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CASE STUDY: MANAGING THE MONITORING SYSTEM FOR ATTENDANCE TRACKING USING SURVEY ADMINISTRATION SOFTWARE[5] [6]

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Abstract: The paper purposes a variation of attendance tracking system based on an online survey administration software (Google Forms and Google Spreadsheets). It includes guide for recreating such system. The system aims to cover the process of attendance tracking in chosen disciplines in University of Ruse "Angel Kanchev" and thus it is affected by particular decisions regarding the specific environment and processes in the organization. The main target for the system was to improve the speed of the traditional (in the organization) attendance monitor system (in particular signing the names and student IDs to a paper sheet) without significant trade-offs. The main disadvantages (comparing to the traditional approach) are requirements of internet-access for the guests at sign-in phase and internet-access for the moderator at checking phase. The system covers specific needs: both online and in-class lessons; anonymous and non-registered users access; ability to export the data to the main journal of the discipline; fast and easy usage for the visitors. Other advantages and limitations comparing other traditional and modern alternatives are discussed.
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JEL Codes: I20, D73, M15

INTRODUCTION

Organizations in educational fields rely on attendance monitoring systems in context to provide the measurement of the quality of the educational process. The conventional approaches for attendance tracking using the attendance sheets require time to collect and transfer the records to the system, and/or require time for the preparation of such attendance sheet. On the other hand, approaches using barcodes, RFID, NFC, biometrics are complex and require additional cost for establishing the whole system. Their limitations and challenges regarding privacy issues, lack of flexibility affects their performance. Additionally, integration of these systems often means loss of manual control over the records by the moderator. It can generate other consequences, i.e. students who are lost/forgot their card cannot attend the event, unexpected guests cannot attend the event, registered guests have to complete their identification profiles in the system (in some cases it means to visit the organization to receive id card/tag or to apply their biometrics.

This article proposes a cost-efficient approach for attendance tracking, that is at least as accurate, as the convenient approaches, compatible both for online and in-room lessons. The comparison with the convenient approaches is presented as well in the context of total time consumption, required by both methods for ensuring the attended visitors are transferred to the information system, used by the moderator

EXPOSITION

Creating attendance monitoring system using Google Drive ecosystem

The attendance monitoring system includes following elements: an online form, linked spreadsheet, main journal of the course (in the particular case a Google Sheet to). The system consists of three phases: preparing the attendance form for the course, providing attendance check at the lessons, and transferring attendance information to the main journal of the course.

The process of creation the attendance form follows steps:
a. Attendance form creation;
b. Preparation of linked spreadsheet for exporting and checking responses;
c. Connecting to the main journal of the course;
d. Organizing the form's distribution.

The attendance check itself contains of following steps:
a. The teacher shares the form with the students;
b. The students fill the attendance form;
c. The teacher approves the entries. Any corrections to the entries can be made on this step.

The transferring phase depends on the integration scheme. In our case the attendance information transfers automatically to the main journal or it transfers after pasting the prepared formulas into the corresponding lesson cells in the main journal of the course.

Attendance form creation

In our case teachers need to create a form for each course using Google Forms application. The ready form is shared to other teachers in the team. A standard form creation process takes between 5 and 20 minutes (using template or copying the fields manually from previous forms). In case the teacher creates non-standard forms with advanced rules this time may be longer.

Description and appearance. The teacher adds the description to the header of the form including the course name, and a brief guide for the guests. Optionally he can adjust the visual appearance of the form.

