity

In [63]:

```
# check this one: https://www.youtube.com/watch?v=0HOqOcln3Z4&t=530s
# standardization sklearn: https://scikit-
learn.org/stable/modules/generated/sklearn.preprocessing.StandardScaler.html
from sklearn.preprocessing import StandardScaler

quantity_scalar = StandardScaler()
quantity_scalar.fit(project_data['quantity'].values.reshape(-1,1)) # finding the mean and standard
deviation of this data
print(f"Mean : {quantity_scalar.mean_[0]}, Standard deviation :
{np.sqrt(quantity_scalar.var_[0])}")

# Now standardize the data with above maen and variance.
quantity_standardized = quantity_scalar.transform(project_data['quantity'].values.reshape(-1, 1))
```

```
C:\Users\kingsubham27091995\Anaconda3\lib\site-packages\sklearn\utils\validation.py:595:
DataConversionWarning:

Data with input dtype int64 was converted to float64 by StandardScaler.
```

```
Mean : 16.5516, Standard deviation : 25.299880186277562
```

```
C:\Users\kingsubham27091995\Anaconda3\lib\site-packages\sklearn\utils\validation.py:595:
DataConversionWarning:

Data with input dtype int64 was converted to float64 by StandardScaler.
```

In [64]:

```
quantity_standardized
```

Out[64]:

```
array([[ 0.25487868],
       [-0.61469066],
       [ 0.2153528 ],
       ...,
       [ 0.0177234 ],
       [-0.57516478],
       [ 0.7687151 ]])
```

Number of Previosly Proposed Project by Teacher

In [65]:

```
import warnings
warnings.filterwarnings('ignore')
# check this one: https://www.youtube.com/watch?v=0HOqOcln3Z4&t=530s
# standardization sklearn: https://scikit-
learn.org/stable/modules/generated/sklearn.preprocessing.StandardScaler.html
from sklearn.preprocessing import StandardScaler #Column Standardisation

# price_standardized = standardScalar.fit(project_data['price'].values)
# this will rise the error
# ValueError: Expected 2D array, got 1D array instead: array=[725.05 213.03 329.   ... 399.   287.
73   5.5 ].
# Reshape your data either using array.reshape(-1, 1)

prev_posts_scalar = StandardScaler()
```

```
prev_posts_scalar.fit(project_data['teacher_number_of_previously_posted_projects'].values.reshape(
-1,1)) # finding the mean and standard deviation of this data
print(f"Mean : {prev_posts_scalar.mean_[0]}, Standard deviation :
{np.sqrt(prev_posts_scalar.var_[0])}")

# Now standardize the data with above maen and variance.
prev_posts_standardized =
prev_posts_scalar.transform(project_data['teacher_number_of_previously_posted_projects'].values.re
shape(-1, 1))
```

```
Mean : 11.2092, Standard deviation : 27.9321398278041
```

In [66]:

```
prev_posts_standardized
```

Out[66]:

```
array([[-0.40130116],
       [-0.15069379],
       [-0.3655001 ],
       ...,
       [-0.25809695],
       [-0.18649484],
       [-0.22229589]])
```

Title Word Count

In [67]:

```
import warnings
warnings.filterwarnings('ignore')
# check this one: https://www.youtube.com/watch?v=0HOqOcln3Z4&t=530s
# standardization sklearn: https://scikit-
learn.org/stable/modules/generated/sklearn.preprocessing.StandardScaler.html
from sklearn.preprocessing import StandardScaler #Column Standardisation



twc_scalar = StandardScaler()
twc_scalar.fit(project_data['title_word_count'].values.reshape(-1,1)) # finding the mean and
standard deviation of this data
print(f"Mean : {twc_scalar.mean_[0]}, Standard deviation : {np.sqrt(twc_scalar.var_[0])}")

# Now standardize the data with above maen and variance.
twc_standardized =twc_scalar.transform(project_data['title_word_count'].values.reshape(-1, 1))
```

```
Mean : 4.3534, Standard deviation : 1.8019734848215718
```

Essay Word Count

In [68]:

```
import warnings
warnings.filterwarnings('ignore')
# check this one: https://www.youtube.com/watch?v=0HOqOcln3Z4&t=530s
# standardization sklearn: https://scikit-
learn.org/stable/modules/generated/sklearn.preprocessing.StandardScaler.html
from sklearn.preprocessing import StandardScaler #Column Standardisation



ewc_scalar = StandardScaler()
ewc_scalar.fit(project_data['essay_word_count'].values.reshape(-1,1)) # finding the mean and
standard deviation of this data
print(f"Mean : {ewc_scalar.mean_[0]}, Standard deviation : {np.sqrt(ewc_scalar.var_[0])}")

# Now standardize the data with above maen and variance.
ewc_standardized =ewc_scalar.transform(project_data['essay_word_count'].values.reshape(-1, 1))
```

```
Mean : 151.2674, Standard deviation : 38.7450396469019
```

Essay Sentiments- positives

In [69]:

```
import warnings
warnings.filterwarnings('ignore')
# check this one: https://www.youtube.com/watch?v=0HOqOcln3Z4&t=530s
# standardization sklearn: https://scikit-
learn.org/stable/modules/generated/sklearn.preprocessing.StandardScaler.html
from sklearn.preprocessing import StandardScaler #Column Standardisation



pos_scalar = StandardScaler()
pos_scalar.fit(project_data['pos'].values.reshape(-1,1)) # finding the mean and standard deviation
of this data
print(f"Mean : {pos_scalar.mean_[0]}, Standard deviation : {np.sqrt(pos_scalar.var_[0])}")

# Now standardize the data with above maen and variance.
pos_standardized =pos_scalar.transform(project_data['pos'].values.reshape(-1, 1))
```

```
Mean : 0.2681366, Standard deviation : 0.07391284557125372
```

Essay Sentiments - negatives

In [70]:

```
import warnings
warnings.filterwarnings('ignore')
# check this one: https://www.youtube.com/watch?v=0HOqOcln3Z4&t=530s
# standardization sklearn: https://scikit-
learn.org/stable/modules/generated/sklearn.preprocessing.StandardScaler.html
from sklearn.preprocessing import StandardScaler #Column Standardisation



neg_scalar = StandardScaler()
neg_scalar.fit(project_data['neg'].values.reshape(-1,1)) # finding the mean and standard deviation
of this data
print(f"Mean : {neg_scalar.mean_[0]}, Standard deviation : {np.sqrt(neg_scalar.var_[0])}")

# Now standardize the data with above maen and variance.
neg_standardized =neg_scalar.transform(project_data['neg'].values.reshape(-1, 1))
```

```
Mean : 0.044761100000000005, Standard deviation : 0.03280353070616028
```

Essay Sentiments - neutrals

In [71]:

```
import warnings
warnings.filterwarnings('ignore')
# check this one: https://www.youtube.com/watch?v=0HOqOcln3Z4&t=530s
# standardization sklearn: https://scikit-
learn.org/stable/modules/generated/sklearn.preprocessing.StandardScaler.html
from sklearn.preprocessing import StandardScaler #Column Standardisation



neu_scalar = StandardScaler()
neu_scalar.fit(project_data['neu'].values.reshape(-1,1)) # finding the mean and standard deviation
of this data
print(f"Mean : {neu_scalar.mean_[0]}, Standard deviation : {np.sqrt(neu_scalar.var_[0])}")

# Now standardize the data with above maen and variance.
neu_standardized =neu_scalar.transform(project_data['neu'].values.reshape(-1, 1))
```

```
Mean : 0.6871028, Standard deviation : 0.07238793568102353
```

Essay Sentiments - compound

In [72]:

```python
import warnings
warnings.filterwarnings('ignore')
# check this one: https://www.youtube.com/watch?v=0HOqOcln3Z4&t=530s
# standardization sklearn: https://scikit-learn.org/stable/modules/generated/sklearn.preprocessing.StandardScaler.html
from sklearn.preprocessing import StandardScaler #Column Standardisation



com_scalar = StandardScaler()
com_scalar.fit(project_data['compound'].values.reshape(-1,1)) # finding the mean and standard deviation of this data
print(f"Mean : {com_scalar.mean_[0]}, Standard deviation : {np.sqrt(com_scalar.var_[0])}")

# Now standardize the data with above maen and variance.
com_standardized =neu_scalar.transform(project_data['compound'].values.reshape(-1, 1))
```

```
Mean : 0.9621767900000001, Standard deviation : 0.14320419292847503
```

Assignment 10: Clustering

- step 1: Choose any vectorizer (data matrix) that you have worked in any of the assignments, and got the best AUC value.
- step 2: Choose any of the feature selection/reduction algorithms ex: selectkbest features, pretrained word vectors, model based feature selection etc and reduce the number of features to 5k features
- step 3: Apply all three kmeans, Agglomerative clustering, DBSCAN
  - **K-Means Clustering:**
    ● Find the best 'k' using the elbow-knee method (plot k vs inertia_)
  - **Agglomerative Clustering:**
    ● Apply agglomerative algorithm and try a different number of clusters like 2,5 etc.
    ● You can take less data points (as this is very computationally expensive one) to perform hierarchical clustering because they do take a considerable amount of time to run.
  - **DBSCAN Clustering:**
    ● Find the best 'eps' using the elbow-knee method.
    ● You can take a smaller sample size for this as well.
- step 4: Summarize each cluster by manually observing few points from each cluster.
- step 5: You need to plot the word cloud with essay text for each cluster for each of algorithms mentioned in step 3.

2. Clustering

Using TFIDF as Vectorizer

In [73]:

```python
# merge two sparse matrices: https://stackoverflow.com/a/19710648/4084039
from scipy.sparse import hstack

X= hstack((project_grade_category_one_hot, categories_one_hot, sub_categories_one_hot,
school_state_one_hot,teacher_prefix_one_hot, price_standardized,quantity_standardized,
prev_posts_standardized,twc_standardized,ewc_standardized,pos_standardized,neg_standardized,neu_standardized,com_standardized,text_tfidf,title_tfidf))
X.shape
```

Out[73]:

```
(10000, 6991)
```

Feature selection with SelectKBest

In [74]:

```
from sklearn.feature_selection import SelectKBest, chi2

X_new = SelectKBest(chi2, k=6000).fit_transform(abs(X),project_data['project_is_approved'])
```

In [75]:

```
X_new.shape
```

Out[75]:

```
(10000, 6000)
```

Applying K-Means

In [204]:

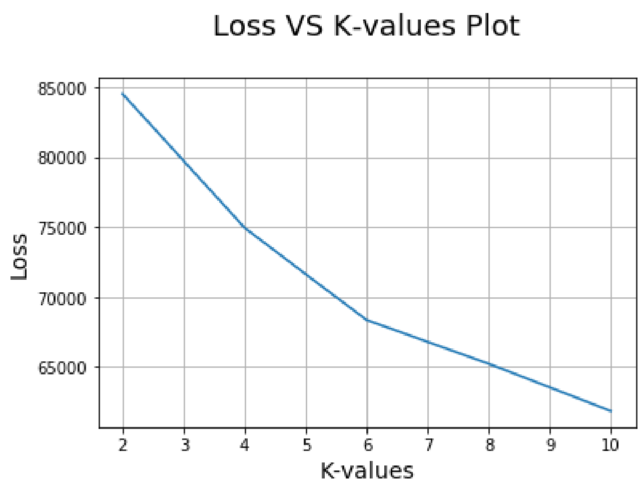
```
from sklearn.cluster import KMeans

k_values = [2,4,5,6,8,10]
loss = []
for i in tqdm(k_values):
    kmeans = KMeans(n_clusters=i, n_jobs=-1).fit(X_new)
    loss.append(kmeans.inertia_)
```

```
100%|██████████████████████████████████████████| 6/6 [36:45<00:00, 378.87s/it]
```

Elbow Method

In [205]:

```
# Draw Loss VS K values plot
plt.plot(k_values, loss)
plt.xlabel('K-values',size=14)
plt.ylabel('Loss',size=14)
plt.title('Loss VS K-values Plot\n',size=18)
plt.grid()
plt.show()
```



Summary :-

- above we can see that there is inflection at K = 5 . Befor it loss was decreasing faster as compared to the loss decreasing after it . So , the best value of K is 5.

In [206]:

```
from sklearn.cluster import KMeans
optimal_k = 5
# Variable that will be used in the conclusion
tfidf_means_k = optimal_k

# Implementing K-Means++ using optimal value of K
kmeans = KMeans(n_clusters=optimal_k, n_jobs=-1).fit(X_new)
```

In [86]:

```
essays = project_data['clean_essays'].values
```

Create Clusters

In [208]:

```
# Getting all the essays in different clusters
cluster1 = []
cluster2 = []
cluster3 = []
cluster4 = []
cluster5 = []

for i in range(kmeans.labels_.shape[0]):
    if kmeans.labels_[i] == 0:
        cluster1.append(essays[i])
    elif kmeans.labels_[i] == 1:
        cluster2.append(essays[i])
    elif kmeans.labels_[i] == 2:
        cluster3.append(essays[i])
    elif kmeans.labels_[i] == 3:
        cluster4.append(essays[i])
    else :
        cluster5.append(essays[i])

# Number of essays in different clusters
print("No. of essays in Cluster-1 : ",len(cluster1))
print("\nNo. of essays in Cluster-2 : ",len(cluster2))
print("\nNo. of essays in Cluster-3 : ",len(cluster3))
print("\nNo. of essays in Cluster-4 : ",len(cluster4))
print("\nNo. of essays in Cluster-5 : ",len(cluster5))
```

```
No. of essays in Cluster-1 :  3840

No. of essays in Cluster-2 :  3731

No. of essays in Cluster-3 :  244

No. of essays in Cluster-4 :  67

No. of essays in Cluster-5 :  2118
```

WordClouds for Cluster 1

In [209]:

```
from nltk import download, FreqDist, WordNetLemmatizer
topWords = []
topWordsCount = []
freqDistribution = FreqDist(str(cluster1).split())
W = [word for word in cluster1 if word not in stopwords]
#Identify the top 500 words
count = 0
for word, value in freqDistribution.most_common():
    if(word in W):
        topWords.append(word)
        topWordsCount.append(value)
        count = count + 1
        if(count == 500):
            break
```

In [210]:

```
freqDistribution
```

Out[210]:

```
FreqDist({'students': 28465, 'i': 10156, 'school': 9345, 'learning': 6140, 'classroom': 5515,
'my': 4964, 'the': 4746, 'they': 4527, 'not': 4507, 'learn': 4476, ...})
```

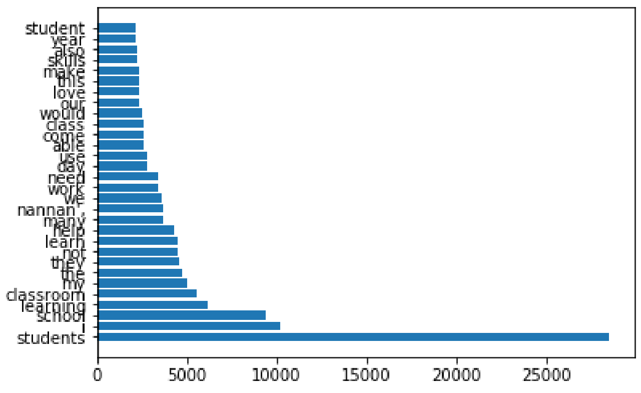
In [211]:

```
mostcommon = freqDistribution.most_common(30)
print(mostcommon)
```

```
[('students', 28465), ('i', 10156), ('school', 9345), ('learning', 6140), ('classroom', 5515),
('my', 4964), ('the', 4746), ('they', 4527), ('not', 4507), ('learn', 4476), ('help', 4333), ('man
y', 3700), ("nannan',", 3669), ('we', 3605), ('work', 3388), ('need', 3385), ('day', 2777), ('use'
, 2731), ('able', 2635), ('come', 2616), ('class', 2575), ('would', 2461), ('our', 2336), ('love',
2321), ('this', 2295), ('make', 2285), ('skills', 2248), ('also', 2221), ('year', 2184), ('student
', 2147)]
```

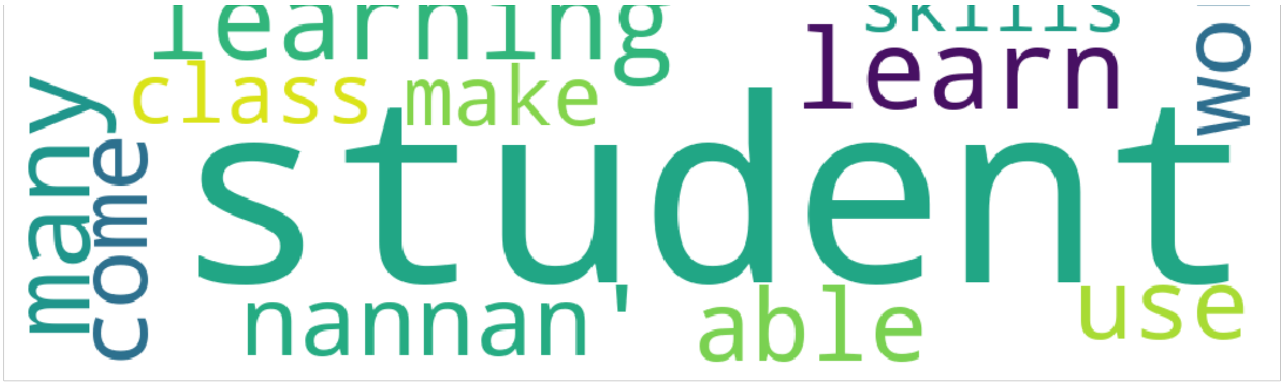
In [212]:

```
plt.barh(range(len(mostcommon)),[val[1] for val in mostcommon], align='center')
plt.yticks(range(len(mostcommon)), [val[0] for val in mostcommon])
plt.show()
```



In [213]:

```
from wordcloud import WordCloud
#convert list to string and generate
unique_string=(" ").join(val[0] for val in mostcommon)
wordcloud = WordCloud(width = 1000, height = 500, background_color ='white').generate(unique_string
)
plt.figure(figsize=(25,10))
plt.imshow(wordcloud)
plt.axis("off")
plt.savefig("Word_Cloud_tfidf"+".png", bbox_inches='tight')
plt.show()
plt.close()
```



WordClouds for Cluster 2

In [214]:

```
topWords = []
topWordsCount = []
freqDistribution = FreqDist(str(cluster2).split())
W = [word for word in cluster2 if word not in stopwords]
#Identify the top 500 words
count = 0
for word, value in freqDistribution.most_common():
    if(word in W):
        topWords.append(word)
        topWordsCount.append(value)
        count = count + 1
        if(count == 500):
            break
```

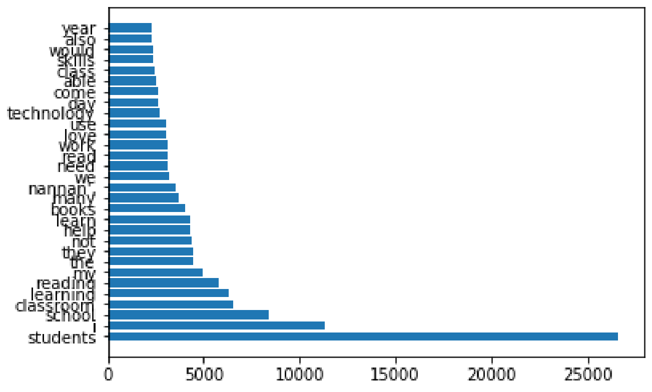
In [215]:

```
mostcommon = freqDistribution.most_common(30)
print(mostcommon)
```

```
[('students', 26665), ('i', 11337), ('school', 8421), ('classroom', 6586), ('learning', 6275),
('reading', 5811), ('my', 5009), ('the', 4471), ('they', 4455), ('not', 4421), ('help', 4328), ('l
earn', 4295), ('books', 4051), ('many', 3708), ("nannan',", 3567), ('we', 3207), ('need', 3138), (
'read', 3121), ('work', 3094), ('love', 3068), ('use', 3049), ('technology', 2734), ('day', 2650),
('come', 2639), ('able', 2578), ('class', 2447), ('skills', 2390), ('would', 2381), ('also', 2308)
, ('year', 2252)]
```

In [216]:

