

Analysis of Automated and Personalized Student Feedback to Improve Learner Experience

Ikechukwu Ogbuchi, Atlantic Technological University, Ireland
Etain Kiely, Atlantic Technological University, Ireland
Cormac Quigley, Atlantic Technological University, Ireland
Donal McGinty, Atlantic Technological University, Ireland

The Paris Conference on Education 2023
Official Conference Proceedings

Abstract

Due to the vast amounts of data generated at educational institutions and need for teachers to personalize feedback to every student, having an automated feedback system to support educators is important. Data research teams at the Atlantic Technological University have developed an automated feedback system that sends lecturer feedback to student based on their performance and learning patterns. This was developed using a combination of different technologies from the application of python programming, data cleansing, and API link using Microsoft Power Automate. This paper reports on the student feedback from this system and their experiences reading them. Data gathered from students regarding their experiences in educational institutions is known as student feedback. This feedback can be expressed in speech, writing, or gestures. Additionally, it is utilized by organizations or educators to implement changes to current practices. Students lose focus on the goal of learning when grades are attached to every assignment, whether it be summative or formative, and instead adopt the mindset that they must perform with mastery even from the first time they tackle an issue. This frequently prompts students to look for holes and short cuts to get a decent mark. They avoid learning so that, even if they have not grasped the content, they are more likely to succeed and receive the highest grades. The only way to escape from this grade-oriented fixation is through a fundamental educational change that emphasizes the value of feedback in student learning rather than relying on grades and results. Data used for this pilot study is taken from a selection of first year students (n=206) and this paper discusses the methods used to automate the personalized student feedback and reports on the student experience of the system.

Keywords: Data Analysis, Students, Automate, Microsoft, Feedback, Personalized, Education

iafor

The International Academic Forum
www.iafor.org

Introduction

Research in the field of education emphasizes the significant role of feedback in enhancing students' learning experiences (Mamoon et al., 2016). Alina Mag's study (2019) acknowledges feedback as a crucial aspect of learning, which has been largely overlooked in recent research, particularly from the perspective of students. Her work also emphasizes that students learn more effectively when they receive clear indications of their learning progress and guidance on how to improve. Henderson et al. (2021) further emphasize that learners have diverse needs, and it is important for educators designing feedback systems to consider these diverse groups of students. Nateil Carby's research (2023) concludes that personalized student feedback is an essential strategy for educators.

These studies underscore the increasing recognition of the importance of personalized feedback for students. However, educators and instructors encounter various challenges and obstacles in providing this vital component of student learning. Brit Paris' research (2022) reveals that instructors struggle with the high workload associated with individually providing feedback to numerous students. Michael et al. (2019) also highlights the time constraints faced by instructors in their work.

These challenges have prompted the need for further research to explore new techniques that can automate the feedback process and make it more personalized. The need to understand reasons for low engagement and student dropout as highlighted by O'Brien, C. (2022) also motivated this research.

Methodology

The first step in developing an automated and personalized student feedback system involved gathering student learner data from their virtual learning environment, Moodle. This data was obtained with appropriate permissions either through manual downloads or by utilizing the Moodle API. For our study, we extracted data for 206 first-year students who were enrolled in a Math Module. Once extracted, the data underwent cleaning and transformation processes using Python programming to make it suitable for analysis and personalized feedback generation. During this process, personally identifiable information, apart from student names and registration numbers (for identification purposes), were carefully removed. From the initial dataset containing 56 columns of data, we selected 8 key columns that were relevant for our reporting. The selected columns are described as follows:

Column	Description.
Average Grade	Grade scored for the math module. Numeric values.
Interactions	Interactions count from log files based on Moodle interactions. Numeric value.
Journal Score	Score of student participation in Journal classes (designed to encourage students work together and practice topics under guidance). Numeric value.
Quiz Scores	Score of students during their quizzes. Numeric values.
Journal Attendance	Gives a Percentage of student journal attendance rate. Numeric Value.
Lecture Attendance	Gives students general lecture attendance rate. Numeric value.
Name	Student name for Identification and personalization. String Value.
Email Address	Student's email, tied to the student registration numbers for sending personalized emails. String values.

During the data preparation phase, we conducted checks for missing values and replaced them to ensure data integrity and prevent errors. Following that, a Python script was executed on specific columns such as average Grade, Interactions, Journal score, Quiz, Journal Attendance, and Lecture Attendance. This script iterated through each student and generated five new columns containing comments based on their respective values.