Identification fields. The form includes fields that will identify the visitors. We use student IDs, as they can be typed faster by students, it is more reliable than typing names. The name, email or any other type of identification information may be added if necessary, but in this case we do not require such information, keeping the form easy and fast. Additionally, we apply validation rules on the student's ID format to avoid entering the wrong type of data.
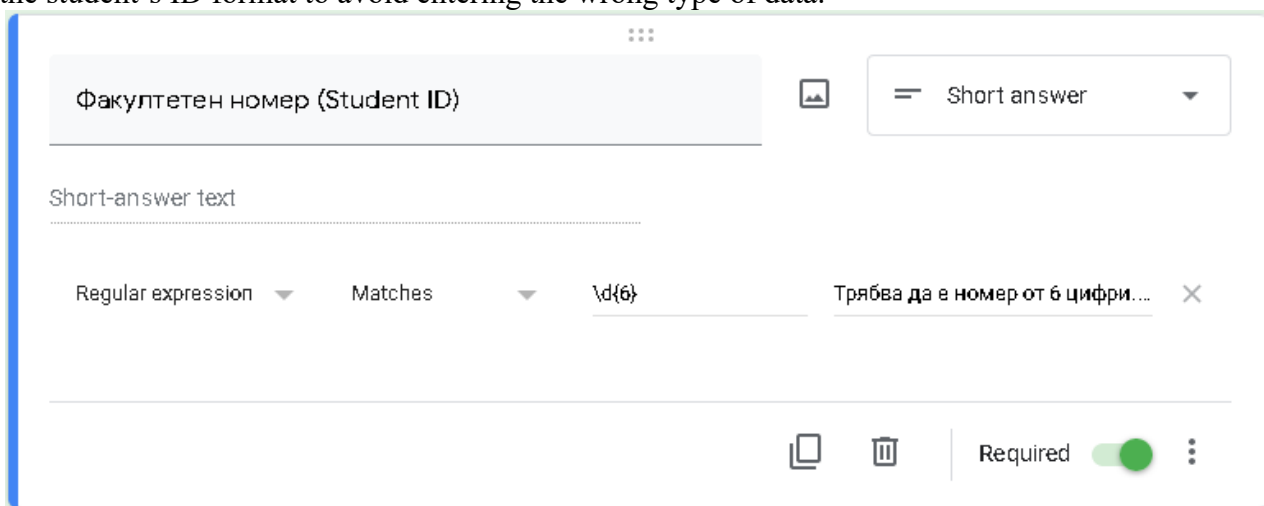

Fig. 1. Creating a text input field for student ID and adding validation rules.

Event type fields. Add a field regarding the event (i.e. type of lesson, section, or visitor action type (entrance/exit)). We have added a type of lesson and it has two options: lecture and seminar (Лекция/Упражнение). The field is helpful in case the moderator tracks different event types, separates groups or modes, tracks repeating events, separates parallel groups learning at the same time etc.

After finishing these steps we get a complete form.

Fig. 2. The look of completed form.

Testing the form. First we try to input some invalid dummy data to ensure that the form performs the field validation. After that we input valid data to ensure that the form receives the responses. Another reason is to have filled rows in the linked spreadsheet when we add formulas. After we ensure the form is ready we get the link to the form.

The completed form can be copied and stored as a template for creating forms for other courses to speed up the process of the form creation.

Spreadsheet preparation

A generated Google spreadsheet is used for the entries processing. After the form is ready we create a new linked spreadsheet to sync all the incoming entries and process them. The linked spreadsheet can be created/opened using the button ⊞ on the responses tab of the form.

Fig. 3. Responses tab of the created form.

Fig. 4. Dummy response recorded on the linked spreadsheet.

We have some initial columns added by the system in the generated spreadsheet: one for response timestamp (column A); and a column for each created field. In our case: lesson type (column B) and student ID number (column C). We fill the headers for additional columns where the values will be manually entered by the moderator (columns D and E) or by pasting formulas (columns F, G and H). We add optional columns for manual input (columns I, J and K). The edited spreadsheet is shown on Fig. 4.

These columns include information on:

- week or lesson number (column D). This data should be entered manually by the teacher. Usually the teacher enters the digit on the first row and pulls it down, copying the value to the rest of the entries.
- hours attended on the particular lesson (column E). Manually entered by the teacher. The usual practice is to enter a default hours' number for all students in the room and edit it afterwards (i.e. at the check time or when the student quits the lesson).
- the record's unique identification, which can be represented by a concatenation function of student id, lesson type and lesson number fields (column F). The purpose of this field is to count the number of entries by the same student, preventing duplicates, since there are no limits for the number of entries for the students. The formula for the row number 2 in the spreadsheet is =CONCATENATE(B2,D2,"_",C2)
- counter of unique records (column G). The column shows the count of the duplicating entries in column F. If its result is 2 or more, it means that the value in column F has duplicates. The teacher needs to manually delete the rows with duplicated data. The formula for the row number 2 is: =COUNTIF(F:F,F2)
- students' names (column H). The column is optional. The names are retrieved from another spreadsheet where the ids and names are stored. The formula for the row number 2 is: =VLOOKUP(C2,IMPORTRANGE("https://...","Sheet1!E:F"),2,0)
    - https://... - URL of the referenced spreadsheet
    - Sheet1 - the name of the sheet with referenced data
    - E:F - the imported columns from the referenced spreadsheet containing ids (E) and names (F)
    - 2 - the number of the column in the above imported range containing the students' names
    - 0 - only the names with the exact match of student id will be shown. If there is no such id, the value of the cell will be "#N/A"
    - After the formula is entered for the first time the teacher connects the referenced spreadsheet by clicking on the "Allow access" button.
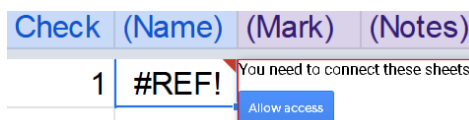