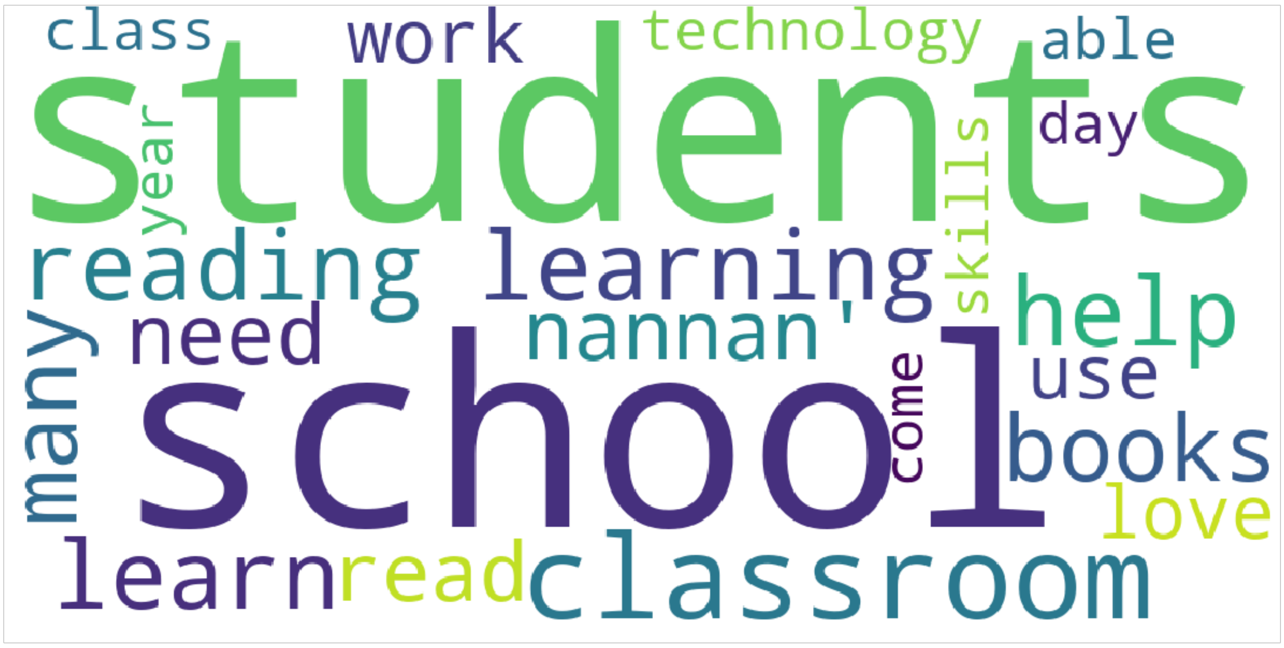
```
plt.barh(range(len(mostcommon)),[val[1] for val in mostcommon], align='center')
plt.yticks(range(len(mostcommon)), [val[0] for val in mostcommon])
plt.show()
```



In [217]:

```
from wordcloud import WordCloud
```

```
#convert list to string and generate
unique_string=(" ").join(val[0] for val in mostcommon)
wordcloud = WordCloud(width = 1000, height = 500, background_color ='white').generate(unique_string
)
plt.figure(figsize=(25,10))
plt.imshow(wordcloud)
plt.axis("off")
plt.savefig("Word_Cloud_tfidf"+".png", bbox_inches='tight')
plt.show()
plt.close()
```



Reading an essay from a cluster

In [218]:

```
count=1
for i in range(3):
    print('Essay-%d : \n %s\n'%(count,cluster1[i]))
    count +=1
```

```
Essay-1 :
 our students arrive school eager learn they polite generous strive best they know education succe
ed life help improve lives our school focuses families low incomes tries give student education de
serve while not much students use materials given best the projector need school crucial academic
improvement students as technology continues grow many resources internet teachers use growth stud
ents however school limited resources particularly technology without disadvantage one things coul
d really help classrooms projector with projector not crucial instruction also growth students wit
h projector show presentations documentaries photos historical land sites math problems much with
projector make teaching learning easier also targeting different types learners classrooms auditor
y visual kinesthetic etc nannan

Essay-2 :
 true champions not always ones win guts by mia hamm this quote best describes students cholla mid
dle school approach playing sports especially girls boys soccer teams the teams made 7th 8th grade
students not opportunity play organized sport due family financial difficulties i teach title one
middle school urban neighborhood 74 students qualify free reduced lunch many come activity sport o
pportunity poor homes my students love participate sports learn new skills apart team atmosphere m
y school lacks funding meet students needs i concerned lack exposure not prepare participating spo
rts teams high school by end school year goal provide students opportunity learn variety soccer sk
ills positive qualities person actively participates team the students campus come school knowing
face uphill battle comes participating organized sports the players would thrive field confidence
appropriate soccer equipment play soccer best abilities the students experience helpful person par
t team teaches positive supportive encouraging others my students using soccer equipment practice
games daily basis learn practice necessary skills develop strong soccer team this experience
create opportunity students learn part team positive contribution teammates the students get oppor
tunity learn practice variety soccer skills use skills game access type experience nearly
impossible without soccer equipment students players utilize practice games nannan
```

```
Essay-3 :
 not students struggle poverty also learning master english language minority students represent 3
5 student population regardless background socioeconomic status students deserve high quality
education these children future these students eager learn filled excitement opportunity use techn
ology classroom however almost 650 students attending school 4 ipad carts entire building not get
much exposure need as educator vital i try help become apart 21 century digital age these ipads al
low my students need 4 ipads latest technology classroom a long time ago used paper pencils
teaching students that time passed in 21st century students need latest technology stay ahead my s
tudents fully engaged use technology hear pin drop room ipads make simplest tasks fun for example
instead worksheets use interactive apps practice math skills the mobility ipad also important stud
ents using around classroom sometimes areas school i requesting 4 ipads use classroom my students
use listen digital books assignments study island study jams interactive sites please help fund pr
oject when get opportunity use ipad cart school i noticed beneficial student learning not donating
project help students also help future nannan
```

In [219]:

```python
count=1
for i in range(3):
    print('Essay-%d : \n %s\n'%(count,cluster2[i]))
    count +=1
```

```
Essay-1 :
 i work unique school filled esl english second language high poverty students our students indivi
dual personal struggles would break heart step doors would not notice anything positive resilient
attitude learning my students love support every aspect learning journey we students all world spe
aking 77 different languages like family every student welcomed open arms regardless come language
speak education love universal language classroom plenty my students live high poverty conditions
limited no access technology ipads provide opportunity learn playing reading math games engage
inspire these ipads surely hottest commodity classroom students beg get play educational games i t
racking data ipad several educational programs help differentiate learning student students also a
ble track progress programs i look forward seeing students grow use ipads nannan

Essay-2 :
 i moving 2nd grade 3rd grade beginning next school year i takings current students move i teach i
nclusion classroom includes students adhd sld well autistic students my students work hard achievi
ng goals no matter struggles may the school i teach houses great deal autistic students well ell s
tudents my student love read work challenge they also love move around they work better able move
room different areas rather usual set these flexible seating options allow students different seat
ing options instead sitting traditional desk chair able use flexible seating tools reduce stress a
nxiety these tools beneficial students special needs also students it proven fact students moving
oxygen going brain means learning taking place these flexible seating options allow students move
traditional seat allows reduce stress classroom this project significantly help students reduce st
ress anxiety standardized testing the students 3rd grade required take state mandated test this pu
ts great deal stress students perform well test if students able work throughout year less
stressful classroom assistance flexible seating obtain skills needed successful standardized test
nannan

Essay-3 :
 my students dynamic energetic group middle schoolers they also generally come low socioeconomic b
ackground result often not access supplies opportunities middle schoolers state i seen excitement
master new skill previously unable accomplish they love using technology respond well computer
based programs they deserving kids need opportunities succeed my students engaging active group ki
ds struggle basic reading writing they daily use well researched reading program called read 180 t
his program necessitates daily computer work while school computer lab not adequate number compute
rs run read 180 reading program in addition many computers shared rest school not always access ne
ed we also need additional computers continual influx new special education students the computers
would also used weekly math practice well class research nannan
```

In [220]:

```python
count=1
for i in range(3):
    print('Essay-%d : \n %s\n'%(count,cluster3[i]))
    count +=1
```

```
Essay-1 :
 my students awesome they creative excited learning i privileged teach music rural public school s
erving 900 students grades kindergarten 4th including special group children facing severe physica
l mental disabilities in school high poverty i strive daily provide equitable music experience
students this experience includes exposing students new instruments musical cultures music history
```

```
music expression self because many students lack funding physical ability travel unique musical se
ttings i strive bring creative musical world classroom i want see students get healthier teaching
students means american teaching folk songs step down african american traditions american folk so
ngs children anna banana 101 jump rope well types folk songs games jumping rope dancing we jumping
rope songs like sheep meadow dancing songs like little sally water playing games songs this
incorporates history well music i think lots fun students well we get moving still learning nannan

Essay-2 :
 aloha na keiki hawai our classroom cheer sums you love preschool my preschool special education c
lass provides early intervention services qualifying special needs children ages 3 5 years we grou
p actively involved teachers therapists children working together hands learning environment my sc
hool located predominantly rural low income neighborhood considerable portion children hawaiian pa
cific island ancestry playground balls get much work kids bounce roll kick throw after several yea
rs literally hitting rough pavement not holding two balls temporarily hold enough air bounce we ne
ed balls everyone play nets make easy carry my students love bubbles blowing chasing drift across
playground it great fun awesome workout best everyone participates but like bubbles chase bubble j
uice not last we need refill i also want surprise students variety wand shapes experiment birthday
s big little bunch we bake cupcakes make cards birthday buddy i discovered terrific books birthday
themes include celebrations we need birthday books read nannan

Essay-3 :
 what time how much longer lunch this daily question asked classroom the students inner city schoo
l immigrant parents low socio economic status parents often work two jobs students often latchkey
kids watched grandparents they english language learners we title i school all students qualify fr
ee meal program research shows fulfilling basic life essential needs clean clothes enough eat help
child succeed school i want students basic needs met i requesting life essentials students the wea
ther changed the rainy season cold season coming upon us combined fact upcoming season may also ab
normally harsher students need life essentials protected exit classroom homes ultimately hoodie ne
w shirt umbrella rain boots bring happiness health deserving individuals donations project improve
well student class with every child possession shirt hoodie umbrella rain boot learning classroom
made easier students primary needs even closer met it evident no child sent school without life es
sentials not help children focus also aid maintaining overall health i hope project support premis
e nannan
```

In [221]:

```python
count=1
for i in range(3):
    print('Essay-%d : \n %s\n'%(count,cluster4[i]))
    count +=1
```

```
Essay-1 :
 my students sixths graders public middle school los angeles the majority students come economical
ly disadvantaged households they face many barriers comes equal access including lack access
technology homes community we unique school incorporates performing arts curricular areas we dance
sing math science our classroom old much furniture broken falling apart i requesting 36 sturdy cha
irs students use daily our current chairs big tables falling apart students uncomfortable even get
hurt our classroom needs flexible far groupings new chairs would make much easier we performing ar
ts school incorporate dance curricular areas these stackable chairs allow us make space movement m
ath science class your donation help make classroom flexible active learning environment the new c
hairs increase peer peer interaction collaboration nannan

Essay-2 :
 my students often borrow calculators class time i not enough loan class i requesting money
purchase class set 10 100 a matched donation would get students approximately 20 calculators use l
earning topics beyond arithmetic my goal algebra algebra prep class not get bogged arithmetic defi
ciencies rather calculators allows reach higher elementary deficiencies otherwise would let these
students families typically not afford purchase calculators my students often not able purchase ca
lculator needed move class beyond arithmetic these students need assistance arithmetic make
algebra topics reachable reasonable i make calculators available period student needs tool i ask c
ollateral remember return obviously get collateral back returning calculator i find students less
intimidated advanced mathematics topics tool available make arithmetic non issue less stress means
learning nannan

Essay-3 :
 our school located hendersonville nc we title i school majority students living poverty we highes
t poverty rate elementary schools county despite circumstances students positive live stephen
covey leader in me habits they worked hard help make us light house school we one five light house
schools state one western north carolina students work hard given limited resources provided the a
mount copies make school limited i need able provide students homework items interactive notebooks
passages practice word problems students mark our school following max thompson teaching program h
e says every day students reading extended passages answering questions related they need paper co
py may able mark paper notes read go back passage prove answers questions students given
opportunity practice successful nannan
```

In [222]:

```
count=1
for i in range(3):
    print('Essay-%d : \n %s\n'%(count,cluster5[i]))
    count +=1
```

```
Essay-1 :
 my students english learners working english second third languages we melting pot refugees immig
rants native born americans bringing gift language school we 24 languages represented english lear
ner program students every level mastery we also 40 countries represented families within school e
ach student brings wealth knowledge experiences us open eyes new cultures beliefs respect the limi
ts language limits world ludwig wittgenstein our english learner strong support system home begs r
esources many times parents learning read speak english along side children sometimes creates
barriers parents able help child learn phonetics letter recognition reading skills by providing dv
d players students able continue mastery english language even no one home able assist all familie
s students within level 1 proficiency status offered part program these educational videos
specially chosen english learner teacher sent home regularly watch the videos help child develop e
arly reading skills parents not access dvd player opportunity check dvd player use year the plan u
se videos educational dvd years come el students nannan

Essay-2 :
 our second grade classroom next year made around 25 kids many coming spanish speaking families ma
ny receive free reduced priced lunch these inquisitive students often not many educational
resources home need these kids curious world excited learn ready find education offer i excited
teach push meet exceed expectations for many students math subject not pertain life subject stress
es i believe making math not fun also important lives a typical part day calendar math section tim
e talk calendar weather properties day these calendar math journals allow student accountable lear
ning it help paying attention involved time students also expected know count 1 120 understand num
bers these charts important resource different math tasks also provide simple task early finishers
ie fill charts done assignment nannan

Essay-3 :
 my students special come variety backgrounds i several english language learners classroom well f
our students receiving special education services i 7 students adhd really benefit technological l
earning we live rural community several families not computer access technology they yearn learn c
lassroom extremely difficult get books hands my students enjoy learning computer student created b
logs adpative learning experiences performance tasks differentiated grade level articles
manipulated highlighting annotating text classroom chromebookcar my name shanlee meyers i 3rd
grade teacher rural nevada i attempting raise money purchase 30 chromebooks laptop charging cart c
lassroom our school encourages use technology classroom yet not adequate funding provide
appropriate 21st century resources classrooms instead waiting several years happen i taking
initiative make it happen assistance at school 500 students makes difficult teach technology one c
hromebook cart shared students chromebooks cost effective efficient resource use classroom they gi
ve instant access internet online apps google google docs google slides etc many lessons assessmen
ts could enriched use tool classroom students would learning valuable skills navigating internet r
esearch based activities publishing pieces writing practicing typing skills completing
differentiated lessons additional information chomebooks enhance student learning provided article
scholastic http www scholastic com teachers article chromebooks classroom your support fund chrome
books my goal raise money beginning 2017 18 school year not earlier use school year in society cen
tered around use technology access technology daily basis enable students learn way textbook not d
eliver just consider your job without access computer internet today student job learn order job e
ffectively must appropriate tools nannan
```

AGGLOMERATIVE CLUSTERING

Hierarchical Clustering with 2 clusters

In [223]:

```
from sklearn.cluster import AgglomerativeClustering
model = AgglomerativeClustering(n_clusters=2).fit(X_new.toarray())

# Getting all the ESSAYS in dif3ferent clusters
cluster1 = []
cluster2 = []

for i in tqdm(range(model.labels_.shape[0])):
    if model.labels_[i] == 0:
        cluster1.append(essays[i])
    else :
        cluster2.append(essays[i])

# Number of essays in different clusters
print("No. of reviews in Cluster-1 : ",len(cluster1))
print("\nNo. of reviews in Cluster-2 : ",len(cluster2))
```

```
100%|████████████████████████████████| 10000/10000 [00:00<00:00, 265766.73it/s]
```

```
No. of reviews in Cluster-1 :  9933

No. of reviews in Cluster-2 :  67
```

WordCloud for Cluster 1

In [224]:

```
topWords = []
topWordsCount = []
freqDistribution = FreqDist(str(cluster1).split())
W = [word for word in cluster1 if word not in stopwords]
#Identify the top 500 words
count = 0
for word, value in freqDistribution.most_common():
    if(word in W):
        topWords.append(word)
        topWordsCount.append(value)
        count = count + 1
        if(count == 500):
            break
```

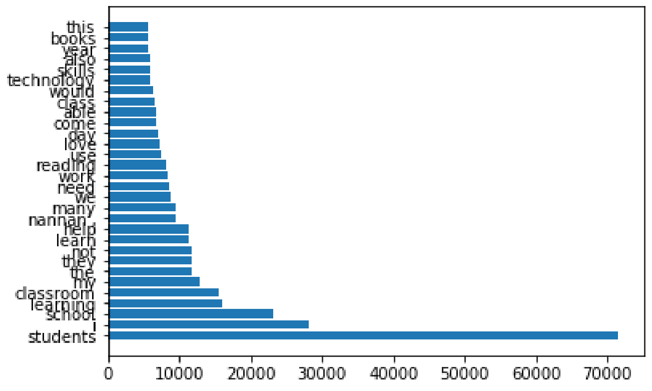
In [225]:

```
mostcommon = freqDistribution.most_common(30)
print(mostcommon)
```

```
[('students', 71585), ('i', 28237), ('school', 23285), ('learning', 15948), ('classroom', 15560),
('my', 12987), ('the', 11873), ('they', 11764), ('not', 11692), ('learn', 11399), ('help', 11277),
("nannan',", 9503), ('many', 9496), ('we', 8891), ('need', 8528), ('work', 8370), ('reading', 8156
), ('use', 7612), ('love', 7213), ('day', 7014), ('come', 6793), ('able', 6744), ('class', 6525),
('would', 6298), ('technology', 5996), ('skills', 5902), ('also', 5825), ('year', 5784), ('books',
5751), ('this', 5696)]
```

In [226]:

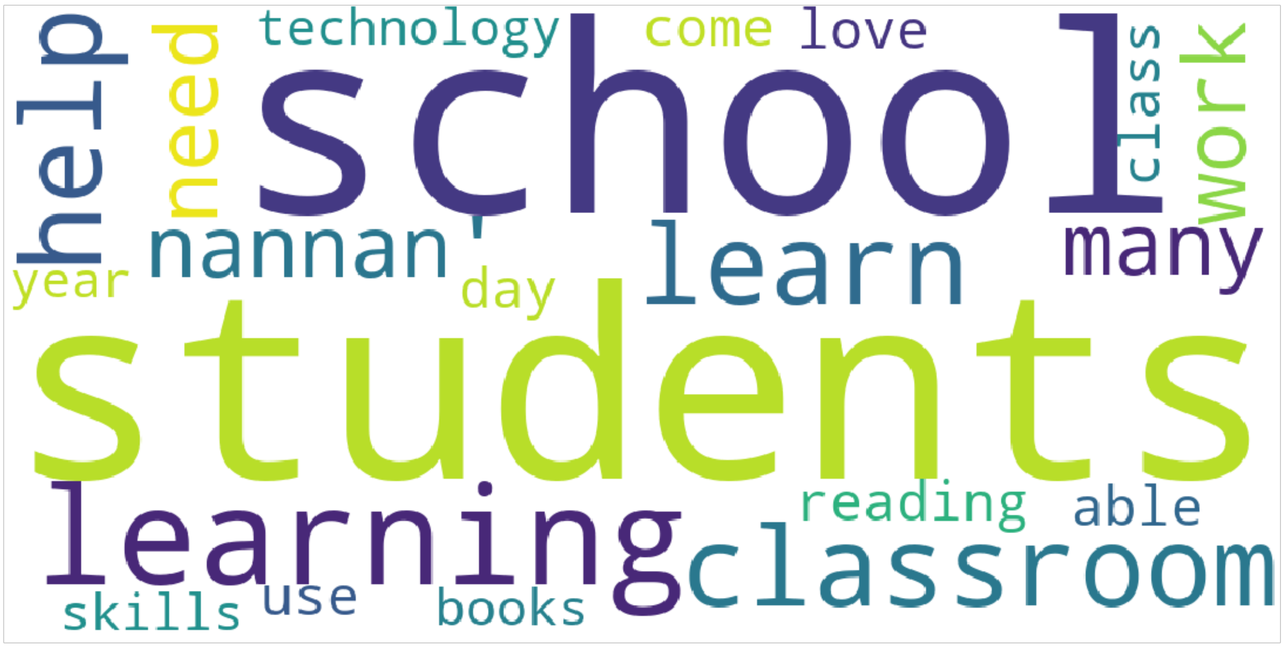
```
plt.barh(range(len(mostcommon)),[val[1] for val in mostcommon], align='center')
plt.yticks(range(len(mostcommon)), [val[0] for val in mostcommon])
plt.show()
```



In [227]:

```
from wordcloud import WordCloud
```

```
#convert list to string and generate
unique_string=(" ").join(val[0] for val in mostcommon)
wordcloud = WordCloud(width = 1000, height = 500, background_color ='white').generate(unique_string
)
plt.figure(figsize=(25,10))
plt.imshow(wordcloud)
plt.axis("off")
plt.savefig("Word_Cloud_tfidf"+".png", bbox_inches='tight')
plt.show()
plt.close()
```



WordCloud for Cluster 2

In [228]:

```
topWords = []
topWordsCount = []
freqDistribution = FreqDist(str(cluster2).split())
W = [word for word in cluster2 if word not in stopwords]
#Identify the top 500 words
count = 0
for word, value in freqDistribution.most_common():
    if(word in W):
        topWords.append(word)
        topWordsCount.append(value)
        count = count + 1
        if(count == 500):
            break
```