The determination of threshold values for these comments relies on the discretion of the lecturer, and the number of comment categories can be expanded if needed. For this study, the comments were limited to 2-3 categories. However, it is flexible to increase the number of categories to meet the personalized feedback requirements of teachers. The essential aspect is to make decisions regarding the type of comments that should be assigned to students based on their scores within the predefined categories established by the teacher.

This is a snippet of the Python script automation to generate new columns:

```

for i in range(data.shape[0]):
    #Journal
    if data['Journal_score'][i]>=4.5:
        data.loc[i,('journalcomment')] += "Your Total Journal score was way above the average. Way to go! Keep it up."
    elif data['Journal_score'][i]>=2.5:
        data.loc[i,('journalcomment')] += "Your Total Journal score was above average.
        "Good one, keep trying hard to complete all journals."
    elif data['Journal_score'][i]<2.5:
        data.loc[i,('journalcomment')] += "Your Total Journal performance was below average.
        "..We know that maths could be challenging, but we believe that with consistent and frequent work you can
        "..achieve better outcomes."

    #Quiz
    if data['Quiz_score'][i]>4:
        data.loc[i,('quizcomment')] += "You performed well above average on your Quizzes. You should be happy! Keep it up"
    elif data['Quiz_score'][i]>=2.5:
        data.loc[i,('quizcomment')] += "You performed above the average score for your quizzes,however mastery requires
        ".. repetition until can't get it wrong."
    elif data['Quiz_score'][i]<2.5:
        data.loc[i,('quizcomment')] += "Your performance on the Quizzes was below average. We believe you can achieve mast
        "..if you try to put in more effort, we can support you."

    #Attendance
    if data['Lecture_attendance'][i]>=70:
        data.loc[i,('attendancecomment')] += "Your attendance rate has been great this semester. Keep it up"
    elif data['Lecture_attendance'][i]<70:
        data.loc[i,('attendancecomment')] += "You need to attend your classes often to improve your attendance score"

    #Interactions
    if data['interactions'][i]>=690:
        data.loc[i,('interactioncomment')] += "Our systems show you are interacting very well with Moodle.
        "That is a good habit. Keep it up"
    elif data['interactions'][i]>200:
        data.loc[i,('interactioncomment')] += "Our systems show your level of interaction with moodle is below average.
        "Evidence shows that students who interact frequently with the online materials perform well in the module."
    elif data['interactions'][i]<=200:
        data.loc[i,('interactioncomment')] += "Our systems show you have not been interacting with moodle that much.
        "We hope everything is okay? Let us know how we can help you through the feedback form"

```

Figure 1: Code Snippet showing Python Comment Automation

In the provided code snippet, thresholds were established for the Journal, Quiz, Attendance, and Interactions columns. Based on the scores within each column, individual comments are generated for every student. Let's consider the Journal score as an example. If a student achieves a score of 4.5 or higher, they are considered to be performing well, and the corresponding comment "Your total journal score was way above average. Way to go! Keep it up" is assigned. In case the first condition is not met, the code proceeds to the next condition, checking if the student's score is 2.5 or higher. In this case, the comment "Your total journal score was above average, good one, keep trying..." is assigned. Lastly, for scores below 2.5, the student is given the comment "Your Total Journal performance was below average. We know that math can be challenging, but we believe that with consistent and frequent work, you can achieve better outcomes."

The automation process applies the same logic for the Quiz, Attendance, and Interactions columns, with thresholds and corresponding comments set by the teacher.

After generating the new columns with comments, a preview of the data is conducted to verify that the columns were created correctly and that the assigned comments align with the corresponding scores, as illustrated in Figure 2.

Out[41]:

Lecture_attendance	attendancecomment	Quiz_score	quizcomment	Journal_attendance	Journal_score	Journal_without	journalcomment	Exam_Contribution
63.16	You need to attend your classes often to impro...	1.5	Your performance on the Quizzes was below aver...	78.57	1.21	1.54	Your Total Journal performance was below avera...	0.00
68.42	You need to attend your classes often to impro...	4.5	You performed well above average on your Quizz...	85.71	2.34	2.73	Your Total Journal performance was below avera...	6.07
94.74	Your attendance rate has been great this semes...	4.5	You performed well above average on your Quizz...	100.00	4.80	4.80	Your Total Journal score was way above the ave...	7.86
77.78	Your attendance rate has been great this semes...	4.5	You performed well above average on your Quizz...	83.33	3.03	3.64	Your Total Journal score was above average. Go...	6.79
22.22	You need to attend your classes often to impro...	0.0	Your performance on the Quizzes was below aver...	16.67	0.06	0.38	Your Total Journal performance was below avera...	0.00
...
50.00	You need to attend your classes often to impro...	0.0	Your performance on the Quizzes was below aver...	16.67	0.00	0.00	Your Total Journal performance was below avera...	0.00
100.00	Your attendance rate has been great this semes...	4.5	You performed well above average on your Quizz...	100.00	3.60	3.60	Your Total Journal score was above average. Go...	6.43
73.68	Your attendance rate has been great this	3.0	You performed above the	85.71	3.07	3.59	Your Total Journal score	7.14

Figure 2: Preview of Combined Data after Automated Comments

A configuration was established to integrate Microsoft Power Automate with the output generated by the Python script, enabling the dispatch of emails using a pre-designed template. The data containing individual comments is directed to Power Automate, where an email template containing general information for all students is generated. To establish the connection between the data with individual comments and the Power BI API, the Python requests package (Chandra et al., 2015) was utilized. In the provided code snippet, the section marked "http://" should be substituted with the URL link provided by Power Automate during the creation of the flow:

```
In [51]: ▶ import requests
count=0
url='http://XXXXXXXXXXXXXXX'
for i in testing_stream:
    headers = {'Content-type': 'application/json', 'Accept': 'text/plain'}
    r = requests.post(url, data=json.dumps(i), headers=headers)
    print(r)
    count+=1
```

Figure 3: Connecting to Power Automate for Email Dispatch

The email template in Flow once the data has been pointed to its URL, would look like this and is customizable:

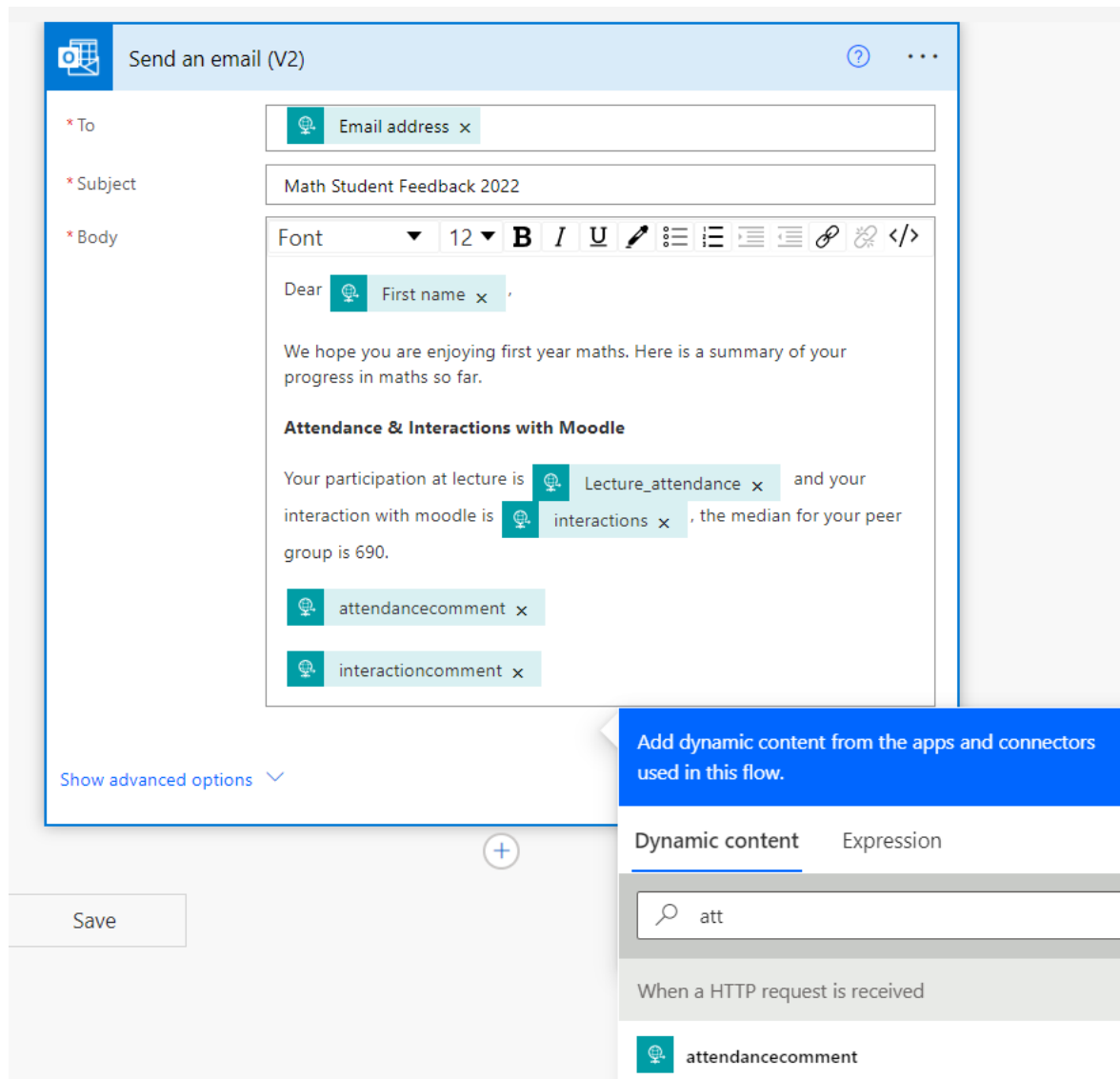


Figure 4: Customizing Power Automate Flow to pick values from automation

As shown in image above, once data from the Python script is connected to Flow, the column values will show as dynamic content. Dynamic content refers to data produced from an action and acts like a placeholder for each row of data coming through the API.

With this dynamic content, once template is created and customized, the personalized comments and different values will be replaced for each email sent from the template.

This was customized and emails were sent out to students within minutes after a few test emails using dummy data was used to test how the email would be received by students. The email below is a preview of the test emails sent with Exam score set at zero.

S Student Feedback - ☺ ⏪ ⏩ ⋮
To: Mon 21/11/2022 14:08



Dear ██████

We hope you are enjoying first year maths. Here is a summary of your progress in maths so far.

Journal Work (20%)	Quizzes (15%)	Exams (65%)	Marks so far	Average Mark so far %
1.21	1.5	0	2.71	100

Remember there is no such thing as a maths gene. All our brains have a remarkable capacity to grow and change with **frequent practice and effort**.

Attendance & Interactions with Moodle

Your participation at lecture is **63.16%** and your interaction with moodle is **376**, the median for your peer group is **690**.

You need to attend your classes often to improve your attendance score

Our systems show your level of interaction with moodle is below average. Evidence shows that students who interact frequently with the online materials perform well in the module.

Journal Work (Mandatory Attendance)

*Your participation in journals is **78.57%***

*Your journal score is **1.54** and weighted by your attendance is **1.21**.*

Your Total Journal performance was below average. We know that maths could be challenging, but we believe that with consistent and frequent work you can achieve better outcomes.

Moodle Quiz Effort

Each Mastery Quiz is worth 1.5%, you need to get 100% in the Quiz to realise this.

*Your quiz score is **1.5***

Your performance on the Quizzes was below average. We believe you can achieve mastery if you try to put in more effort, we can support you.

Quizzes are a great opportunity to practise and learn from your mistakes

Exams

*You achieved **0** in your exams so far.*

Total Marks For Maths

*Your marks so far in maths is **2.71** out of the 19.5% available. This gives you an average score of **100** calculated by (course contribution/available marks) * 100%*

We would like to get your feedback by 12:00pm on Friday, 25th November, 2022 through the form at this link: [Course Feedback Link](#)

Figure 5: Test Sample Email Created for Demonstration Purposes

After confirming the satisfactory appearance of the test emails, all 206 emails were automatically sent to the respective students based on their uniquely generated comments.

Results

Results of the feedback form received from the students to get their perspective on the form showed that 93% found this feedback very useful.