Fig. 5. Allow access button for connecting the spreadsheets.

- student's mark (column I). The column is optional. It may be connected with the main journal passing back the marks for each lesson.
- notes (column J). The column is optional.
- subject of the lesson (column K). The column is optional. It is helpful, when teacher rotation is in place; different groups of students have different schedules; the study program is flexible, etc.

	A	B	C	D	E	F	G	H	I	
1	Timestamp	Тип занятие /	Факултетен номер	Номер занятие	Часове присъствия	ID	Check	Име (Name)	Оценка (Mark)	Забежк (No
2	08/10/2021	Лекция	123456	1	2	Лекция1_123456	1	#N/A		
3	19/10/2021	Лекция	255001	1	2	Лекция1_255001	1	Павлина Ставрова		
4	19/10/2021	Лекция	255002	1	2	Лекция1_255002	1	Христо Благоев		
5	19/10/2021	Лекция	255003	1	2	Лекция1_255003	1	Петя Костадинова		
6	19/10/2021	Лекция	255004	1	2	Лекция1_255004	1	Емилия Димитрова		
7	19/10/2021	Лекция	255005	1	2	Лекция1_255005	1	Момчил Михайлов		
8	19/10/2021	Лекция	255006	1	2	Лекция1_255006	1	Октай Ахмедов		
9	19/10/2021	Лекция	255007	1	2	Лекция1_255007	1	Даниела Петкова		
10										

Fig. 6. Filled form with students' test entries. (The names and student IDs are fictional)

Form distribution

Google Forms can be distributed to the respondents in several ways: via email, link or as embedded part of html page. We use link sharing to give the students access to the form. We store the link with other class materials. We paste the link to the public chat at the beginning of each online lesson; publish it on the e-learning platform page. When we have face-to-face lessons we present a short link on the screen (i.e. using URL shortener such as bit.ly), or showing QR-code (i.e. generated on qrcode-monkey.com). Since the form URL is static the link and QR-code can be printed as well. The teacher has to keep in mind that some symbols look similar (capital "o" and zero digit, etc) when he shows the link on screen or prints it on paper. We recommend using monospace fonts with clear symbol differentiation (i.e. Roboto mono, Courier New, etc.) and check the final look of the link before printing.

Fig. 7. QR code and shortened URL linked to the attendance form.

Filling the attendance form

After the link is presented to the students they enter the form and fill their information: student ID and lesson type. The form sets no limits for responses from any visitor, no sign-in is required to fill the form.

While the form receiving the responses the teacher adds values for the number of the lesson and the duration of the lesson, checks if any student enters wrong information (wrong lesson number or a typing mistake in student ID). At this point the teacher can correct such mistakes by hand inside the spreadsheet. After the responses are filled the formulas for additional columns can be pasted. The teacher can delete duplicating records if there are any.

Optional roll call

If the guest list requires additional accuracy control, the teacher could initiate additional check in the same way as it proceeds in the traditional approach:

a.Counting the filled rows, counting the visitors in the room, comparing the results. If the numbers are unequal - the information in the list is probably incorrect.

b. Reading aloud the names in the list. The visitors raise their hand or say their names.

c.Asking visitors to say their name in the order of the seats in the room.

The teacher marks approved guests by either applying rich formatting on their records (bold, underline text, etc.) or writing notes in the corresponding column.

Integration with other systems

Since the attendance form is based on Google Form and Google Spreadsheet applications it can be easily integrated with other Google Spreadsheets in the Google Docs ecosystem. That is, the approved entries from the linked spreadsheet can be passed to the main journal of the course, in case it is based on Google Spreadsheets as well. It can also be exported to the outer systems using services like Zapier. The third option is to use Google App Script to transfer the attendance from the spreadsheet to any third-party system using http requests.