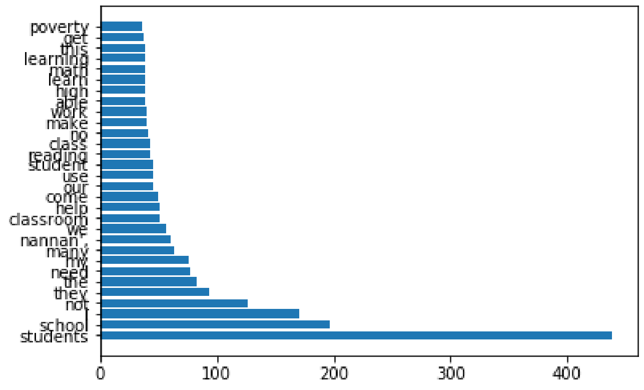
In [229]:

```
mostcommon = freqDistribution.most_common(30)
print(mostcommon)
```

```
[('students', 438), ('school', 196), ('i', 170), ('not', 127), ('they', 94), ('the', 82), ('need',
77), ('my', 76), ('many', 63), ("nannan',", 61), ('we', 56), ('classroom', 51), ('help', 51), ('co
me', 49), ('our', 46), ('use', 45), ('student', 45), ('reading', 43), ('class', 42), ('no', 41), (
'make', 40), ('work', 40), ('able', 39), ('high', 39), ('learn', 39), ('math', 38), ('learning', 3
8), ('this', 38), ('get', 37), ('poverty', 36)]
```

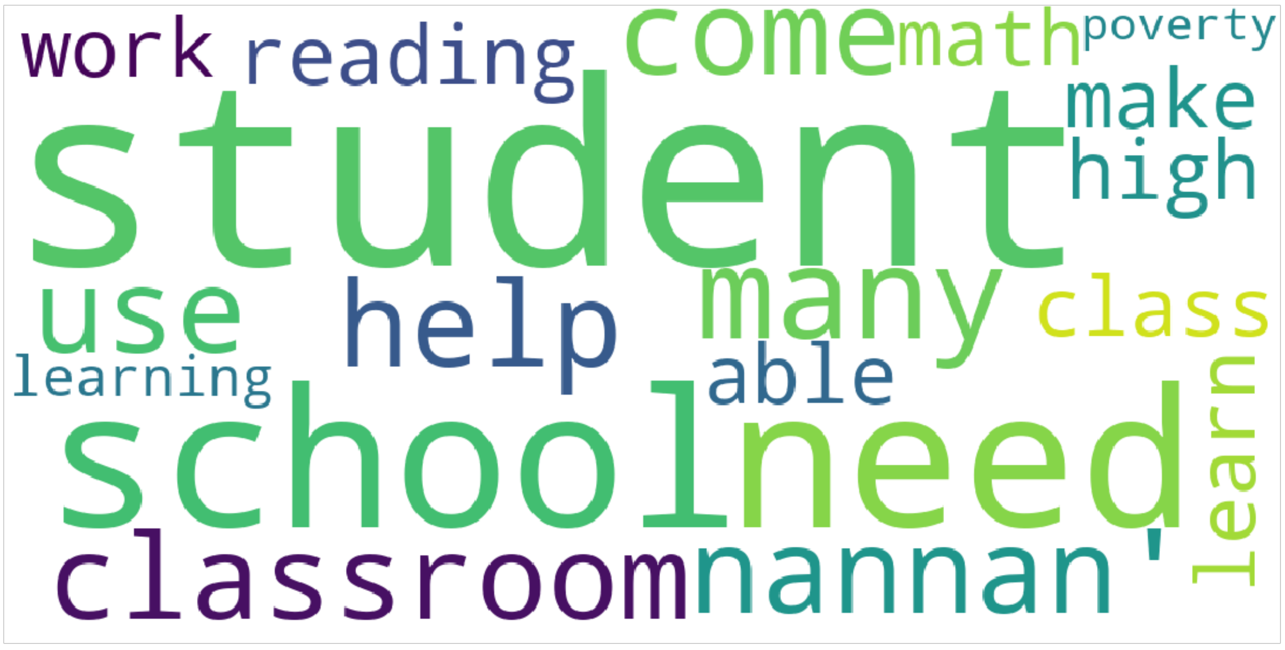
In [230]:

```
plt.barh(range(len(mostcommon)),[val[1] for val in mostcommon], align='center')
plt.yticks(range(len(mostcommon)), [val[0] for val in mostcommon])
plt.show()
```



In [231]:

```
from wordcloud import WordCloud
#convert list to string and generate
unique_string=(" ").join(val[0] for val in mostcommon)
wordcloud = WordCloud(width = 1000, height = 500, background_color ='white').generate(unique_string
)
plt.figure(figsize=(25,10))
plt.imshow(wordcloud)
plt.axis("off")
plt.savefig("Word_Cloud_tfidf"+".png", bbox_inches='tight')
plt.show()
plt.close()
```



Reading essays from a cluster

In [232]:

```
## Cluster 1
count=1
for i in range(3):
    if i < len(cluster1):
        print('Essay-%d : \n %s\n'%(count,cluster1[i]))
        count +=1
```

```
Essay-1 :
 my students english learners working english second third languages we melting pot refugees immig
rants native born americans bringing gift language school we 24 languages represented english lear
ner program students every level mastery we also 40 countries represented families within school e
```

```
ach student brings wealth knowledge experiences us open eyes new cultures beliefs respect the limi
ts language limits world ludwig wittgenstein our english learner strong support system home begs r
esources many times parents learning read speak english along side children sometimes creates
barriers parents able help child learn phonetics letter recognition reading skills by providing dv
d players students able continue mastery english language even no one home able assist all familie
s students within level 1 proficiency status offered part program these educational videos
specially chosen english learner teacher sent home regularly watch the videos help child develop e
arly reading skills parents not access dvd player opportunity check dvd player use year the plan u
se videos educational dvd years come el students nannan

Essay-2 :
 our students arrive school eager learn they polite generous strive best they know education succe
ed life help improve lives our school focuses families low incomes tries give student education de
serve while not much students use materials given best the projector need school crucial academic
improvement students as technology continues grow many resources internet teachers use growth stud
ents however school limited resources particularly technology without disadvantage one things coul
d really help classrooms projector with projector not crucial instruction also growth students wit
h projector show presentations documentaries photos historical land sites math problems much with
projector make teaching learning easier also targeting different types learners classrooms auditor
y visual kinesthetic etc nannan

Essay-3 :
 true champions not always ones win guts by mia hamm this quote best describes students cholla mid
dle school approach playing sports especially girls boys soccer teams the teams made 7th 8th grade
students not opportunity play organized sport due family financial difficulties i teach title one
middle school urban neighborhood 74 students qualify free reduced lunch many come activity sport o
pportunity poor homes my students love participate sports learn new skills apart team atmosphere m
y school lacks funding meet students needs i concerned lack exposure not prepare participating spo
rts teams high school by end school year goal provide students opportunity learn variety soccer sk
ills positive qualities person actively participates team the students campus come school knowing
face uphill battle comes participating organized sports the players would thrive field confidence
appropriate soccer equipment play soccer best abilities the students experience helpful person par
t team teaches positive supportive encouraging others my students using soccer equipment practice
games daily basis learn practice necessary skills develop strong soccer team this experience
create opportunity students learn part team positive contribution teammates the students get oppor
tunity learn practice variety soccer skills use skills game access type experience nearly
impossible without soccer equipment students players utilize practice games nannan
```

In [233]:

```python
## Cluster 2
count=1
for i in range(3):
    if i < len(cluster2):
        print('Essay-%d : \n %s\n'%(count,cluster2[i]))
        count +=1
```

```
Essay-1 :
 my students sixths graders public middle school los angeles the majority students come economical
ly disadvantaged households they face many barriers comes equal access including lack access
technology homes community we unique school incorporates performing arts curricular areas we dance
sing math science our classroom old much furniture broken falling apart i requesting 36 sturdy cha
irs students use daily our current chairs big tables falling apart students uncomfortable even get
hurt our classroom needs flexible far groupings new chairs would make much easier we performing ar
ts school incorporate dance curricular areas these stackable chairs allow us make space movement m
ath science class your donation help make classroom flexible active learning environment the new c
hairs increase peer peer interaction collaboration nannan

Essay-2 :
 my students often borrow calculators class time i not enough loan class i requesting money
purchase class set 10 100 a matched donation would get students approximately 20 calculators use l
earning topics beyond arithmetic my goal algebra algebra prep class not get bogged arithmetic defi
ciencies rather calculators allows reach higher elementary deficiencies otherwise would let these
students families typically not afford purchase calculators my students often not able purchase ca
lculator needed move class beyond arithmetic these students need assistance arithmetic make
algebra topics reachable reasonable i make calculators available period student needs tool i ask c
ollateral remember return obviously get collateral back returning calculator i find students less
intimidated advanced mathematics topics tool available make arithmetic non issue less stress means
learning nannan

Essay-3 :
 our school located hendersonville nc we title i school majority students living poverty we highes
t poverty rate elementary schools county despite circumstances students positive live stephen
covey leader in me habits they worked hard help make us light house school we one five light house
schools state one western north carolina students work hard given limited resources provided the a
schools state the western north carolina students work hard given limited resources provided the a
mount copies make school limited i need able provide students homework items interactive notebooks
passages practice word problems students mark our school following max thompson teaching program h
e says every day students reading extended passages answering questions related they need paper co
py may able mark paper notes read go back passage prove answers questions students given
opportunity practice successful nannan
```

Hierarchical Clustering with 5 clusters

In [234]:

```
model = AgglomerativeClustering(n_clusters=5).fit(X_new.toarray())

cluster1 = []
cluster2 = []
cluster3 = []
cluster4 = []
cluster5 = []

for i in range(model.labels_.shape[0]):
    if model.labels_[i] == 0:
        cluster1.append(essays[i])
    elif model.labels_[i] == 1:
        cluster2.append(essays[i])
    elif model.labels_[i] == 2:
        cluster3.append(essays[i])
    elif model.labels_[i] == 3:
        cluster4.append(essays[i])
    else :
        cluster5.append(essays[i])

# Number of essays in different clusters
print("No. of essays in Cluster-1 : ",len(cluster1))
print("\nNo. of essays in Cluster-2 : ",len(cluster2))
print("\nNo. of essays in Cluster-3 : ",len(cluster3))
print("\nNo. of essays in Cluster-4 : ",len(cluster4))
print("\nNo. of essays in Cluster-5 : ",len(cluster5))
```

```
No. of essays in Cluster-1 :  7404

No. of essays in Cluster-2 :  2306

No. of essays in Cluster-3 :  213

No. of essays in Cluster-4 :  10

No. of essays in Cluster-5 :  67
```

WordCloud for Cluster 1

In [235]:

```
topWords = []
topWordsCount = []
freqDistribution = FreqDist(str(cluster1).split())
W = [word for word in cluster1 if word not in stopwords]
#Identify the top 500 words
count = 0
for word, value in freqDistribution.most_common():
    if(word in W):
        topWords.append(word)
        topWordsCount.append(value)
        count = count + 1
        if(count == 500):
            break
```

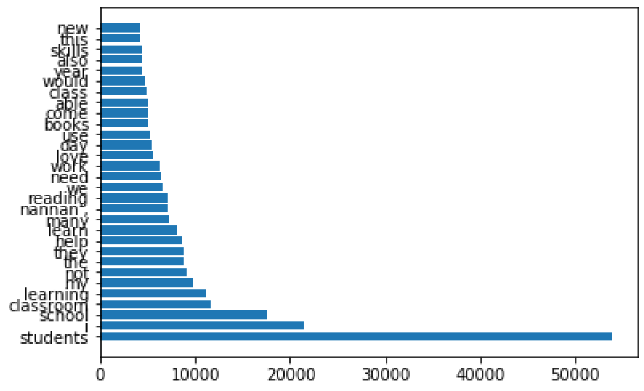
In [236]:

```
mostcommon = freqDistribution.most_common(30)
print(mostcommon)
```

```
[('students', 53801), ('i', 21418), ('school', 17639), ('classroom', 11580), ('learning', 11189),
('my', 9817), ('not', 9100), ('the', 8843), ('they', 8723), ('help', 8547), ('learn', 8160), ('man
y', 7201), ("nannan',", 7083), ('reading', 7030), ('we', 6539), ('need', 6454), ('work', 6236), ('
love', 5521), ('day', 5389), ('use', 5261), ('books', 5094), ('come', 5083), ('able', 4995), ('cla
ss', 4927), ('would', 4696), ('year', 4419), ('also', 4378), ('skills', 4355), ('this', 4271), ('n
ew', 4192)]
```

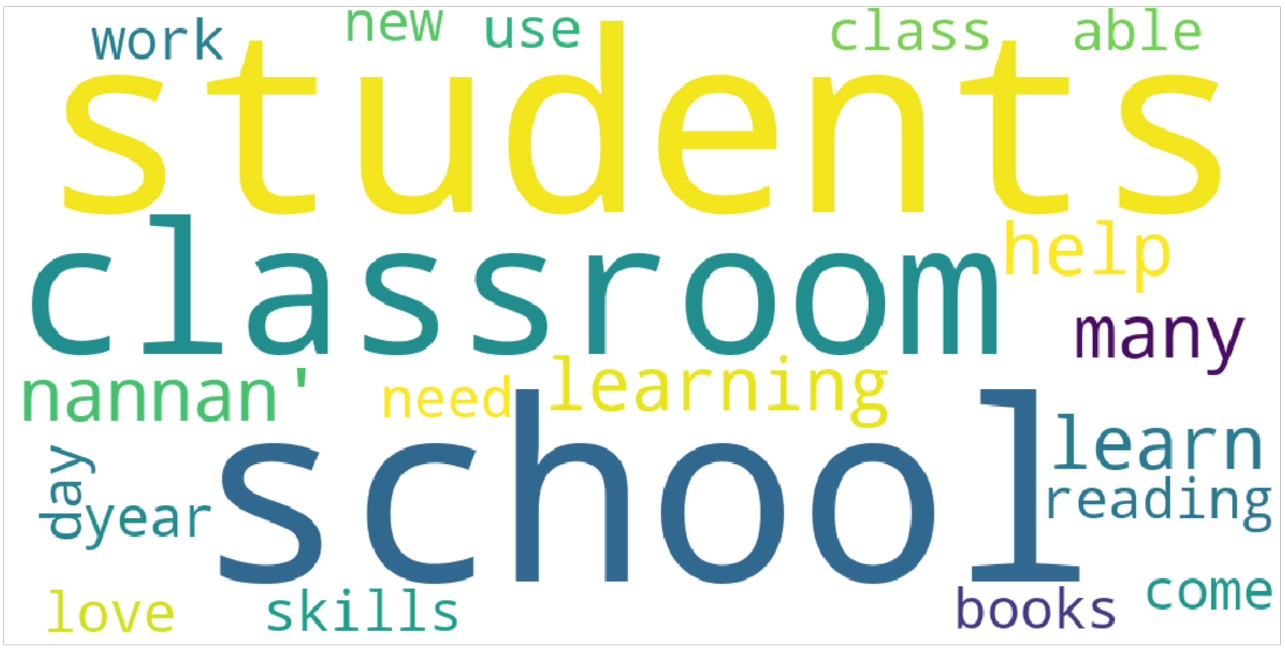
In [237]:

```python
plt.barh(range(len(mostcommon)),[val[1] for val in mostcommon], align='center')
plt.yticks(range(len(mostcommon)), [val[0] for val in mostcommon])
plt.show()
```



In [238]:

```python
from wordcloud import WordCloud
#convert list to string and generate
unique_string=(" ").join(val[0] for val in mostcommon)
wordcloud = WordCloud(width = 1000, height = 500, background_color ='white').generate(unique_string
)
plt.figure(figsize=(25,10))
plt.imshow(wordcloud)
plt.axis("off")
plt.savefig("Word_Cloud_tfidf"+".png", bbox_inches='tight')
plt.show()
plt.close()
```



WordCloud for Cluster 2

In [239]:

```
topWords = []
topWordsCount = []
freqDistribution = FreqDist(str(cluster2).split())
W = [word for word in cluster2 if word not in stopwords]
#Identify the top 500 words
count = 0
for word, value in freqDistribution.most_common():
    if(word in W):
        topWords.append(word)
        topWordsCount.append(value)
        count = count + 1
        if(count == 500):
            break
```

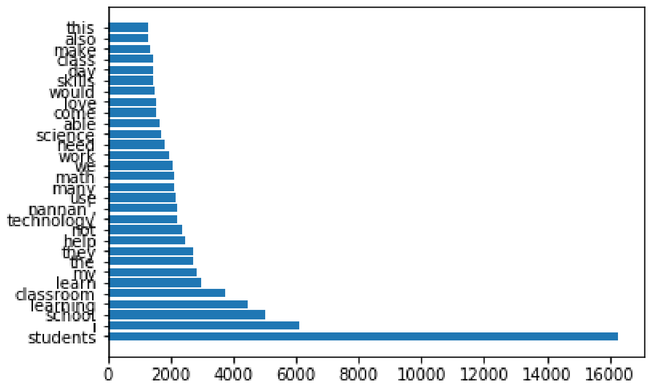
In [240]:

```
mostcommon = freqDistribution.most_common(30)
print(mostcommon)
```

```
[('students', 16295), ('i', 6119), ('school', 5055), ('learning', 4473), ('classroom', 3752),
('learn', 2990), ('my', 2838), ('the', 2743), ('they', 2725), ('help', 2487), ('not', 2369), ('tec
hnology', 2213), ("nannan',", 2203), ('use', 2186), ('many', 2111), ('math', 2104), ('we', 2079),
('work', 1957), ('need', 1826), ('science', 1729), ('able', 1634), ('come', 1578), ('love', 1542),
('would', 1480), ('skills', 1466), ('day', 1461), ('class', 1449), ('make', 1327), ('also', 1324),
('this', 1282)]
```

In [241]:

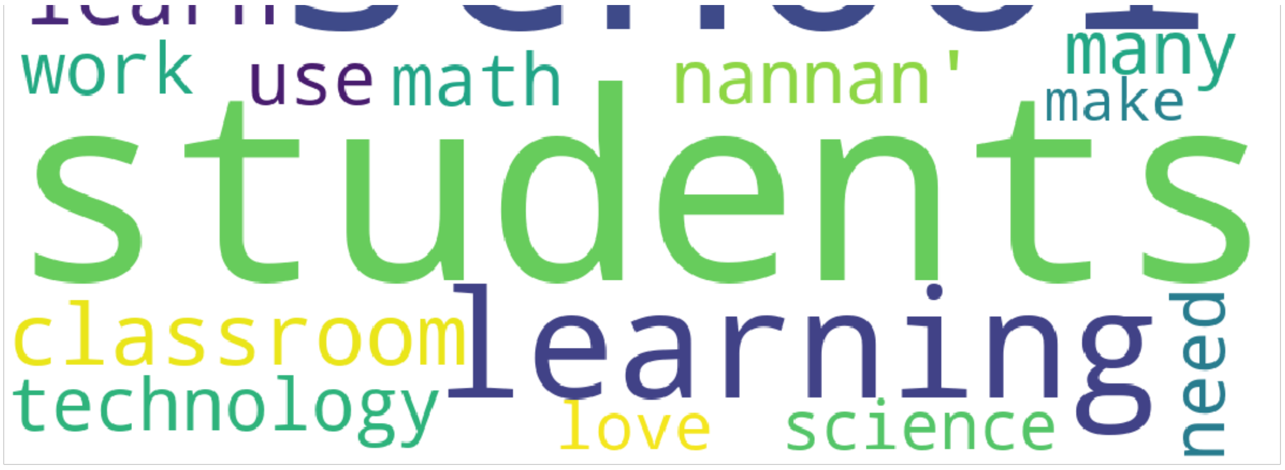
```
plt.barh(range(len(mostcommon)),[val[1] for val in mostcommon], align='center')
plt.yticks(range(len(mostcommon)), [val[0] for val in mostcommon])
plt.show()
```



In [242]:

```
from wordcloud import WordCloud
#convert list to string and generate
unique_string=(" ").join(val[0] for val in mostcommon)
wordcloud = WordCloud(width = 1000, height = 500, background_color ='white').generate(unique_string
)
plt.figure(figsize=(25,10))
plt.imshow(wordcloud)
plt.axis("off")
plt.savefig("Word_Cloud_tfidf"+".png", bbox_inches='tight')
plt.show()
plt.close()
```

help
class
skills
day
learn
school
come
able



WordCloud for Cluster 3

In [243]:

```
topWords = []
topWordsCount = []
freqDistribution = FreqDist(str(cluster3).split())
W = [word for word in cluster3 if word not in stopwords]
#Identify the top 500 words
count = 0
for word, value in freqDistribution.most_common():
    if(word in W):
        topWords.append(word)
        topWordsCount.append(value)
        count = count + 1
        if(count == 500):
            break
```