Rate the personalised feedback email (5 = really good, 1 = poor)

[More Details](#)

 Insights

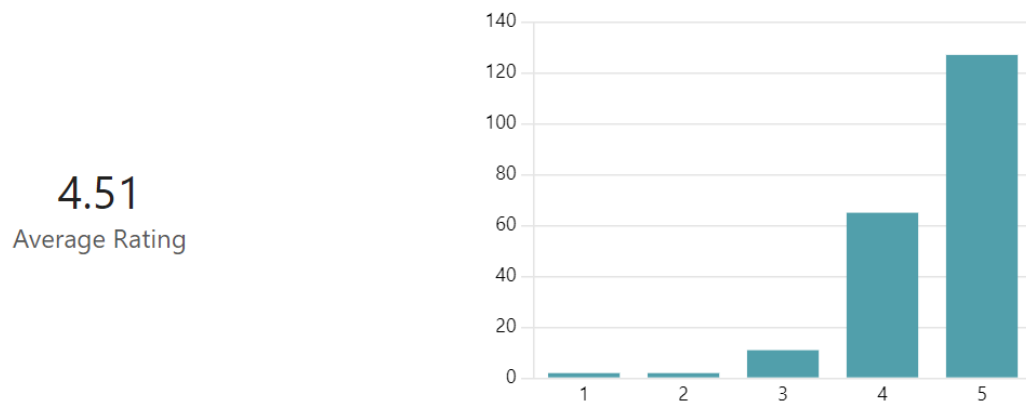


Figure 6: Overall Rating of Student Feedback by Participating Students

93% rated between "4 - 5" for this question

Score distribution



Figure 7: Rating Distribution for Question

We also asked students to comment freely on their choice of rating and we received 203 response many of which found the feedback good and useful. The figure below shows a word cloud of the most common responses we got:

Please comment

[More Details](#)

[Insights](#)

203
Responses

Latest Responses

"good"

"You get your feedback, that's all."

"i find them very handy and easy to understand"

[Update](#)

53 respondents (26%) answered **good** for this question.



Figure 8: Word Cloud of Free Comments from the Students

We asked the students how best they would want to receive this kind of feedback and we found majority of students preferred to receive this kind of feedback by email as the word cloud of responses showed:

169 respondents (82%) answered **email** for this question.



Figure 9: Word Cloud of Student Preference to Receiving Personalized Feedback

Finally, we wanted to find out how the language used for this feedback made them feel. It was interesting to see a lot of positive responses as shown in the word cloud:

How did the language used in the personalised feedback form make you feel?

[More Details](#)

[Insights](#)

206

Responses

Latest Responses

"good"

"I understood it so it's not too complicated "

"good "

[Update](#)

55 respondents (27%) answered **Good** for this question.



Figure 10: word Cloud Preview of How Language Used Made Students Feel

Conclusion

We believe from results of this research that automating personalized feedback for student hold potential to be of value to students and support educators overcome the challenges of having to give this kind of feedback considering the volume of students and time commitment required.

Acknowledgements

Grateful to the management and Staff of the Atlantic Technological University for sponsoring this research under the Research, Innovation and Strategic Endowment (RISE) funding streams.

References

- Carby, N. (2023). Personalized Feedback in a Virtual Learning Environment. *Journal of Educational Supervision*, 6(1). <https://doi.org/10.31045/jes.6.1.3>
- Chandra, R. V., & Varanasi, B. S. (2015). *Python requests essentials*. Packt Publishing Ltd.
- Henderson, M., Ryan, T., Boud, D., Dawson, P., Phillips, M., Molloy, E., & Mahoney, P. (2021). The usefulness of feedback. *Active Learning in Higher Education*, 22(3), 229–243. <https://doi.org/10.1177/1469787419872393>
- Henderson, M., Ryan, T., & Phillips, M. (2019). The challenges of feedback in higher education. *Assessment & Evaluation in Higher Education*, 44(8), 1237-1252. <https://doi.org/10.1080/02602938.2019.1599815>
- Mag, A. (2019). The value of students' feedback. *MATEC Web of Conferences*, 290, 13006. <https://doi.org/10.1051/mateconf/201929013006>
- Mamoon-Al-Bashir, M., Kabir, M. R., & Rahman, I. (2016). The value and effectiveness of feedback in improving students' learning and professionalizing teaching in higher education. *Journal of Education and Practice*, 7(16), 38.
- O'Brien, C. (2022). Student dropout rates climb across several universities amid concern over low engagement. *The Irish Times*. <https://www.irishtimes.com/ireland/education/2022/05/28/student-dropout-rates-climb-across-many-universities-amid-concern-over-low-engagement/>
- Paris, B. M. (2022). Instructors' Perspectives of Challenges and Barriers to Providing Effective Feedback. *Teaching & Learning Inquiry*, 10. <https://doi.org/10.20343/teachlearningqu.10.3>

Contact emails: ikechukwu.nigel@yahoo.com
ikechukwu.ogbuchi@research.atu.ie