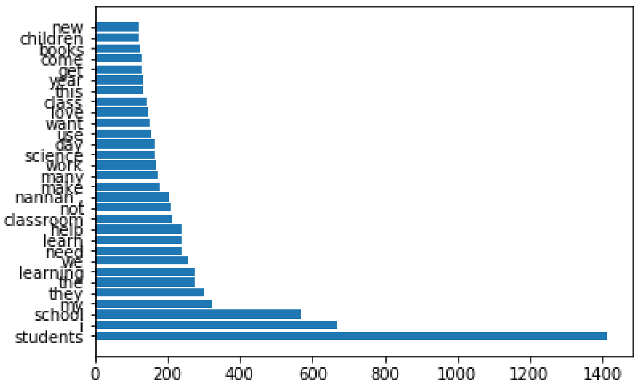
In [244]:

```
mostcommon = freqDistribution.most_common(30)
print(mostcommon)
```

```
[('students', 1412), ('i', 671), ('school', 569), ('my', 324), ('they', 302), ('the', 275),
('learning', 274), ('we', 255), ('need', 239), ('learn', 239), ('help', 239), ('classroom', 212),
('not', 209), ("nannan',", 205), ('make', 178), ('many', 175), ('work', 168), ('science', 165), ('
day', 163), ('use', 155), ('want', 152), ('love', 147), ('class', 142), ('this', 135), ('year', 13
2), ('get', 130), ('come', 127), ('books', 123), ('children', 119), ('new', 119)]
```

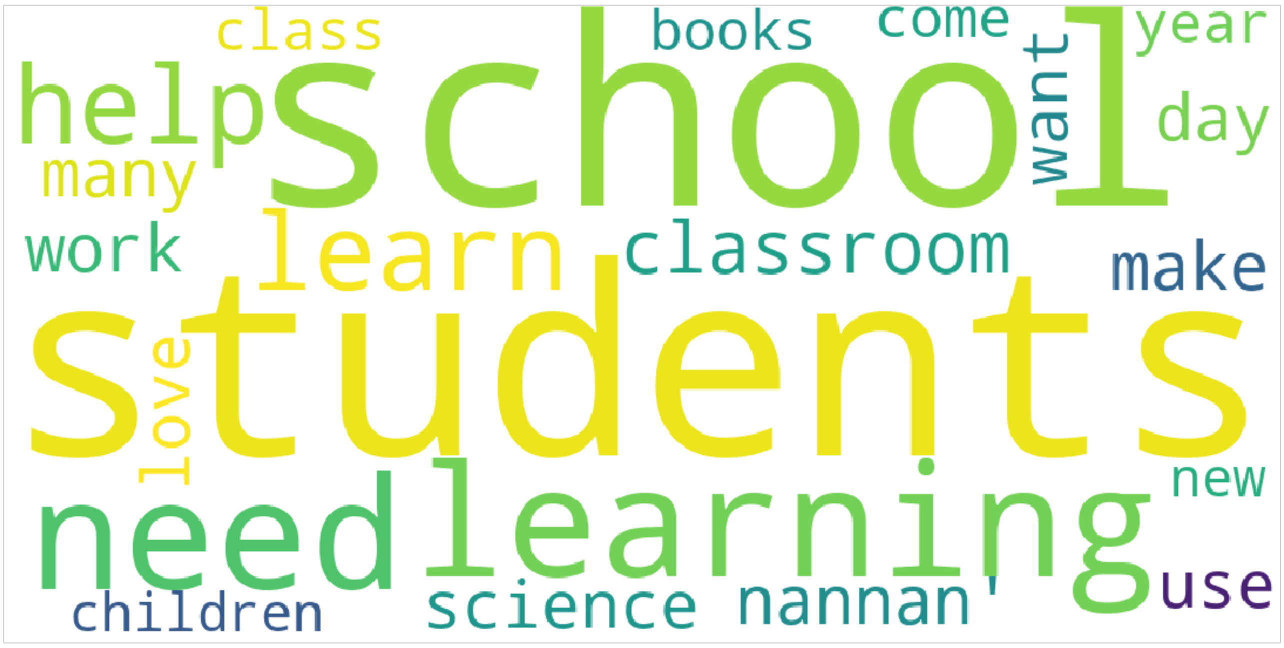
In [245]:

```
plt.barh(range(len(mostcommon)),[val[1] for val in mostcommon], align='center')
plt.yticks(range(len(mostcommon)), [val[0] for val in mostcommon])
plt.show()
```



In [246]:

```
from wordcloud import WordCloud
#convert list to string and generate
unique_string=(" ").join(val[0] for val in mostcommon)
wordcloud = WordCloud(width = 1000, height = 500, background_color ='white').generate(unique_string
)
plt.figure(figsize=(25,10))
plt.imshow(wordcloud)
plt.axis("off")
plt.savefig("Word_Cloud_tfidf"+".png", bbox_inches='tight')
plt.show()
plt.close()
```



WordCloud for Cluster 4

In [247]:

```
topWordsCount = []
freqDistribution = FreqDist(str(cluster4).split())
W = [word for word in cluster4 if word not in stopwords]
#Identify the top 500 words
count = 0
for word, value in freqDistribution.most_common():
    if(word in W):
        topWords.append(word)
        topWordsCount.append(value)
        count = count + 1
        if(count == 500):
            break
```

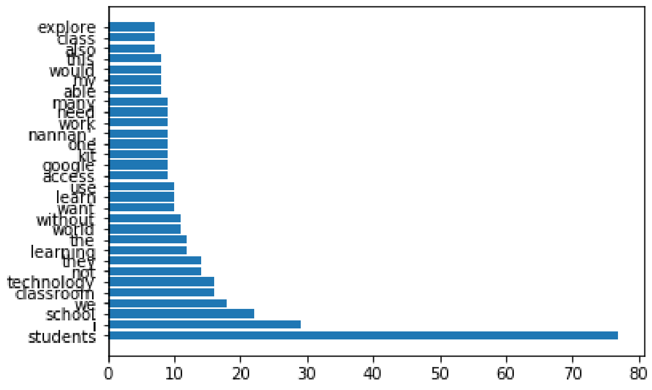
In [248]:

```
mostcommon = freqDistribution.most_common(30)
print(mostcommon)
```

```
[('students', 77), ('i', 29), ('school', 22), ('we', 18), ('classroom', 16), ('technology', 16), (
'not', 14), ('they', 14), ('learning', 12), ('the', 12), ('world', 11), ('without', 11), ('want',
10), ('learn', 10), ('use', 10), ('access', 9), ('google', 9), ('kit', 9), ('one', 9),
("nannan',", 9), ('work', 9), ('need', 9), ('many', 9), ('able', 8), ('my', 8), ('would', 8), ('th
is', 8), ('also', 7), ('class', 7), ('explore', 7)]
```

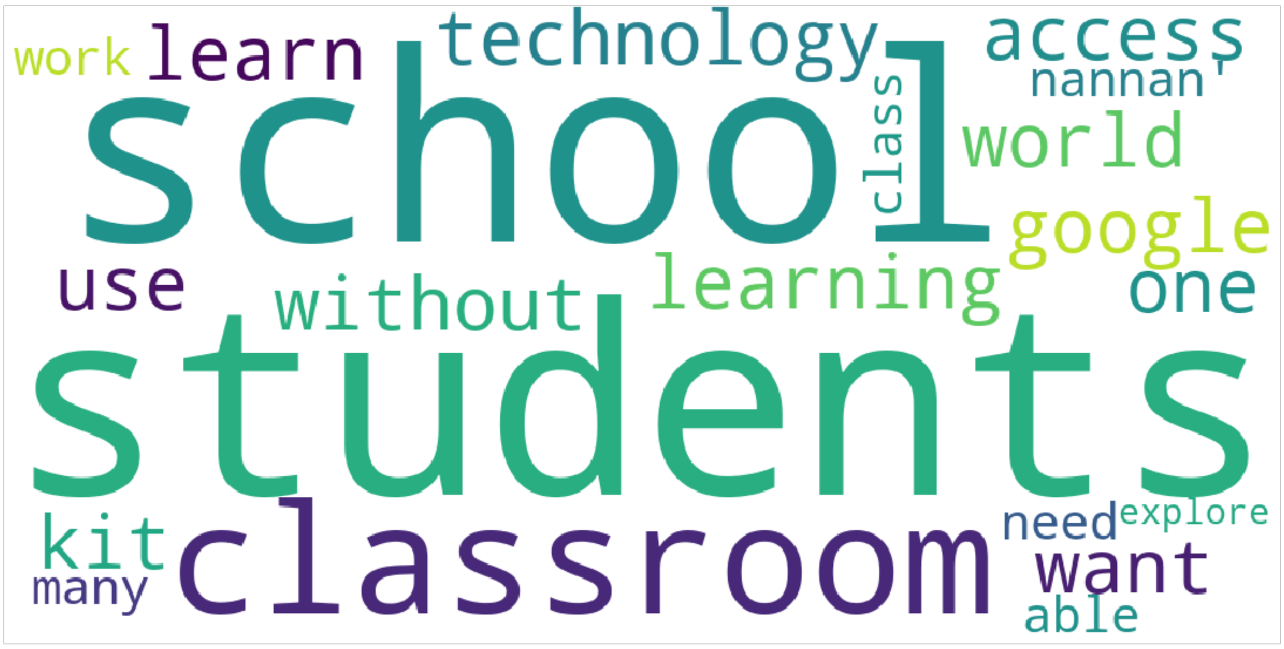
In [249]:

```
plt.barh(range(len(mostcommon)),[val[1] for val in mostcommon], align='center')
plt.yticks(range(len(mostcommon)), [val[0] for val in mostcommon])
plt.yticks(range(len(mostcommon)), [val[0] for val in mostcommon])
plt.show()
```



In [250]:

```
from wordcloud import WordCloud
#convert list to string and generate
unique_string=(" ").join(val[0] for val in mostcommon)
wordcloud = WordCloud(width = 1000, height = 500, background_color ='white').generate(unique_string
)
plt.figure(figsize=(25,10))
plt.imshow(wordcloud)
plt.axis("off")
plt.savefig("Word_Cloud_tfidf"+".png", bbox_inches='tight')
plt.show()
plt.close()
```



WordCloud for Cluster 5

In [251]:

```
topWordsCount = []
freqDistribution = FreqDist(str(cluster5).split())
W = [word for word in cluster5 if word not in stopwords]
#Identify the top 500 words
count = 0
for word, value in freqDistribution.most_common():
    if(word in W):
        topWords.append(word)
        topWordsCount.append(value)
        count = count + 1
        if(count == 500):
            break
```

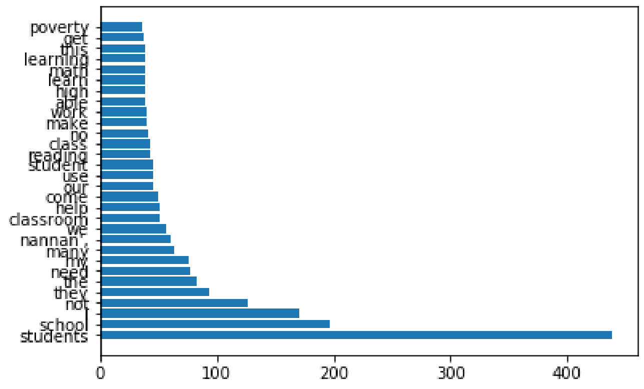
In [252]:

```
mostcommon = freqDistribution.most_common(30)
print(mostcommon)
```

```
[('students', 438), ('school', 196), ('i', 170), ('not', 127), ('they', 94), ('the', 82), ('need',
77), ('my', 76), ('many', 63), ("nannan',", 61), ('we', 56), ('classroom', 51), ('help', 51), ('co
me', 49), ('our', 46), ('use', 45), ('student', 45), ('reading', 43), ('class', 42), ('no', 41), (
'make', 40), ('work', 40), ('able', 39), ('high', 39), ('learn', 39), ('math', 38), ('learning', 3
8), ('this', 38), ('get', 37), ('poverty', 36)]
```

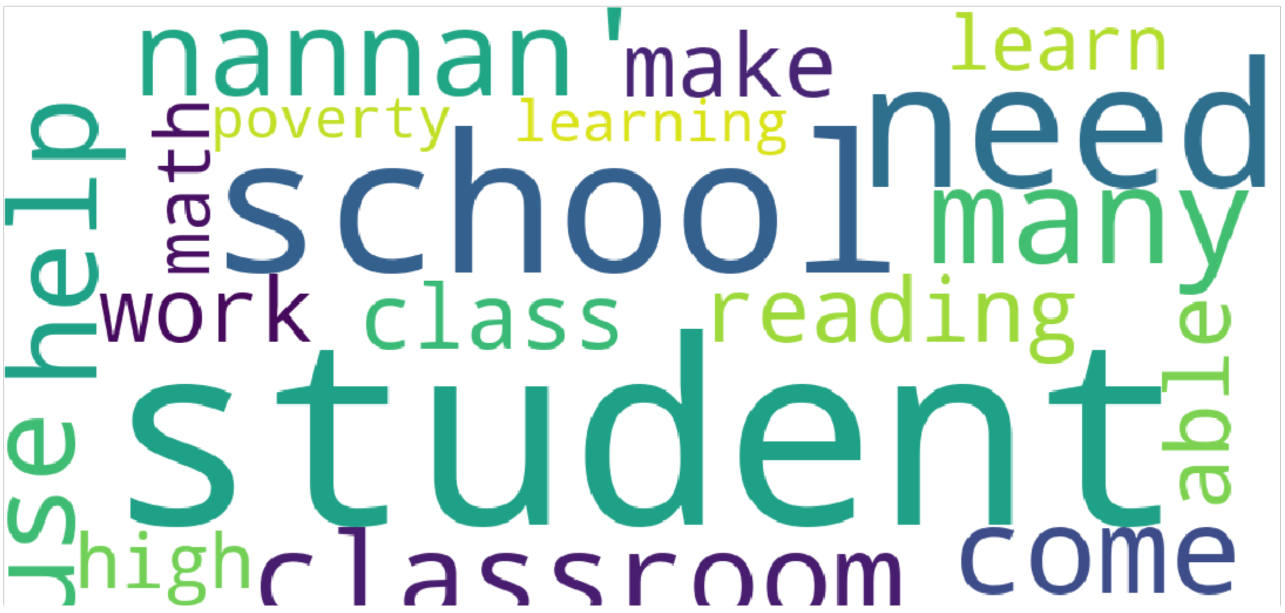
In [253]:

```
plt.barh(range(len(mostcommon)),[val[1] for val in mostcommon], align='center')
plt.yticks(range(len(mostcommon)), [val[0] for val in mostcommon])
plt.show()
```



In [254]:

```
from wordcloud import WordCloud
#convert list to string and generate
unique_string=(" ").join(val[0] for val in mostcommon)
wordcloud = WordCloud(width = 1000, height = 500, background_color ='white').generate(unique_string
)
plt.figure(figsize=(25,10))
plt.imshow(wordcloud)
plt.axis("off")
plt.savefig("Word_Cloud_tfidf"+".png", bbox_inches='tight')
plt.show()
plt.close()
```



Reading essays from a cluster

In [255]:

```
## Cluster 1
count=1
for i in range(3):
    if i < len(cluster1):
        print('Essay-%d : \n %s\n'%(count,cluster1[i]))
        count +=1
```

```
Essay-1 :
 my students english learners working english second third languages we melting pot refugees immig
rants native born americans bringing gift language school we 24 languages represented english lear
ner program students every level mastery we also 40 countries represented families within school e
ach student brings wealth knowledge experiences us open eyes new cultures beliefs respect the limi
ts language limits world ludwig wittgenstein our english learner strong support system home begs r
esources many times parents learning read speak english along side children sometimes creates
barriers parents able help child learn phonetics letter recognition reading skills by providing dv
d players students able continue mastery english language even no one home able assist all familie
s students within level 1 proficiency status offered part program these educational videos
specially chosen english learner teacher sent home regularly watch the videos help child develop e
arly reading skills parents not access dvd player opportunity check dvd player use year the plan u
se videos educational dvd years come el students nannan

Essay-2 :
 our students arrive school eager learn they polite generous strive best they know education succe
ed life help improve lives our school focuses families low incomes tries give student education de
serve while not much students use materials given best the projector need school crucial academic
improvement students as technology continues grow many resources internet teachers use growth stud
ents however school limited resources particularly technology without disadvantage one things coul
d really help classrooms projector with projector not crucial instruction also growth students wit
h projector show presentations documentaries photos historical land sites math problems much with
projector make teaching learning easier also targeting different types learners classrooms auditor
y visual kinesthetic etc nannan

Essay-3 :
 true champions not always ones win guts by mia hamm this quote best describes students cholla mid
dle school approach playing sports especially girls boys soccer teams the teams made 7th 8th grade
students not opportunity play organized sport due family financial difficulties i teach title one
middle school urban neighborhood 74 students qualify free reduced lunch many come activity sport o
pportunity poor homes my students love participate sports learn new skills apart team atmosphere m
y school lacks funding meet students needs i concerned lack exposure not prepare participating spo
rts teams high school by end school year goal provide students opportunity learn variety soccer sk
ills positive qualities person actively participates team the students campus come school knowing
face uphill battle comes participating organized sports the players would thrive field confidence
appropriate soccer equipment play soccer best abilities the students experience helpful person par
t team teaches positive supportive encouraging others my students using soccer equipment practice
games daily basis learn practice necessary skills develop strong soccer team this experience
create opportunity students learn part team positive contribution teammates the students get oppor
tunity learn practice variety soccer skills use skills game access type experience nearly
impossible without soccer equipment students players utilize practice games nannan
```

In [256]:

```
## Cluster 2
count=1
for i in range(3):
    if i < len(cluster2):
        print('Essay-%d : \n %s\n'%(count,cluster2[i]))
        count +=1
```

```
Essay-1 :
 not students struggle poverty also learning master english language minority students represent 3
5 student population regardless background socioeconomic status students deserve high quality
education these children future these students eager learn filled excitement opportunity use techn
ology classroom however almost 650 students attending school 4 ipad carts entire building not get
much exposure need as educator vital i try help become apart 21 century digital age these ipads al
```

```
low my students need 4 ipads latest technology classroom a long time ago used paper pencils
teaching students that time passed in 21st century students need latest technology stay ahead my s
tudents fully engaged use technology hear pin drop room ipads make simplest tasks fun for example
instead worksheets use interactive apps practice math skills the mobility ipad also important stud
ents using around classroom sometimes areas school i requesting 4 ipads use classroom my students
use listen digital books assignments study island study jams interactive sites please help fund pr
oject when get opportunity use ipad cart school i noticed beneficial student learning not donating
project help students also help future nannan

Essay-2 :
 my students always working new projects time want work enviornment connection ecosystem all takes
time hard work after great year learning cells bodies many organ systems class ready hands
experience they want connect lives habitat ecosystem need real life authentic experiences i want s
tudents internalize importance protecting earth importantly immediate community my spanish dual la
nguage students always ready hands experiences science classroom i crossroads life science decided
search great hands kits let explore organ systems really like differ habitats i want figure
similarities well active exploration discovery always key lessons seeing lightbulb go gift every t
eacher loves receive they work collaborative groups always seem come great answers together build
science perspectives science fun i always need give students chance explore different ways nannan

Essay-3 :
 my students highly motivated succeed unfortunately lack resources reach potential my students com
e low income highly mobile families my school large elementary school 1 000 students k 5 with larg
e amount students many fall cracks get overlooked my students desire learn not resources available
reach goals set these math games help reinforce skill strategy covered fun way beneficial students
i learned students fun actually learning activity by using games stations time productive engaging
currently i would first introduce game week small group times students know exactly then i would r
otate game stations continue practice skill strategy by donating project classroom gain much neede
d resources i tried making games similar i cannot afford pocket with resources students learn mast
er necessary standards skills successful life long learners nannan
```

In [257]:

```python
## Cluster 3
count=1
for i in range(3):
    if i < len(cluster3):
        print('Essay-%d : \n %s\n'%(count,cluster3[i]))
        count +=1
```

```
Essay-1 :
 my students awesome they creative excited learning i privileged teach music rural public school s
erving 900 students grades kindergarten 4th including special group children facing severe physica
l mental disabilities in school high poverty i strive daily provide equitable music experience
students this experience includes exposing students new instruments musical cultures music history
music expression self because many students lack funding physical ability travel unique musical se
ttings i strive bring creative musical world classroom i want see students get healthier teaching
students means american teaching folk songs step down african american traditions american folk so
ngs children anna banana 101 jump rope well types folk songs games jumping rope dancing we jumping
rope songs like sheep meadow dancing songs like little sally water playing games songs this
incorporates history well music i think lots fun students well we get moving still learning nannan

Essay-2 :
 orchestra class unlike ordinary class aside obvious signs class not traditional chair desk look s
tudents class unlike to specific orchestra always enthusiastic even gloomiest days always filled p
ositive energy however music department true exception our combined choir instrumental programs pr
oduced phenomenally talented young adults leaders strive inspire countless audience members it dif
ficult distinguish ordinary high school students first glance yet little know much empowered arts
i teach classroom music grades 1 6 currently class not enough instruments pass around students if
get bells students engaged daily lesson i plan lessons involve students this definitely step right
direction these new bells welcome addition ever growing music classes the students better chance r
ealize musical creative potential as get closer concert performance season plenty students ready c
onfidently creating music nannan

Essay-3 :
 aloha na keiki hawai our classroom cheer sums you love preschool my preschool special education c
lass provides early intervention services qualifying special needs children ages 3 5 years we grou
p actively involved teachers therapists children working together hands learning environment my sc
hool located predominantly rural low income neighborhood considerable portion children hawaiian pa
cific island ancestry playground balls get much work kids bounce roll kick throw after several yea
rs literally hitting rough pavement not holding two balls temporarily hold enough air bounce we ne
ed balls everyone play nets make easy carry my students love bubbles blowing chasing drift across
playground it great fun awesome workout best everyone participates but like bubbles chase bubble j
uice not last we need refill i also want surprise students variety wand shapes experiment birthday
```

```
s big little bunch we bake cupcakes make cards birthday buddy i discovered terrific books birthday
themes include celebrations we need birthday books read nannan
```

In [258]:

```python
## Cluster 4
count=1
for i in range(3):
    if i < len(cluster4):
        print('Essay-%d : \n %s\n'%(count,cluster4[i]))
        count +=1
```

```
Essay-1 :
 i always trying show students much i care want able see classroom safe place learn social academi
c skills i want give students access much learning tools possible take i show use make stronger ar
eas go grow school having google expedition kit classroom allow different style learning one way e
xpedition kit used show students different locations around world land sea another way students us
e kit building knowledge different animals environments creating reports based virtual experiences
these google expedition kids also deepen science math reading writing lessons exposing students di
fferent environments around world because technology gap school i hoping kit help close gap introd
uce new way experiencing learning i truly hoping students get experience expedition kit end year n
annan

Essay-2 :
 every morning start saying good morning half schools esl students chinese by obtaining apple
products i easily translate words students still lesson projected board another benefit students s
hare project work wirelessly the higher level mathematics requires advanced technologies we techno
logy ages the way study mathematics completely different old days i remembered i study logarithm t
ables memorize every sin x table but technologies advances mathematics advances along apple produc
ts known reliable last long i not asking class set nor i need class set the purpose getting imac s
tudents sit back room explore potential study without troubling students the purpose getting ipad
teacher walk around room wireless assess student knowledge checking understanding the purpose macb
ook pro allow teacher work school home also providing students flexibility school demonstrate know
ledge wirelessly without technologies students need depend memorization better using time study le
arn rather memorizing formula without understanding my students esl students technologies provide
translation visual aid especially apple offers translation dictionary pronunciation applications n
annan

Essay-3 :
 our school truly one best schools nashville the adults building families community go beyond ensu
re students successful our school family believes continue work team nothing cannot accomplish our
school located antioch tn urban district we nearly 800 students 76 percent students qualifying fre
e reduced lunch additionally 70 students minority backgrounds 26 students english language
learners representing 10 languages for last year i using google cardboard classroom students atten
d virtual reality field trips i seen joy type innovation brings students ages unfortunately i
limited devices cardboard glasses students variety devices use class not compatible google
cardboard when students use type technology groups 3 4 most classes around 20 students to many stu
dents traveling not something get experience families google expeditions cost not factor would lik
e travel many students english language learners i believe program would valuable students underst
anding family this may inspire students pursue career may not otherwise considered without access
type technology if project receives funding students option explore locations around world whole g
roup led teacher google expeditions used every student school steam related arts class also used e
xtracurricular stem club nannan
```

In [259]:

```python
## Cluster 5
count=1
for i in range(3):
    if i < len(cluster5):
        print('Essay-%d : \n %s\n'%(count,cluster5[i]))
        count +=1
```

```
Essay-1 :
 my students sixths graders public middle school los angeles the majority students come economical
ly disadvantaged households they face many barriers comes equal access including lack access
technology homes community we unique school incorporates performing arts curricular areas we dance
sing math science our classroom old much furniture broken falling apart i requesting 36 sturdy cha
irs students use daily our current chairs big tables falling apart students uncomfortable even get
hurt our classroom needs flexible far groupings new chairs would make much easier we performing ar
ts school incorporate dance curricular areas these stackable chairs allow us make space movement m
ath science class your donation help make classroom flexible active learning environment the new c
```

```
hairs increase peer peer interaction collaboration nannan

Essay-2 :
 my students often borrow calculators class time i not enough loan class i requesting money
purchase class set 10 100 a matched donation would get students approximately 20 calculators use l
earning topics beyond arithmetic my goal algebra algebra prep class not get bogged arithmetic defi
ciencies rather calculators allows reach higher elementary deficiencies otherwise would let these
students families typically not afford purchase calculators my students often not able purchase ca
lculator needed move class beyond arithmetic these students need assistance arithmetic make
algebra topics reachable reasonable i make calculators available period student needs tool i ask c
ollateral remember return obviously get collateral back returning calculator i find students less
intimidated advanced mathematics topics tool available make arithmetic non issue less stress means
learning nannan

Essay-3 :
 our school located hendersonville nc we title i school majority students living poverty we highes
t poverty rate elementary schools county despite circumstances students positive live stephen
covey leader in me habits they worked hard help make us light house school we one five light house
schools state one western north carolina students work hard given limited resources provided the a
mount copies make school limited i need able provide students homework items interactive notebooks
passages practice word problems students mark our school following max thompson teaching program h
e says every day students reading extended passages answering questions related they need paper co
py may able mark paper notes read go back passage prove answers questions students given
opportunity practice successful nannan
```

Hierarchical Clustering with 10 clusters

In [260]:

```python
model = AgglomerativeClustering(n_clusters=10).fit(X_new.toarray())
# Getting all the essays in different clusters
cluster1 = []
cluster2 = []
cluster3 = []
cluster4 = []
cluster5 = []
cluster6 = []
cluster7 = []
cluster8 = []
cluster9 = []
cluster10 = []

for i in range(model.labels_.shape[0]):
    if model.labels_[i] == 0:
        cluster1.append(essays[i])
    elif model.labels_[i] == 1:
        cluster2.append(essays[i])
    elif model.labels_[i] == 2:
        cluster3.append(essays[i])
    elif model.labels_[i] == 3:
        cluster4.append(essays[i])
    elif model.labels_[i] == 4:
        cluster5.append(essays[i])
    elif model.labels_[i] == 5:
        cluster6.append(essays[i])
    elif model.labels_[i] == 6:
        cluster7.append(essays[i])
    elif model.labels_[i] == 7:
        cluster8.append(essays[i])
    elif model.labels_[i] == 8:
        cluster9.append(essays[i])
    else :
        cluster10.append(essays[i])

print("  No. of essays in Cluster-1 : ",len(cluster1))
print("\nNo. of essays in Cluster-2 : ",len(cluster2))
print("\nNo. of essays in Cluster-3 : ",len(cluster3))
print("\nNo. of essays in Cluster-4 : ",len(cluster4))
print("\nNo. of essays in Cluster-5 : ",len(cluster5))
print("\nNo. of essays in Cluster-6 : ",len(cluster6))
print("\nNo. of essays in Cluster-7 : ",len(cluster7))
print("\nNo. of essays in Cluster-8 : ",len(cluster8))
print("\nNo. of essays in Cluster-9 : ",len(cluster9))
print("\nNo. of essays in Cluster-10 : ",len(cluster10))
```

```
  No. of essays in Cluster-1 :  2449

No. of essays in Cluster-2 :  2306

No. of essays in Cluster-3 :  2670

No. of essays in Cluster-4 :  521

No. of essays in Cluster-5 :  67

No. of essays in Cluster-6 :  213

No. of essays in Cluster-7 :  321

No. of essays in Cluster-8 :  10

No. of essays in Cluster-9 :  951

No. of essays in Cluster-10 :  492
```

For Cluster 1:

In [261]:

```
topWords = []
topWordsCount = []
freqDistribution = FreqDist(str(cluster1).split())
W = [word for word in cluster1 if word not in stopwords]
#Identify the top 500 words
count = 0
for word, value in freqDistribution.most_common():
    if(word in W):
        topWords.append(word)
        topWordsCount.append(value)
        count = count + 1
        if(count == 500):
            break
```

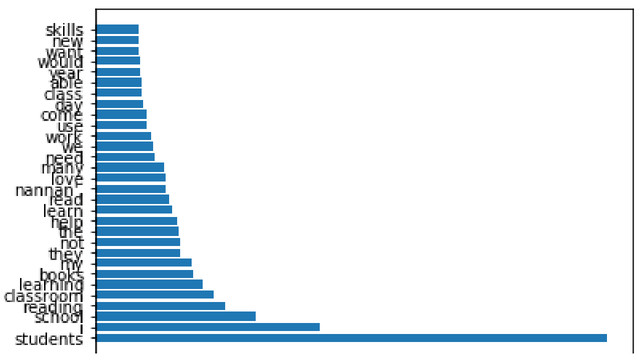
In [262]:

```
mostcommon = freqDistribution.most_common(30)
print(mostcommon)
```

```
[('students', 16905), ('i', 7405), ('school', 5283), ('reading', 4307), ('classroom', 3944),
('learning', 3537), ('books', 3258), ('my', 3207), ('they', 2837), ('not', 2826), ('the', 2758), (
'help', 2712), ('learn', 2572), ('read', 2455), ("nannan',", 2356), ('love', 2318), ('many', 2279)
, ('need', 1967), ('we', 1917), ('work', 1840), ('use', 1685), ('come', 1685), ('day', 1591), ('cl
ass', 1565), ('able', 1537), ('year', 1512), ('would', 1510), ('want', 1430), ('new', 1414), ('ski
lls', 1408)]
```

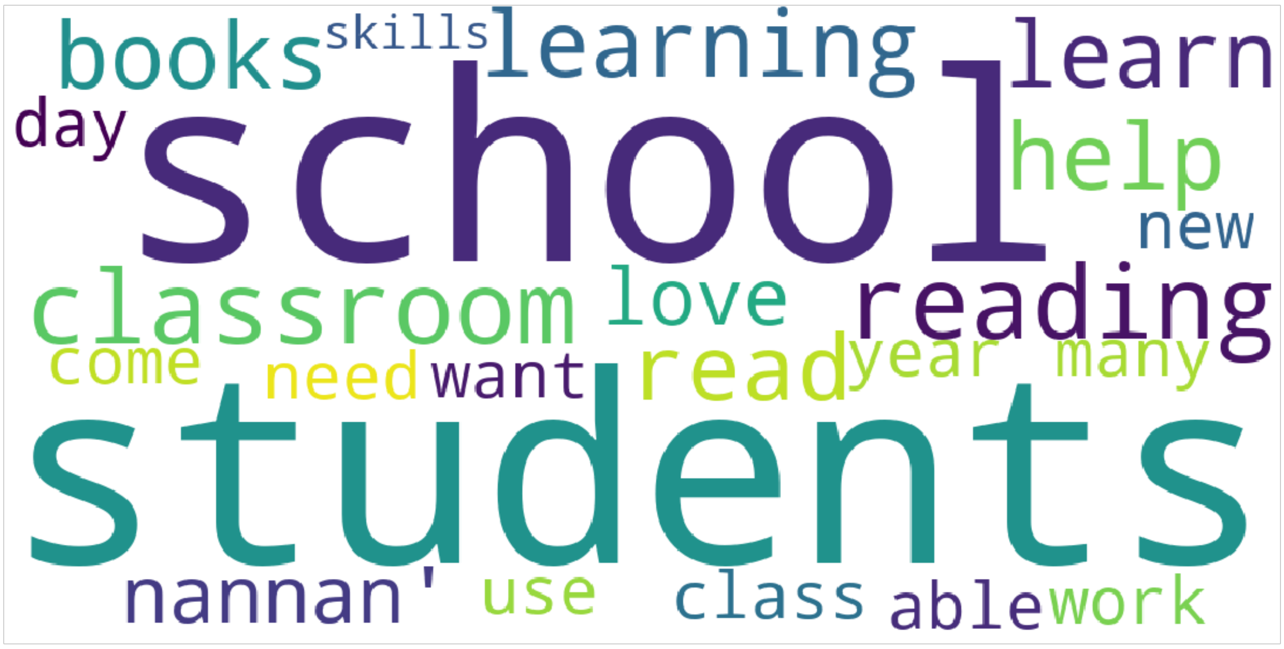
In [263]:

```
plt.barh(range(len(mostcommon)),[val[1] for val in mostcommon], align='center')
plt.yticks(range(len(mostcommon)), [val[0] for val in mostcommon])
plt.show()
```



In [264]:

```
from wordcloud import WordCloud
#convert list to string and generate
unique_string=(" ").join(val[0] for val in mostcommon)
wordcloud = WordCloud(width = 1000, height = 500, background_color ='white').generate(unique_string
)
plt.figure(figsize=(25,10))
plt.imshow(wordcloud)
plt.axis("off")
plt.savefig("Word_Cloud_tfidf"+".png", bbox_inches='tight')
plt.show()
plt.close()
```



For Cluster 2:

In [265]:

```
topWords = []
topWordsCount = []
freqDistribution = FreqDist(str(cluster2).split())
W = [word for word in cluster2 if word not in stopwords]
#Identify the top 500 words
count = 0
for word, value in freqDistribution.most_common():
    if(word in W):
        topWords.append(word)
        topWordsCount.append(value)
        count = count + 1
        if(count == 500):
            break
```

In [266]:

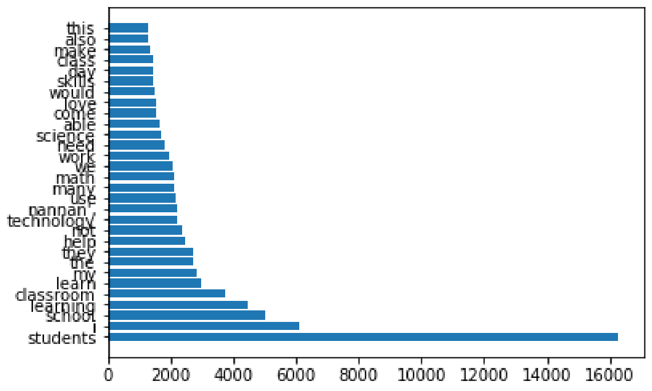
```
mostcommon = freqDistribution.most_common(30)
print(mostcommon)
```

```
[('students', 16295), ('i', 6119), ('school', 5055), ('learning', 4473), ('classroom', 3752),
('learn', 2990), ('my', 2838), ('the', 2743), ('they', 2725), ('help', 2487), ('not', 2369), ('tec
hnology', 2213), ("nannan',", 2203), ('use', 2186), ('many', 2111), ('math', 2104), ('we', 2079),
('work', 1957), ('need', 1826), ('science', 1729), ('able', 1634), ('come', 1578), ('love', 1542),
('would', 1480), ('skills', 1466), ('day', 1461), ('class', 1449), ('make', 1327), ('also', 1324),
('this', 1282)]
```

```
('this', 1202)]
```

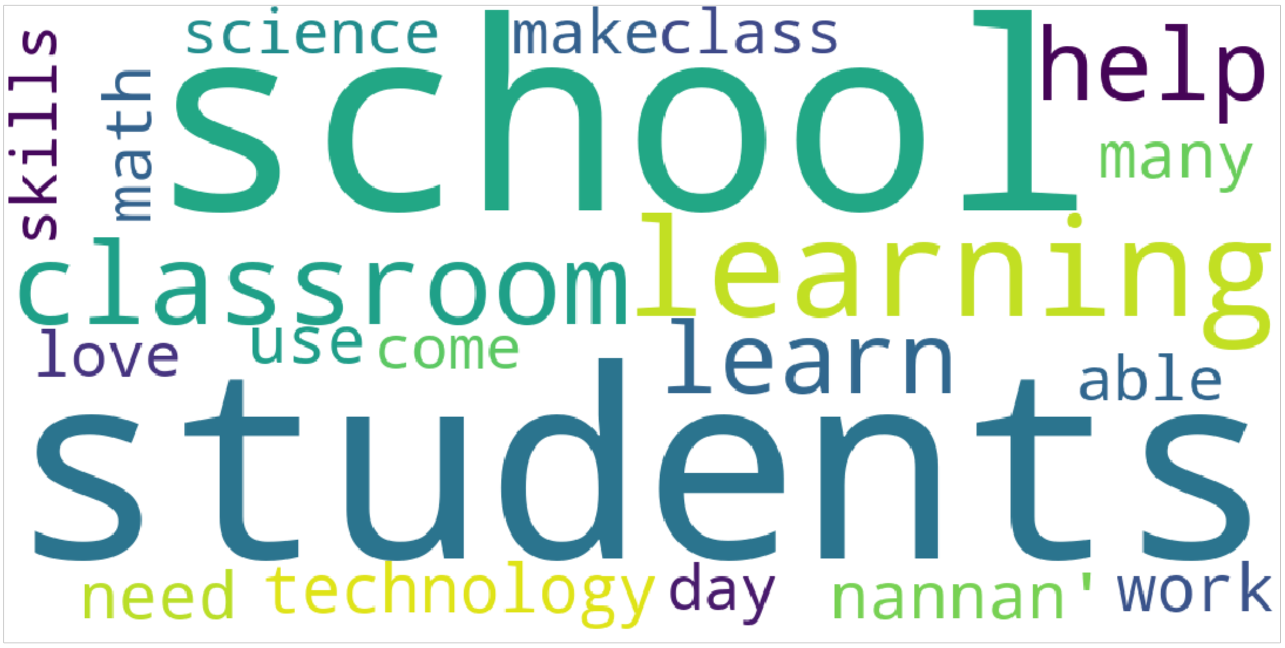
In [267]:

```
plt.barh(range(len(mostcommon)),[val[1] for val in mostcommon], align='center')
plt.yticks(range(len(mostcommon)), [val[0] for val in mostcommon])
plt.show()
```



In [268]:

```
from wordcloud import WordCloud
#convert list to string and generate
unique_string=(" ").join(val[0] for val in mostcommon)
wordcloud = WordCloud(width = 1000, height = 500, background_color ='white').generate(unique_string
)
plt.figure(figsize=(25,10))
plt.imshow(wordcloud)
plt.axis("off")
plt.savefig("Word_Cloud_tfidf"+".png", bbox_inches='tight')
plt.show()
plt.close()
```



For Cluster 3:

In [269]:

```
topWords = []
topWordsCount = []
freqDistribution = FreqDist(str(cluster3).split())
W = [word for word in cluster3 if word not in stopwords]
```

```
#Identify the top 500 words
count = 0
for word, value in freqDistribution.most_common():
    if(word in W):
        topWords.append(word)
        topWordsCount.append(value)
        count = count + 1
        if(count == 500):
            break
```

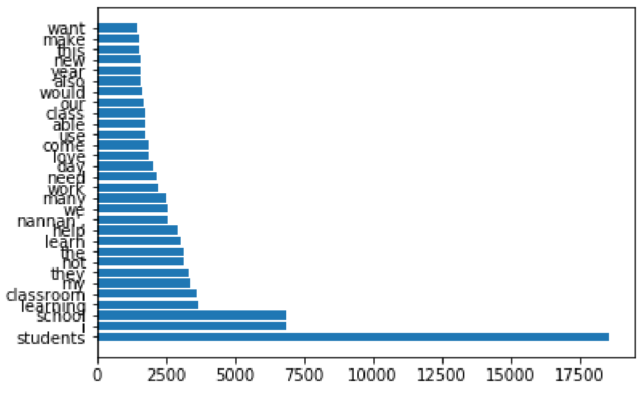
In [270]:

```
mostcommon = freqDistribution.most_common(30)
print(mostcommon)
```

```
[('students', 18530), ('i', 6867), ('school', 6835), ('learning', 3663), ('classroom', 3593),
('my', 3376), ('they', 3291), ('not', 3166), ('the', 3119), ('learn', 3006), ('help', 2909), ("nan
nan',", 2569), ('we', 2542), ('many', 2503), ('work', 2184), ('need', 2165), ('day', 2048), ('love
', 1880), ('come', 1858), ('use', 1775), ('able', 1765), ('class', 1733), ('our', 1682), ('would',
1638), ('also', 1600), ('year', 1563), ('new', 1558), ('this', 1531), ('make', 1503), ('want', 145
6)]
```

In [271]:

```
plt.barh(range(len(mostcommon)),[val[1] for val in mostcommon], align='center')
plt.yticks(range(len(mostcommon)), [val[0] for val in mostcommon])
plt.show()
```



In [272]:

```
from wordcloud import WordCloud
#convert list to string and generate
unique_string=(" ").join(val[0] for val in mostcommon)
wordcloud = WordCloud(width = 1000, height = 500, background_color ='white').generate(unique_string
)
plt.figure(figsize=(25,10))
plt.imshow(wordcloud)
plt.axis("off")
plt.savefig("Word_Cloud_tfidf"+".png", bbox_inches='tight')
plt.show()
plt.close()
```

need
learn
nannan'
many
year
students
learning
classroom
new
come

able
new
love
help
school
use
day
work
want
class
make

For Cluster 4:

In [273]:

```
topWords = []
topWordsCount = []
freqDistribution = FreqDist(str(cluster4).split())
W = [word for word in cluster4 if word not in stopwords]
#Identify the top 500 words
count = 0
for word, value in freqDistribution.most_common():
    if(word in W):
        topWords.append(word)
        topWordsCount.append(value)
        count = count + 1
        if(count == 500):
            break
```

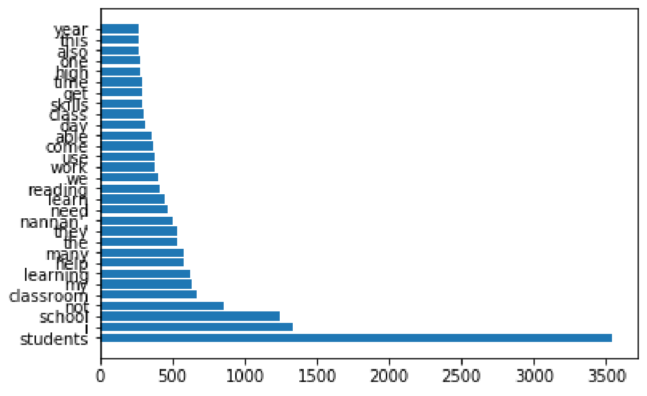
In [274]:

```
mostcommon = freqDistribution.most_common(30)
print(mostcommon)
```

```
[('students', 3537), ('i', 1331), ('school', 1239), ('not', 850), ('classroom', 662), ('my', 633),
('learning', 624), ('help', 581), ('many', 576), ('the', 533), ('they', 529), ("nannan',", 499), (
'need', 464), ('learn', 441), ('reading', 412), ('we', 398), ('work', 382), ('use', 377), ('come',
371), ('able', 350), ('day', 307), ('class', 300), ('skills', 294), ('get', 289), ('time', 284),
('high', 279), ('one', 273), ('also', 271), ('this', 265), ('year', 264)]
```

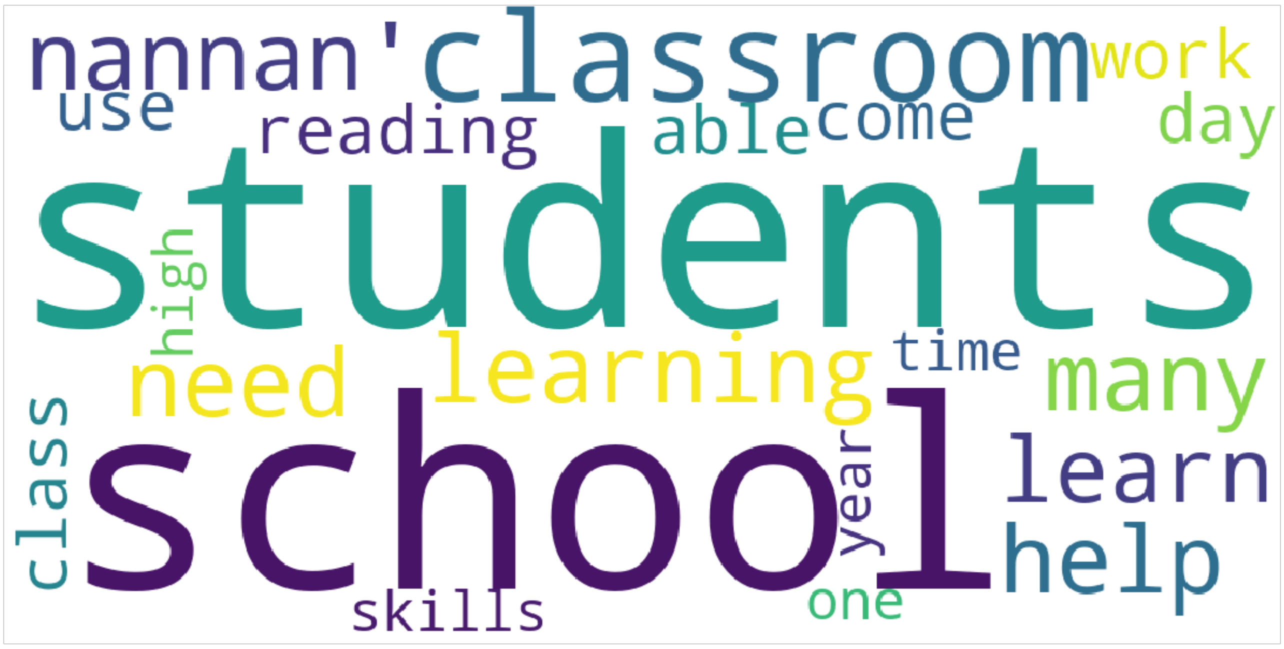
In [275]:

```
plt.barh(range(len(mostcommon)),[val[1] for val in mostcommon], align='center')
plt.yticks(range(len(mostcommon)), [val[0] for val in mostcommon])
plt.show()
```



In [276]:

```
from wordcloud import WordCloud
#convert list to string and generate
unique_string=(" ").join(val[0] for val in mostcommon)
wordcloud = WordCloud(width = 1000, height = 500, background_color ='white').generate(unique_string
)
plt.figure(figsize=(25,10))
plt.imshow(wordcloud)
plt.axis("off")
plt.savefig("Word_Cloud_tfidf"+".png", bbox_inches='tight')
plt.show()
plt.close()
```



For Cluster 5:

In [277]:

```
topWords = []
topWordsCount = []
freqDistribution = FreqDist(str(cluster5).split())
W = [word for word in cluster5 if word not in stopwords]
#Identify the top 500 words
count = 0
for word, value in freqDistribution.most_common():
    if(word in W):
        topWords.append(word)
        topWordsCount.append(value)
        count = count + 1
        if(count == 500):
            break
```

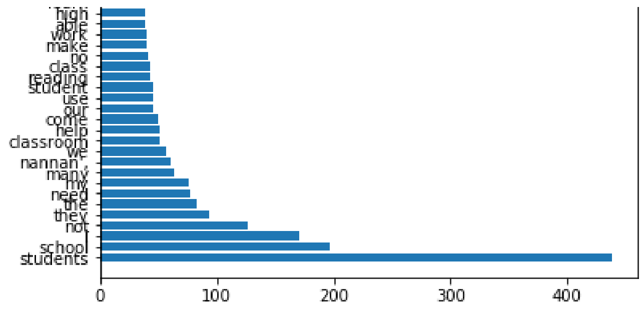
In [278]:

```
mostcommon = freqDistribution.most_common(30)
print(mostcommon)
```

```
[('students', 438), ('school', 196), ('i', 170), ('not', 127), ('they', 94), ('the', 82), ('need',
77), ('my', 76), ('many', 63), ("nannan',", 61), ('we', 56), ('classroom', 51), ('help', 51), ('co
me', 49), ('our', 46), ('use', 45), ('student', 45), ('reading', 43), ('class', 42), ('no', 41), (
'make', 40), ('work', 40), ('able', 39), ('high', 39), ('learn', 39), ('math', 38), ('learning', 3
8), ('this', 38), ('get', 37), ('poverty', 36)]
```

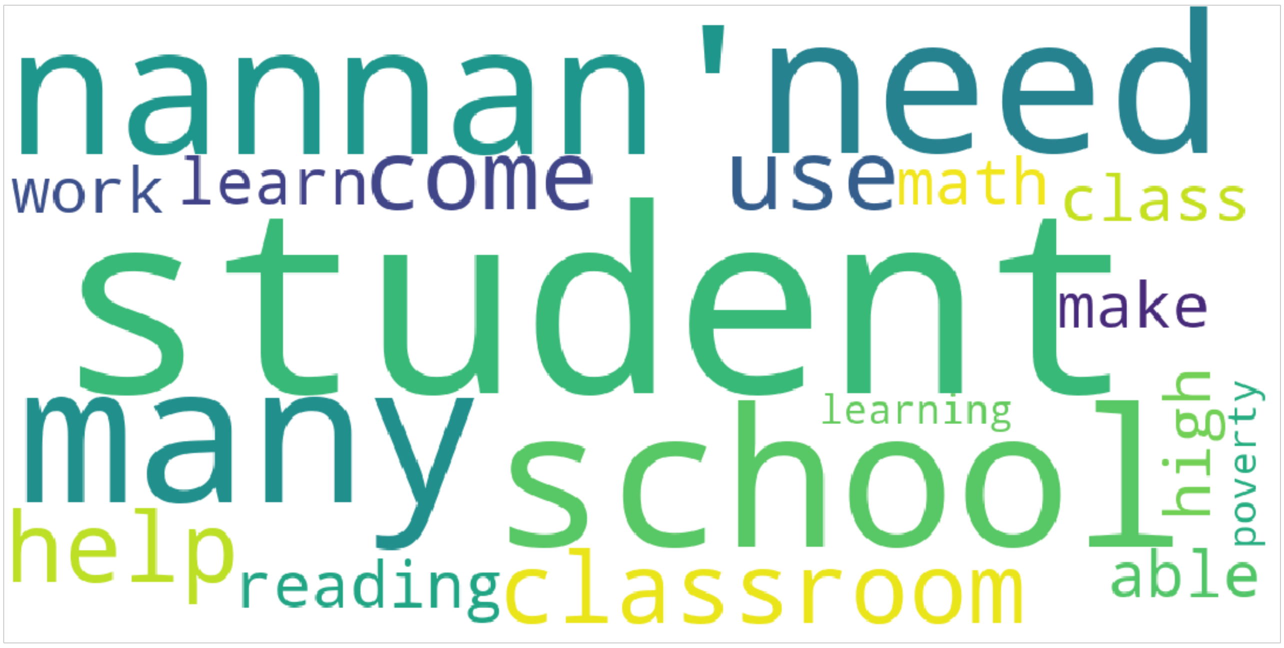
In [279]:

```
plt.barh(range(len(mostcommon)),[val[1] for val in mostcommon], align='center')
plt.yticks(range(len(mostcommon)), [val[0] for val in mostcommon])
plt.show()
```



In [280]:

```
from wordcloud import WordCloud
#convert list to string and generate
unique_string=(" ").join(val[0] for val in mostcommon)
wordcloud = WordCloud(width = 1000, height = 500, background_color ='white').generate(unique_string
)
plt.figure(figsize=(25,10))
plt.imshow(wordcloud)
plt.axis("off")
plt.savefig("Word_Cloud_tfidf"+".png", bbox_inches='tight')
plt.show()
plt.close()
```



For Cluster 6:

In [281]:

```
topWords = []
topWordsCount = []
freqDistribution = FreqDist(str(cluster6).split())
W = [word for word in cluster6 if word not in stopwords]
#Identify the top 500 words
count = 0
for word, value in freqDistribution.most_common():
    if(word in W):
        topWords.append(word)
        topWordsCount.append(value)
        count = count + 1
        if(count == 500):
            break
```

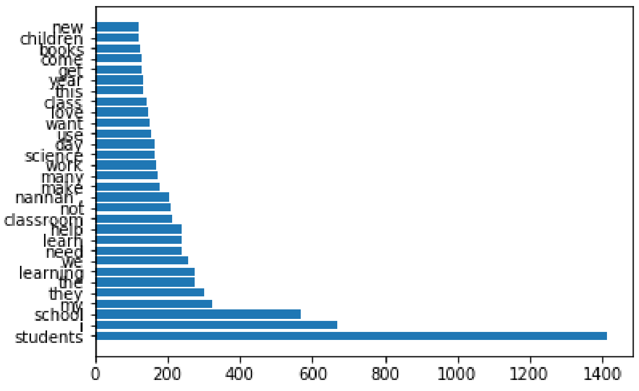
In [282]:

```
mostcommon = freqDistribution.most_common(30)
print(mostcommon)
```

```
[('students', 1412), ('i', 671), ('school', 569), ('my', 324), ('they', 302), ('the', 275),
('learning', 274), ('we', 255), ('need', 239), ('learn', 239), ('help', 239), ('classroom', 212),
('not', 209), ("nannan',", 205), ('make', 178), ('many', 175), ('work', 168), ('science', 165), ('
day', 163), ('use', 155), ('want', 152), ('love', 147), ('class', 142), ('this', 135), ('year', 13
2), ('get', 130), ('come', 127), ('books', 123), ('children', 119), ('new', 119)]
```

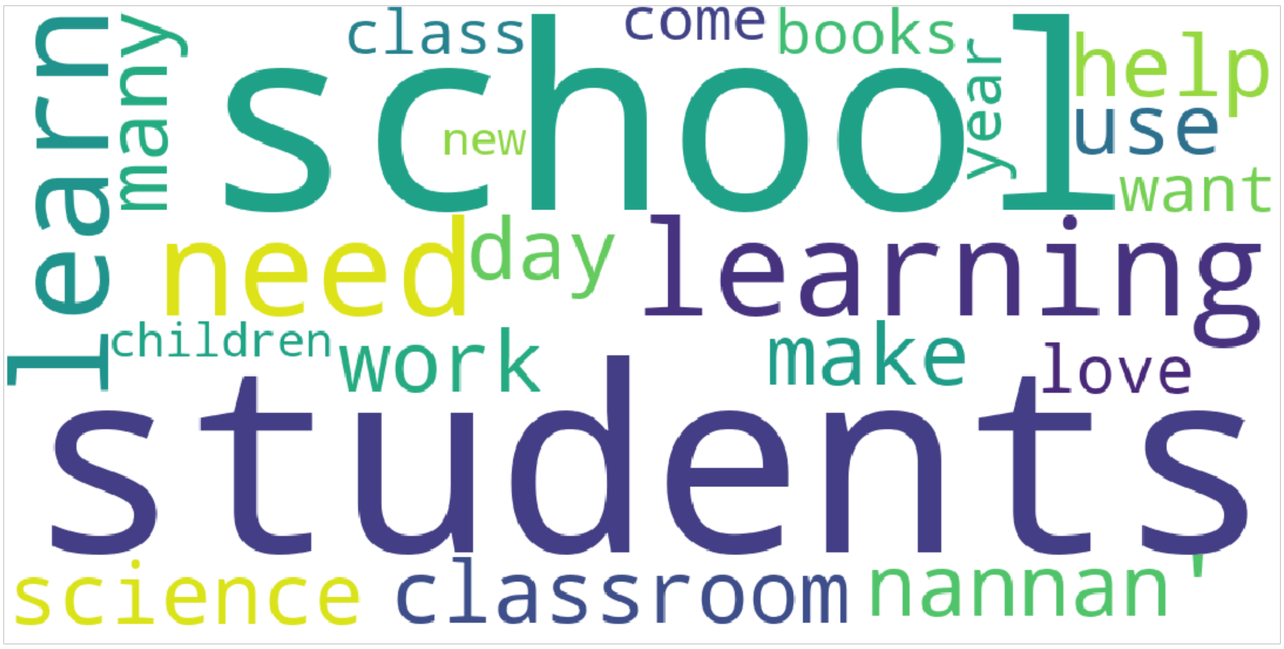
In [283]:

```
plt.barh(range(len(mostcommon)),[val[1] for val in mostcommon], align='center')
plt.yticks(range(len(mostcommon)), [val[0] for val in mostcommon])
plt.show()
```



In [284]:

```
from wordcloud import WordCloud
#convert list to string and generate
unique_string=(" ").join(val[0] for val in mostcommon)
wordcloud = WordCloud(width = 1000, height = 500, background_color ='white').generate(unique_string
)
plt.figure(figsize=(25,10))
plt.imshow(wordcloud)
plt.axis("off")
plt.savefig("Word_Cloud_tfidf"+".png", bbox_inches='tight')
plt.show()
plt.close()
```



For Cluster 7:

In [285]:

```
topWords = []
topWordsCount = []
freqDistribution = FreqDist(str(cluster7).split())
W = [word for word in cluster7 if word not in stopwords]
#Identify the top 500 words
count = 0
for word, value in freqDistribution.most_common():
    if(word in W):
        topWords.append(word)
        topWordsCount.append(value)
        count = count + 1
        if(count == 500):
            break
```

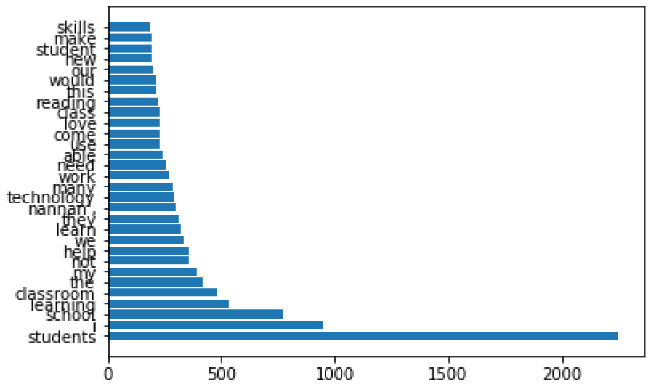
In [286]:

```
mostcommon = freqDistribution.most_common(30)
print(mostcommon)
```

```
[('students', 2254), ('i', 953), ('school', 771), ('learning', 530), ('classroom', 482), ('the', 42
3), ('my', 389), ('not', 358), ('help', 355), ('we', 336), ('learn', 324), ('they', 317),
("nannan',", 301), ('technology', 294), ('many', 287), ('work', 274), ('need', 255), ('able', 245)
, ('use', 231), ('come', 229), ('love', 227), ('class', 226), ('reading', 219), ('this', 218),
('would', 212), ('our', 204), ('new', 196), ('student', 193), ('make', 191), ('skills', 187)]
```

In [287]:

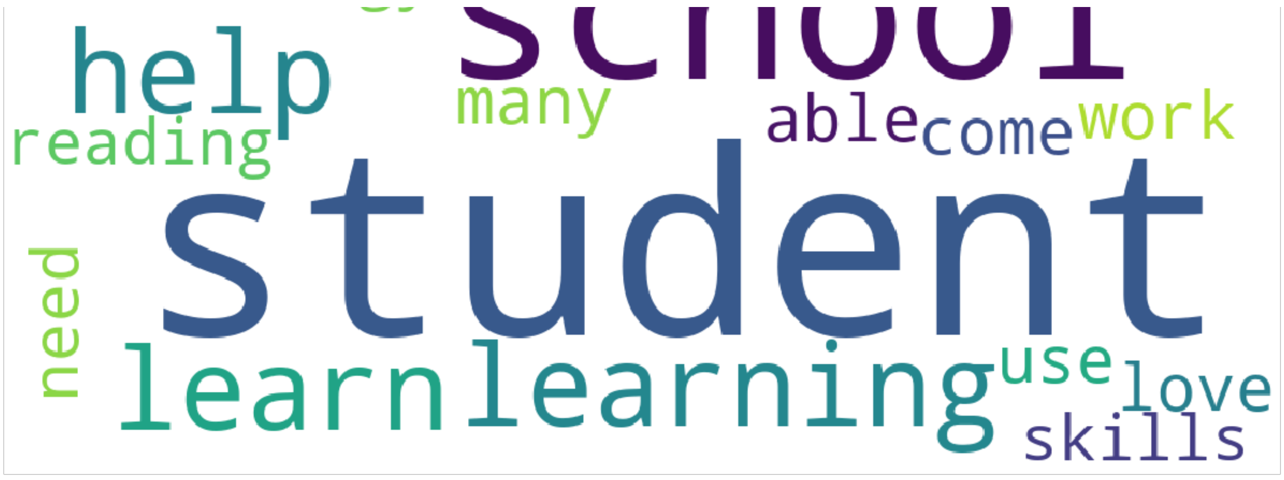
```
plt.barh(range(len(mostcommon)),[val[1] for val in mostcommon], align='center')
plt.yticks(range(len(mostcommon)), [val[0] for val in mostcommon])
plt.show()
```



In [288]:

```
from wordcloud import WordCloud
#convert list to string and generate
unique_string=(" ").join(val[0] for val in mostcommon)
wordcloud = WordCloud(width = 1000, height = 500, background_color ='white').generate(unique_string
)
plt.figure(figsize=(25,10))
plt.imshow(wordcloud)
plt.axis("off")
plt.savefig("Word_Cloud_tfidf"+".png", bbox_inches='tight')
plt.show()
plt.close()
```

classroom
nannan'
make
class
technology
school
new



For Cluster 8:

In [289]:

```
topWords = []
topWordsCount = []
freqDistribution = FreqDist(str(cluster8).split())
W = [word for word in cluster8 if word not in stopwords]
#Identify the top 500 words
count = 0
for word, value in freqDistribution.most_common():
    if(word in W):
        topWords.append(word)
        topWordsCount.append(value)
        count = count + 1
        if(count == 500):
            break
```

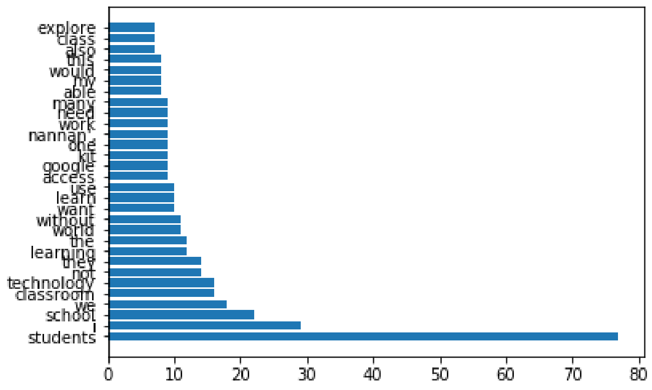
In [290]:

```
mostcommon = freqDistribution.most_common(30)
print(mostcommon)
```

```
[('students', 77), ('i', 29), ('school', 22), ('we', 18), ('classroom', 16), ('technology', 16), (
'not', 14), ('they', 14), ('learning', 12), ('the', 12), ('world', 11), ('without', 11), ('want',
10), ('learn', 10), ('use', 10), ('access', 9), ('google', 9), ('kit', 9), ('one', 9),
("nannan",", 9), ('work', 9), ('need', 9), ('many', 9), ('able', 8), ('my', 8), ('would', 8), ('th
is', 8), ('also', 7), ('class', 7), ('explore', 7)]
```

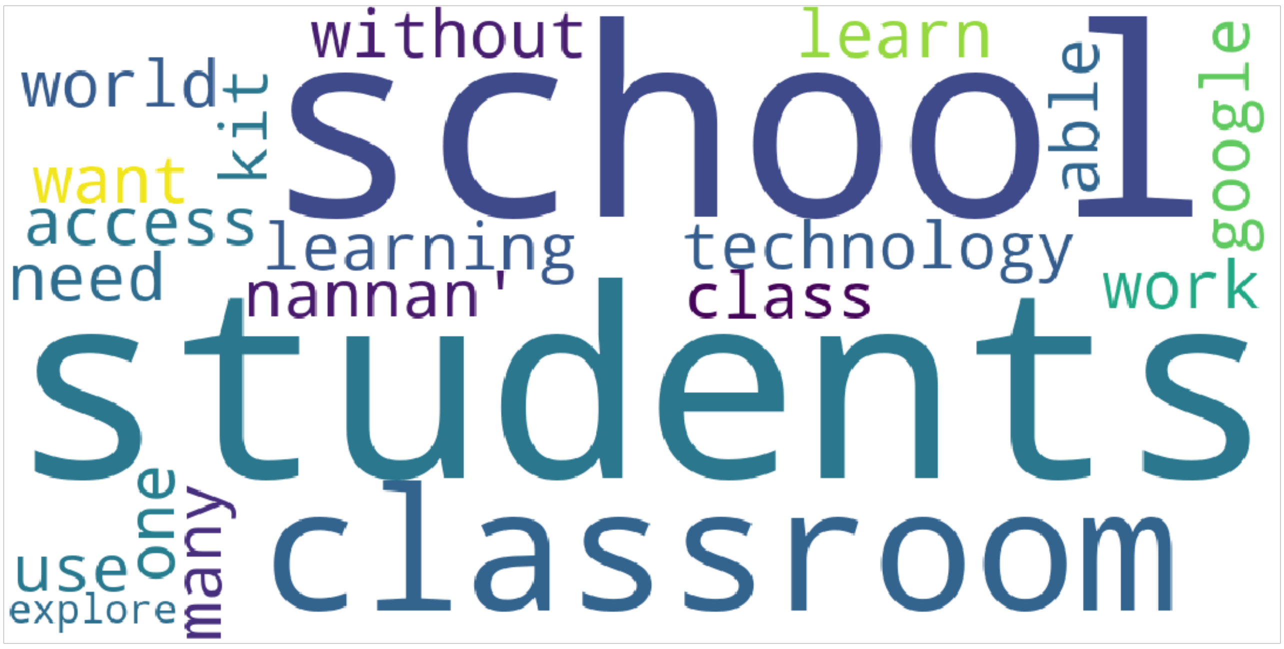
In [291]:

```
plt.barh(range(len(mostcommon)),[val[1] for val in mostcommon], align='center')
plt.yticks(range(len(mostcommon)), [val[0] for val in mostcommon])
plt.show()
```



In [292]:

```
from wordcloud import WordCloud
#convert list to string and generate
unique_string=(" ").join(val[0] for val in mostcommon)
wordcloud = WordCloud(width = 1000, height = 500, background_color ='white').generate(unique_string
)
plt.figure(figsize=(25,10))
plt.imshow(wordcloud)
plt.axis("off")
plt.savefig("Word_Cloud_tfidf"+".png", bbox_inches='tight')
plt.show()
plt.close()
```



For Cluster 9:

In [293]:

```
topWords = []
topWordsCount = []
freqDistribution = FreqDist(str(cluster9).split())
W = [word for word in cluster9 if word not in stopwords]
#Identify the top 500 words
count = 0
for word, value in freqDistribution.most_common():
    if(word in W):
        topWords.append(word)
        topWordsCount.append(value)
        count = count + 1
        if(count == 500):
            break
```

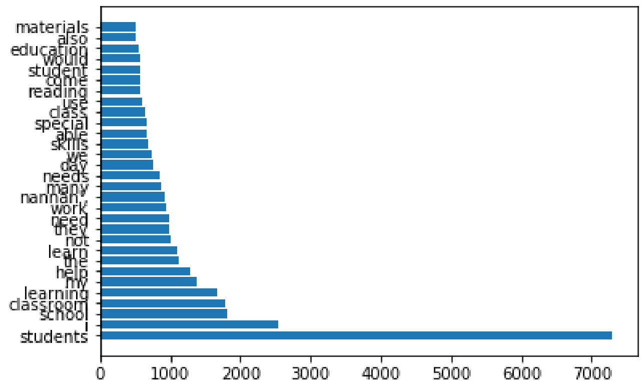
In [294]:

```
mostcommon = freqDistribution.most_common(30)
print(mostcommon)
```

```
[('students', 7285), ('i', 2543), ('school', 1815), ('classroom', 1777), ('learning', 1667),
('my', 1366), ('help', 1281), ('the', 1125), ('learn', 1092), ('not', 1014), ('they', 994), ('need
', 990), ('work', 941), ("nannan',", 908), ('many', 869), ('needs', 843), ('day', 756), ('we',
740), ('skills', 692), ('able', 674), ('special', 672), ('class', 639), ('use', 587), ('reading',
581), ('come', 568), ('student', 567), ('would', 564), ('education', 553), ('also', 514),
('materials', 513)]
```

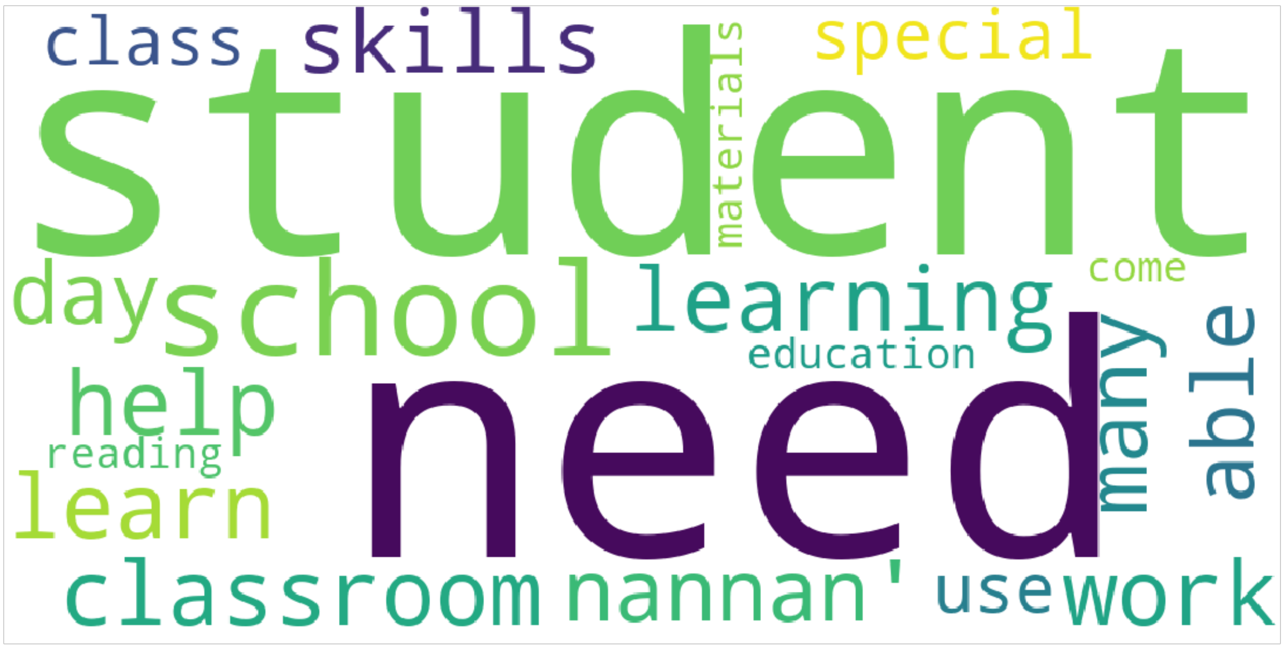
In [295]:

```
plt.barh(range(len(mostcommon)),[val[1] for val in mostcommon], align='center')
plt.yticks(range(len(mostcommon)), [val[0] for val in mostcommon])
plt.show()
```



In [296]:

```
from wordcloud import WordCloud
#convert list to string and generate
unique_string=(" ").join(val[0] for val in mostcommon)
wordcloud = WordCloud(width = 1000, height = 500, background_color ='white').generate(unique_string
)
plt.figure(figsize=(25,10))
plt.imshow(wordcloud)
plt.axis("off")
plt.savefig("Word_Cloud_tfidf"+".png", bbox_inches='tight')
plt.show()
plt.close()
```



For Cluster 10:

In [297]:

```
topWords = []
topWordsCount = []
freqDistribution = FreqDist(str(cluster10).split())
W = [word for word in cluster10 if word not in stopwords]
#Identify the top 500 words
count = 0
for word, value in freqDistribution.most_common():
    if(word in W):
        topWords.append(word)
        topWordsCount.append(value)
        count = count + 1
        if(count == 500):
            break
```

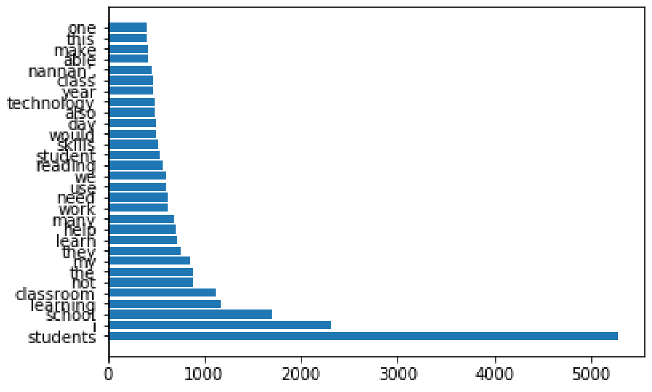
In [298]:

```
mostcommon = freqDistribution.most_common(30)
print(mostcommon)
```

```
[('students', 5290), ('i', 2319), ('school', 1696), ('learning', 1168), ('classroom', 1122),
('not', 886), ('the', 885), ('my', 846), ('they', 755), ('learn', 725), ('help', 709), ('many', 68
7), ('work', 615), ('need', 613), ('use', 606), ('we', 606), ('reading', 565), ('student', 534), (
'skills', 526), ('would', 509), ('day', 509), ('also', 494), ('technology', 491), ('year', 467), (
'class', 464), ("nannan',", 447), ('able', 424), ('make', 417), ('this', 411), ('one', 408)]
```

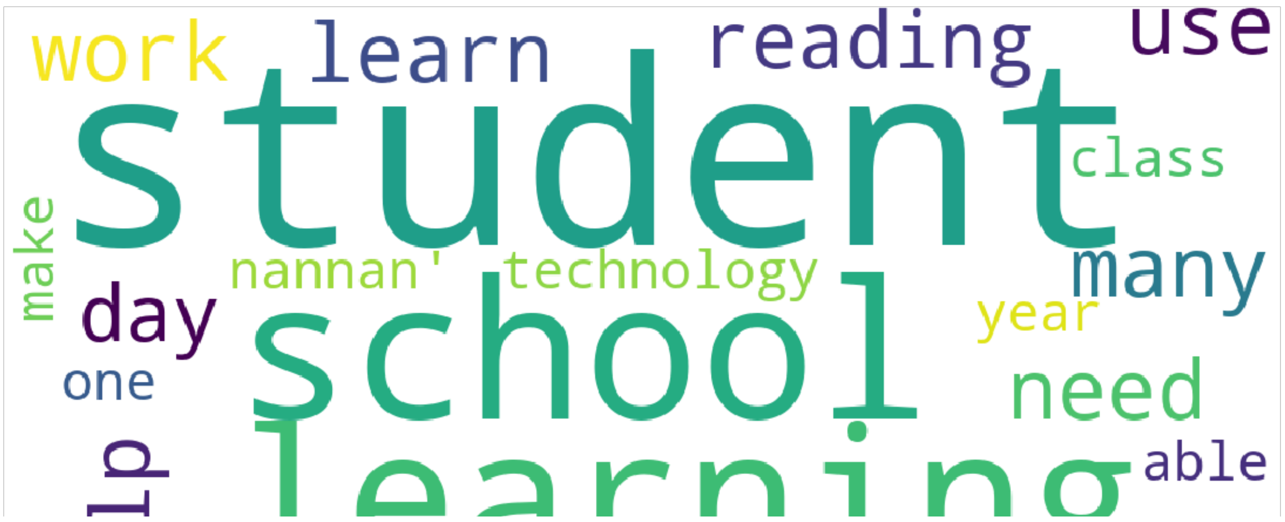
In [299]:

```
plt.barh(range(len(mostcommon)),[val[1] for val in mostcommon], align='center')
plt.yticks(range(len(mostcommon)), [val[0] for val in mostcommon])
plt.show()
```



In [300]:

```
from wordcloud import WordCloud
#convert list to string and generate
unique_string=(" ").join(val[0] for val in mostcommon)
wordcloud = WordCloud(width = 1000, height = 500, background_color ='white').generate(unique_string
)
plt.figure(figsize=(25,10))
plt.imshow(wordcloud)
plt.axis("off")
plt.savefig("Word_Cloud_tfidf"+".png", bbox_inches='tight')
plt.show()
plt.close()
```



Reading essays from a cluster

In [301]:

```
# Cluster 1
count=1
for i in range(3):
    if i < len(cluster1):
        print('Essay-%d : \n %s\n'%(count,cluster1[i]))
        count +=1
```

```
Essay-1 :
 my students english learners working english second third languages we melting pot refugees immig
rants native born americans bringing gift language school we 24 languages represented english lear
ner program students every level mastery we also 40 countries represented families within school e
ach student brings wealth knowledge experiences us open eyes new cultures beliefs respect the limi
ts language limits world ludwig wittgenstein our english learner strong support system home begs r
esources many times parents learning read speak english along side children sometimes creates
barriers parents able help child learn phonetics letter recognition reading skills by providing dv
d players students able continue mastery english language even no one home able assist all familie
s students within level 1 proficiency status offered part program these educational videos
specially chosen english learner teacher sent home regularly watch the videos help child develop e
arly reading skills parents not access dvd player opportunity check dvd player use year the plan u
se videos educational dvd years come el students nannan

Essay-2 :
 over 95 students free reduced lunch i homeless despite come school eagerness learn my students in
quisitive eager learners embrace challenge not great books resources every day many not afforded o
pportunity engage big colorful pages book regular basis home not travel public library it duty tea
cher i provide student opportunity succeed every aspect life reading fundamental my students read
books boosting comprehension skills these books used read alouds partner reading independent
reading they engage reading build love reading reading pure enjoyment they introduced new authors
well old favorites i want students ready 21st century know pleasure holding good hard back book ha
nd there nothing like good book read my students soar reading consideration generous funding
contribution this help build stamina prepare 3rd grade thank much reading proposal nannan

Essay-3 :
 there many little ways enlarge world love books best jacqueline kennedy i work title 1 school
serves students lower income families they often enter 5th grade reading second grade level notion
reading another thing not good i provide motivation want pick book snuggle bean bag read ever life
time i 8 sets students enjoy books classroom library throughout past years result falling apart it
testament much loved reading unfortunately books soon need retired with purchase new books ensure
joy reading continues past school year a haunted mystery series word mouse the babysitters club bo
oks students would love read my students struggle building vocabulary time reach 5th grade no inte
rest picking book i determined change futures sharing joy reading reading allows make connections
beyond limited world gives gateway limitless opportunities your donations help improve classroom
library tangible evidence students i not one thinks reading changes lives nannan
```

In [302]:

```
# Cluster 4
count=1
for i in range(3):
    if i < len(cluster4):
        print('Essay-%d : \n %s\n'%(count,cluster4[i]))
        count +=1
```

```
Essay-1 :
 true champions not always ones win guts by mia hamm this quote best describes students cholla mid
dle school approach playing sports especially girls boys soccer teams the teams made 7th 8th grade
students not opportunity play organized sport due family financial difficulties i teach title one
middle school urban neighborhood 74 students qualify free reduced lunch many come activity sport o
pportunity poor homes my students love participate sports learn new skills apart team atmosphere m
y school lacks funding meet students needs i concerned lack exposure not prepare participating spo
rts teams high school by end school year goal provide students opportunity learn variety soccer sk
```

```
ills positive qualities person actively participates team the students campus come school knowing
face uphill battle comes participating organized sports the players would thrive field confidence
appropriate soccer equipment play soccer best abilities the students experience helpful person par
t team teaches positive supportive encouraging others my students using soccer equipment practice
games daily basis learn practice necessary skills develop strong soccer team this experience
create opportunity students learn part team positive contribution teammates the students get oppor
tunity learn practice variety soccer skills use skills game access type experience nearly
impossible without soccer equipment students players utilize practice games nannan

Essay-2 :
 i work unique school filled esl english second language high poverty students our students indivi
dual personal struggles would break heart step doors would not notice anything positive resilient
attitude learning my students love support every aspect learning journey we students all world spe
aking 77 different languages like family every student welcomed open arms regardless come language
speak education love universal language classroom plenty my students live high poverty conditions
limited no access technology ipads provide opportunity learn playing reading math games engage
inspire these ipads surely hottest commodity classroom students beg get play educational games i t
racking data ipad several educational programs help differentiate learning student students also a
ble track progress programs i look forward seeing students grow use ipads nannan

Essay-3 :
 our second grade classroom next year made around 25 kids many coming spanish speaking families ma
ny receive free reduced priced lunch these inquisitive students often not many educational
resources home need these kids curious world excited learn ready find education offer i excited
teach push meet exceed expectations for many students math subject not pertain life subject stress
es i believe making math not fun also important lives a typical part day calendar math section tim
e talk calendar weather properties day these calendar math journals allow student accountable lear
ning it help paying attention involved time students also expected know count 1 120 understand num
bers these charts important resource different math tasks also provide simple task early finishers
ie fill charts done assignment nannan
```

In [303]:

```python
# Cluster 6
count=1
for i in range(3):
    if i < len(cluster6):
        print('Essay-%d : \n %s\n'%(count,cluster6[i]))
        count +=1
```

```
Essay-1 :
 my students awesome they creative excited learning i privileged teach music rural public school s
erving 900 students grades kindergarten 4th including special group children facing severe physica
l mental disabilities in school high poverty i strive daily provide equitable music experience
students this experience includes exposing students new instruments musical cultures music history
music expression self because many students lack funding physical ability travel unique musical se
ttings i strive bring creative musical world classroom i want see students get healthier teaching
students means american teaching folk songs step down african american traditions american folk so
ngs children anna banana 101 jump rope well types folk songs games jumping rope dancing we jumping
rope songs like sheep meadow dancing songs like little sally water playing games songs this
incorporates history well music i think lots fun students well we get moving still learning nannan

Essay-2 :
 orchestra class unlike ordinary class aside obvious signs class not traditional chair desk look s
tudents class unlike to specific orchestra always enthusiastic even gloomiest days always filled p
ositive energy however music department true exception our combined choir instrumental programs pr
oduced phenomenally talented young adults leaders strive inspire countless audience members it dif
ficult distinguish ordinary high school students first glance yet little know much empowered arts
i teach classroom music grades 1 6 currently class not enough instruments pass around students if
get bells students engaged daily lesson i plan lessons involve students this definitely step right
direction these new bells welcome addition ever growing music classes the students better chance r
ealize musical creative potential as get closer concert performance season plenty students ready c
onfidently creating music nannan

Essay-3 :
 aloha na keiki hawai our classroom cheer sums you love preschool my preschool special education c
lass provides early intervention services qualifying special needs children ages 3 5 years we grou
p actively involved teachers therapists children working together hands learning environment my sc
hool located predominantly rural low income neighborhood considerable portion children hawaiian pa
cific island ancestry playground balls get much work kids bounce roll kick throw after several yea
rs literally hitting rough pavement not holding two balls temporarily hold enough air bounce we ne
ed balls everyone play nets make easy carry my students love bubbles blowing chasing drift across
playground it great fun awesome workout best everyone participates but like bubbles chase bubble j
uice not last we need refill i also want surprise students variety wand shapes experiment birthday
```

```
s big little bunch we bake cupcakes make cards birthday buddy i discovered terrific books birthday
themes include celebrations we need birthday books read nannan
```

In [304]:

```python
# Cluster 10
count=1
for i in range(3):
    if i < len(cluster10):
        print('Essay-%d : \n %s\n'%(count,cluster10[i]))
        count +=1
```

```
Essay-1 :
 all students receive free breakfast lunch school care struggle life great kids these young minds
eager learn waiting opportunities succeed they wonderful around really enjoy spending time friends
teachers community members coaches whenever opportunity they already experienced obstacles adults
ever encounter fewer 25 students meeting grade level standards absolutely love forming rapports le
arning high interest resources manipulate sharing special talents singing dancing cooking etc
normal kid when get see come life sharing special talents non instructional time reinforces
flashes success confidence eventually transfer classroom academically please give students chance
basic school need backpacks develop holistic enjoyment school supporting project you create lifeti
me learners unlock opportunities may otherwise nonexistent with three chromebooks i teach common c
ore standards efficiently enhancing small group learning center classroom our new technology offer
opportunities class intervention without depleting budget hiring personnel run intervention group
rather using uninteresting textbooks able access various online tools resources listen watch
stories utilize interactive math manipulatives video clips modeled lessons help teach reteach
skills district approved curriculums our english language learners struggling even higher performi
ng students receive differentiated instruction meet learning goals frequently in many cases
technology paint picture even adults always searching place identity world parents also learn use
chromebooks drop pick children interact current software programs used class check child
diagnostic assessments identify areas need improvement see exactly child relation current school y
ear calendar with extra copy paper print parent diagnostic reports additional home lessons parents
consistently attend encourage child address areas needed improvement for children parents school c
ommunity insufficient inaccurate communication presented insurmountable challenges as first grade
teacher responsibility show parents students belong school tools ability succeed hopefully create
solid foundation build upon navigate elementary school grade levels eventually dream students
obtain college degree someday journey must begin today nannan

Essay-2 :
 my students special come variety backgrounds i several english language learners classroom well f
our students receiving special education services i 7 students adhd really benefit technological l
earning we live rural community several families not computer access technology they yearn learn c
lassroom extremely difficult get books hands my students enjoy learning computer student created b
logs adpative learning experiences performance tasks differentiated grade level articles
manipulated highlighting annotating text classroom chromebookcar my name shanlee meyers i 3rd
grade teacher rural nevada i attempting raise money purchase 30 chromebooks laptop charging cart c
lassroom our school encourages use technology classroom yet not adequate funding provide
appropriate 21st century resources classrooms instead waiting several years happen i taking
initiative make it happen assistance at school 500 students makes difficult teach technology one c
hromebook cart shared students chromebooks cost effective efficient resource use classroom they gi
ve instant access internet online apps google google docs google slides etc many lessons assessmen
ts could enriched use tool classroom students would learning valuable skills navigating internet r
esearch based activities publishing pieces writing practicing typing skills completing
differentiated lessons additional information chomebooks enhance student learning provided article
scholastic http www scholastic com teachers article chromebooks classroom your support fund chrome
books my goal raise money beginning 2017 18 school year not earlier use school year in society cen
tered around use technology access technology daily basis enable students learn way textbook not d
eliver just consider your job without access computer internet today student job learn order job e
ffectively must appropriate tools nannan

Essay-3 :
 as teacher low income high poverty school district students faced several challenges classroom de
spite challenges face i try make classroom environment feel safe able accomplish anything dream my
students sweet fun loving children i want every one reach stars they love fun activities lots move
ment love reading books hunger nurturing positive attention from minute walk door classroom i focu
s potential growth i may not able control home lives however i certainly control experience school
day by creative positive way i hopeful inspire even earliest learners continue path academic excel
lence sometimes simple hug turn whole child day around unlimited supply around my class filled swe
et students large variety needs learning abilities teaching class many different needs real
challenge as teacher goal provide comfortable learning environment every student for children auti
sm regular classroom scary intimidating place with said belong classroom they intelligent kids i e
ver met fill heart joy everyday i recently went hunt around school find earmuffs students could pa
rticipate classroom brain breaks sadly i found broken pair old headphones cord cut my sweet
students deserve these silencing headphones help students well students receive pull services redu
cing noise help feel comfortable environments lot noise people as teacher i desire everything kids
cing noise help feel comfortable environments lot noise people as teacher i desire everything kids
needs successful it however unrealistic believe i able provide things the sensory seat cushions sp
ecial grip left handed scissors job name badges provide extra tools ensure every child room need s
uccessful enjoy learning nannan
```

DBSCAN

Function To Compute Distance of nth-nearest neighbour

In [76]:

```
# function to determine the distance of nth-nearest neighbour to all points in a multi-dimensional
array
def n_neighbour(vectors , n):
    distance = []
    for point in vectors:
        temp = np.sort(np.sum((vectors-point)**2,axis=1),axis=None)
        distance.append(temp[n])
    return np.sqrt(np.array(distance))
```

Function to call DBSCAN

In [77]:

```
# Function definition for implementing DBSCAN
def dbscan(epsilon, samples, Data):
    from sklearn.cluster import DBSCAN
    db = DBSCAN(eps=epsilon, min_samples=samples, n_jobs=-1).fit(Data)

    # Number of clusters in labels, ignoring noise(-1) if present.
    n_clusters = len(set(db.labels_))
    print("Number of clusters for MinPts = %d and Epsilon = %f is : %d
"%(samples,epsilon,n_clusters))
    print("Labels(-1 is for Noise) : ",set(db.labels_))
    print()
    return db
```

ELBOW METHOD TO FIND RIGHT EPSILON :

In [78]:

```
X_new_agg = X_new.todense()[:5000]
```

In [79]:

```
# Standardising the data
import warnings
warnings.filterwarnings('ignore')
from sklearn.preprocessing import StandardScaler
data = StandardScaler().fit_transform(X_new_agg)
```

In [80]:

```
data.shape
```

Out[80]:

```
(5000, 6000)
```

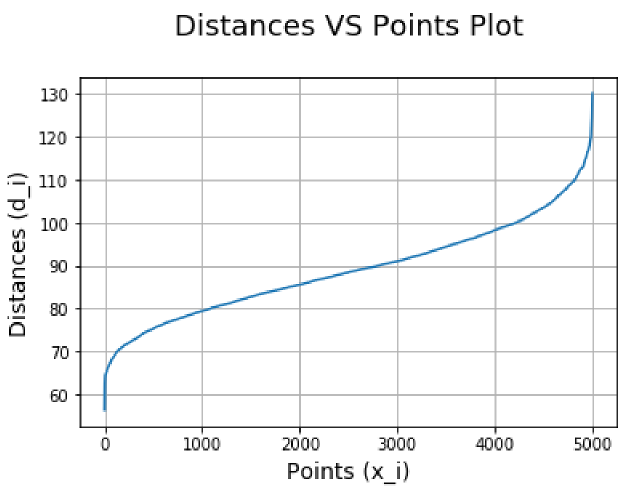
In [81]:

```
min_points = 8
# (ln(5000)=8.5)
# Computing distances of nth-nearest neighbours
```

```
distances = n_neighbour(data,min_points)
```

In [83]:

```
sorted_distance = np.sort(distances)
points = [i for i in range(X_new_agg.shape[0])]

# Draw distances(d_i) VS points(x_i) plot
plt.plot(points, sorted_distance)
plt.xlabel('Points (x_i)',size=14)
plt.ylabel('Distances (d_i)',size=14)
plt.title('Distances VS Points Plot\n',size=18)
plt.grid()
plt.show()
```



In [84]:

```
optimal_eps = 110
# Clustering with right epsilon
db1 = dbscan(optimal_eps, min_points, data)
```

```
Number of clusters for MinPts = 8 and Epsilon = 110.000000 is : 2
Labels(-1 is for Noise) :  {0, -1}
```

- the right value of Epsilon is 110

Creating clusters

In [88]:

```
cluster1 = []
cluster2 = []



for i in range(db1.labels_.shape[0]):
    if db1.labels_[i] == 0:
        cluster1.append(essays[i])

    else :
        cluster2.append(essays[i])


# Number of essays in different clusters
print("No. of essays in Cluster-1 : ",len(cluster1))
print("\nNo. of essays in Cluster-2 : ",len(cluster2))
```

```
No. of essays in Cluster-1 :  4921

No. of essays in Cluster-2 :  79
No. of essays in cluster 2 : 79
```

Word Cloud for Cluster 1:

In [90]:

```python
from nltk import download, FreqDist, WordNetLemmatizer

topWords = []
topWordsCount = []
freqDistribution = FreqDist(str(cluster1).split())
W = [word for word in cluster1 if word not in stopwords]
#Identify the top 500 words
count = 0
for word, value in freqDistribution.most_common():
    if(word in W):
        topWords.append(word)
        topWordsCount.append(value)
        count = count + 1
        if(count == 500):
            break
```

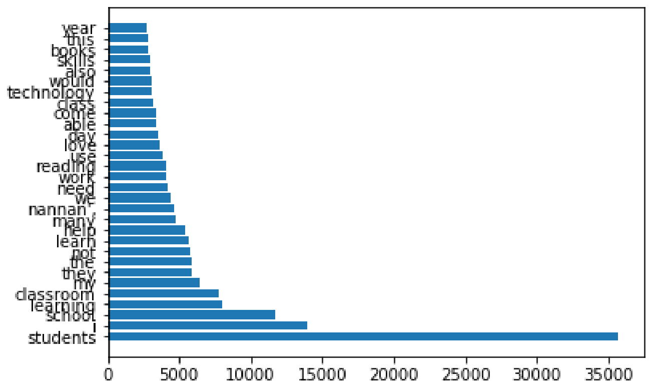
In [91]:

```python
mostcommon = freqDistribution.most_common(30)
print(mostcommon)
```

```
[('students', 35743), ('i', 13929), ('school', 11678), ('learning', 8043), ('classroom', 7834),
('my', 6418), ('they', 5930), ('the', 5922), ('not', 5820), ('learn', 5611), ('help', 5468), ('man
y', 4788), ("nannan',", 4694), ('we', 4395), ('need', 4230), ('work', 4105), ('reading', 4061), ('
use', 3836), ('love', 3590), ('day', 3512), ('able', 3394), ('come', 3362), ('class', 3228), ('tec
hnology', 3121), ('would', 3105), ('also', 2987), ('skills', 2948), ('books', 2829), ('this', 2810
), ('year', 2772)]
```

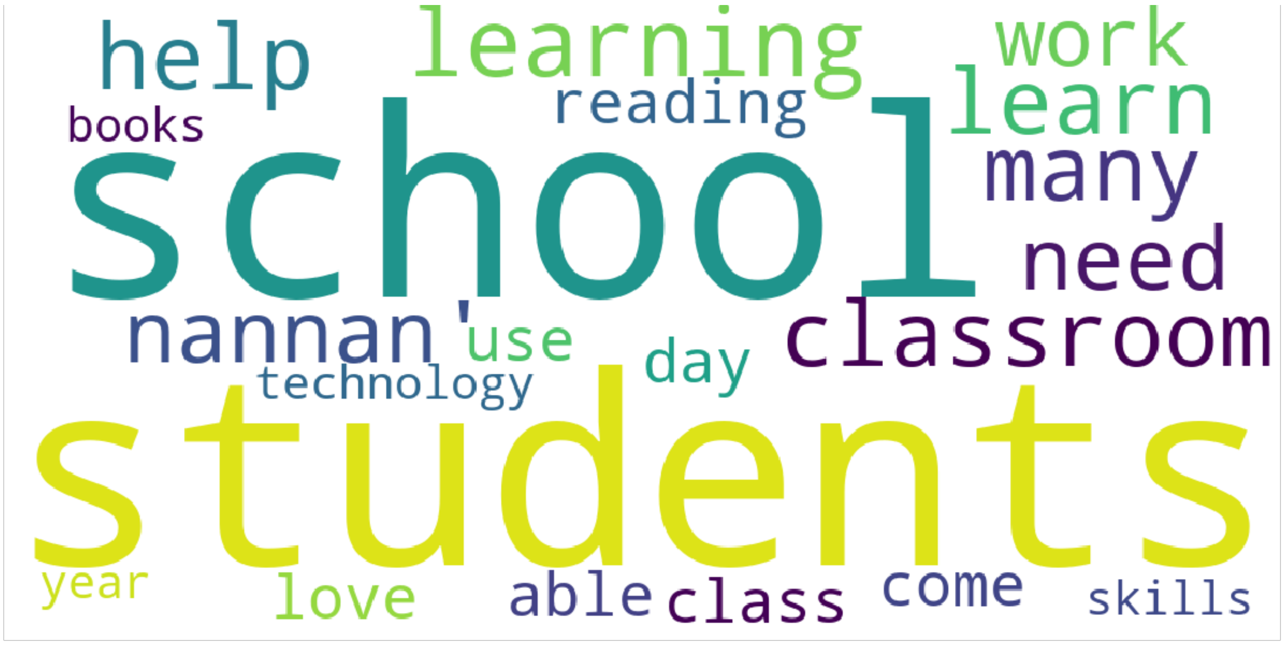
In [92]:

```python
plt.barh(range(len(mostcommon)),[val[1] for val in mostcommon], align='center')
plt.yticks(range(len(mostcommon)), [val[0] for val in mostcommon])
plt.show()
```



In [93]:

```python
from wordcloud import WordCloud
#convert list to string and generate
unique_string=(" ").join(val[0] for val in mostcommon)
wordcloud = WordCloud(width = 1000, height = 500, background_color ='white').generate(unique_string
)
plt.figure(figsize=(25,10))
plt.imshow(wordcloud)
plt.axis("off")
plt.savefig("Word_Cloud_tfidf"+".png", bbox_inches='tight')
plt.show()
plt.close()
```



Word Cloud for Cluster 2:

In [94]:

```
topWords = []
topWordsCount = []
freqDistribution = FreqDist(str(cluster2).split())
W = [word for word in cluster2 if word not in stopwords]
#Identify the top 500 words
count = 0
for word, value in freqDistribution.most_common():
    if(word in W):
        topWords.append(word)
        topWordsCount.append(value)
        count = count + 1
        if(count == 500):
            break
```

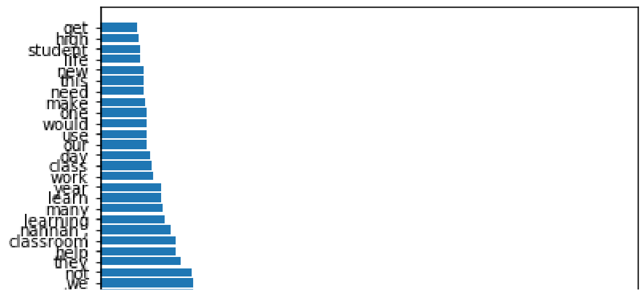
In [95]:

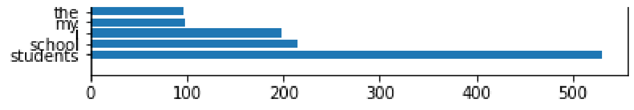
```
mostcommon = freqDistribution.most_common(30)
print(mostcommon)
```

```
[('students', 530), ('school', 215), ('i', 198), ('my', 98), ('the', 97), ('we', 96), ('not', 95),
('they', 84), ('help', 79), ('classroom', 78), ("nannan',", 74), ('learning', 67), ('many', 65), (
'learn', 64), ('year', 63), ('work', 55), ('class', 53), ('day', 51), ('our', 49), ('use', 49), ('
would', 49), ('one', 48), ('make', 46), ('need', 45), ('this', 45), ('new', 45), ('life', 42), ('s
tudent', 41), ('high', 40), ('get', 39)]
```

In [96]:

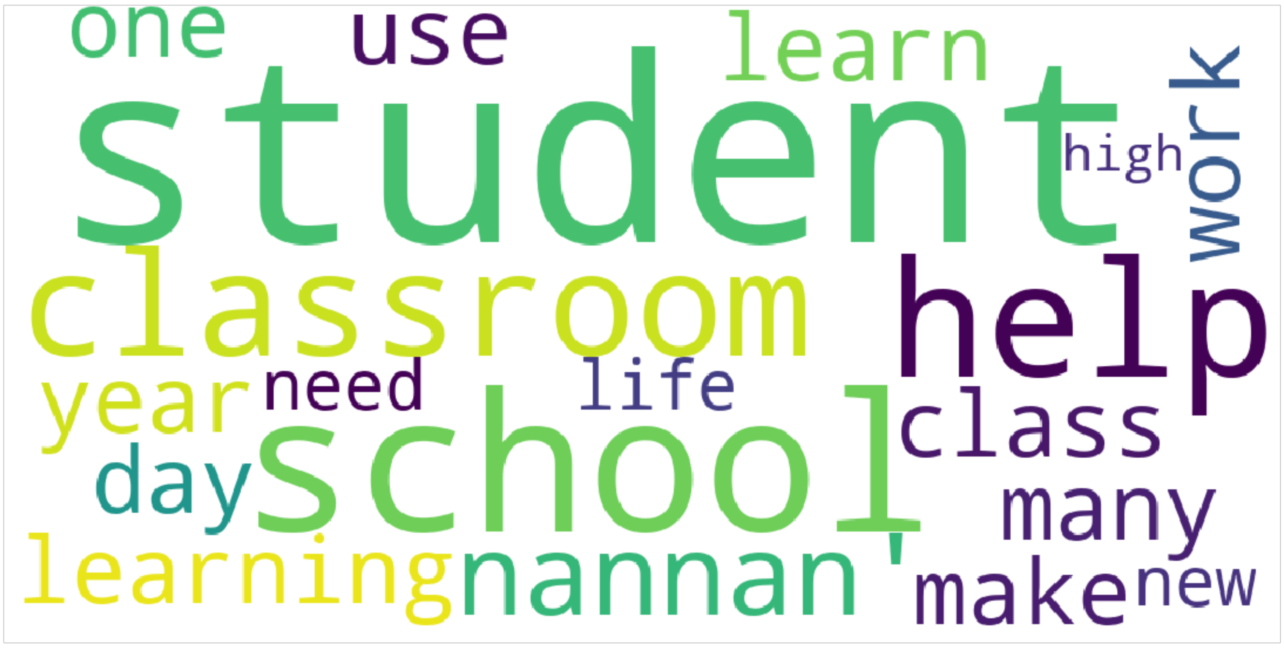
```
plt.barh(range(len(mostcommon)),[val[1] for val in mostcommon], align='center')
plt.yticks(range(len(mostcommon)), [val[0] for val in mostcommon])
plt.show()
```





In [97]:

```
from wordcloud import WordCloud
#convert list to string and generate
unique_string=(" ").join(val[0] for val in mostcommon)
wordcloud = WordCloud(width = 1000, height = 500, background_color ='white').generate(unique_string
)
plt.figure(figsize=(25,10))
plt.imshow(wordcloud)
plt.axis("off")
plt.savefig("Word_Cloud_tfidf"+".png", bbox_inches='tight')
plt.show()
plt.close()
```



Pretty Table

In [100]:

```
# Please compare all your models using Prettytable library
# http://zetcode.com/python/prettytable/

from prettytable import PrettyTable

#If you get a ModuleNotFoundError error , install prettytable using: pip3 install prettytable

x = PrettyTable()
x.field_names = ["Vectorizer Used", "Model", "Tried on 'n' clusters"]

x.add_row(["TFIDF", "KMeans Clustering(Optimal k = 5)", "5"])
x.add_row(["TFIDF", "Agglomerative Clustering","2,5 and 10"])
x.add_row(["TFIDF", "DBSCAN Clustering(minPts=8, Optimal Epsilon=110)","2"])



print(x)
```

```
+-----------------+---------------------------------------------------+------------------------+
| Vectorizer Used |                       Model                       | Tried on 'n' clusters |
+-----------------+---------------------------------------------------+------------------------+
|      TFIDF      |         KMeans Clustering(Optimal k = 5)          |           5            |
|      TFIDF      |             Agglomerative Clustering              |       2,5 and 10       |
|      TFIDF      | DBSCAN Clustering(minPts=8, Optimal Epsilon=110)  |           2            |
|      TFIDF      | DBSCAN Clustering(minPts=8, Optimal Epsilon=110) |           2           |
+-----------------+--------------------------------------------------+-----------------------+
```

3. Conclusions

Procedure followed for K-Means :-

1. Fetch the preprocessed data and TFIDF vectorised data(Similarly we can do for Bow, W2V etc.)
2. Implementing KMeans Clustering
3. Create Clusters
4. Plot WordCloud for each clusters
5. Reading reviews manually for both algorithm KMeans

Procedure Followed for Agglomerative Clustering:-

1. Fetch the preprocessed data and TFIDF vectorised data(Similarly we can do for Bow, W2V etc.)
2. Implementing Hierarchical Clustering using multiple values of clusters such as 2,5 and 10
3. Plotted Word Cloud for all the clusters.
4. Reading reviews manually for each cluster 2,5 and 10

Procedure Followed for DBSCAN :-

1. Fetch the preprocessed data and TFIDF vectorised data(Similarly we can do for Bow, W2V etc.)
2. Then vectorize the data to apply DBSCAN Clustering
3. Standardizing the vectorized data
4. Select the minPts.
5. Applying the Elbow Method or knee method in order to find the correct value of Epsilon
6. Plot distances(radius) VS points to know the inflection point for right value of epsilon
7. Implementing DBSCAN Cluster with optimal Epsilon
8. Create clusters and plot the WordCloud for each cluster