RESULTS

Tested environment

The approach has been tested in several courses starting from 2018 including full-time mode (14 lectures + 14 seminars), part-time mode (5 lectures + 5 seminars), e-learning mode, periodically migrating between face-to-face and online lessons due to COVID-19 situation:

2018-present - Supply Chain Management: total 90-130 students/year, 8-9 groups/year,

2018-present - Marketing Management: total 70-130 students/year, 5-6 groups/year

2020-present - Computer-based research skills: total 7 students/year, 1 group/year

2021-present - Cyber attacks and National Security: total 15 students/year, 1 group/year

2021-present - Information Systems and Technologies, Part II. This course has some specifics, reflecting on attendance checks. There are 7 lectures. The course is split in two sub-courses, there are two independent teams of teachers - one for each sub-course. Each team provides 7 seminars. In seminars the students are split in sub-groups (8-15 students). The sub-groups can work sequentially or in parallel (in different rooms with different teachers).

Since March, 2020 due to the COVID-19 situation the study process mode has been periodically changing between online and face-to-face environments. The proposed approach had been applied for the both environments without significant modifications (posting the links to the e-learning or video-conferencing platform instead of showing the link/code on the whiteboard on face-to-face lessons)

Average processing time

Creating the form - Average time needed to prepare the form for using in the class. For the proposed approach it means to create a single form which can be used by each group in the course. For the traditional approach it means finding a blank sheet.

First time interaction - Average time for explanation on how to fill the attendance form. For the proposed approach in face-to-face mode it can include guidance on how to enter the URL, scan the QR-code or where to find the posted link.

Process the attendance checks - The time needed for the group to fill the form. This time should be taken into account only for specific purposes (i.e. does the teacher have enough time to accomplish the attendance check). In most cases this process goes in parallel with the lesson. Still the process may distract the attention of the student for the time of filling the form.

Processing responses - The time spent to add the attendance records to the main journal.

Table 1. Estimated time values for the components of attendance check in traditional and proposed approaches.

Time (minutes)	Traditional approach	Proposed approach (face-to-face mode)	Proposed approach (online mode)
Creating the form	0	20	20
First time interaction	2	8-15*	1
Process the attendance check	3-17*	3-8*	2-3*
Processing responses (copy to the main journal)	2-8*	2	2

* Depends on the number of students in the group

Total time spent by teacher for attendance check

Here we compare the traditional approach and the proposed approach in different environments (number of students in a group, using existing form or creating a new one, number of lessons where the attendance check is initiated).

First we compare the approaches in the following scenario: the teacher creates the form for attendance check and uses it for one group of students only; there will be 14 lessons, the attendance check is initiated on every lesson. We can see that the proposed approach performs better if the group of students is more than 15 people. The difference becomes significant for groups with more than 25 students. For small groups (5 students) the proposed approach requires twice as much time as the traditional approach.
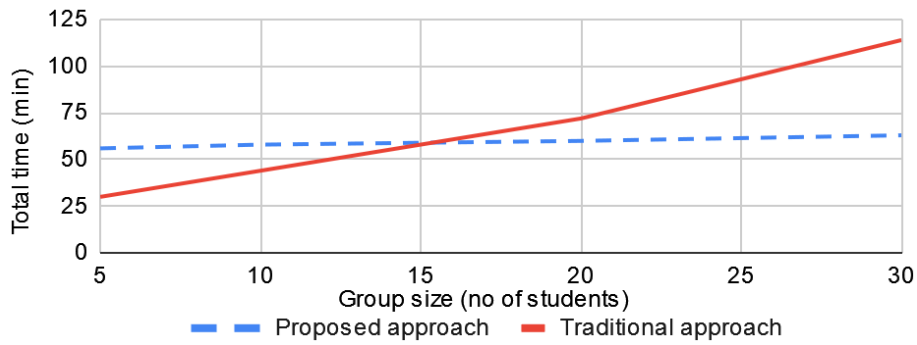
Fig. 8. Total time spent by teacher for attendance check in different group sizes (creating a new form, 14 lessons, face-to-face mode). Lower is better.

There are common situations, where the number of the lessons with performed attendance check is less than 14 (i.e. teacher does not initiate the attendance check on every lesson; the program of a particular course has less hours than in a standard one, etc.). Here we present a scenario where the teacher creates a new form, uses it for one group only, initiates 7 attendance checks in the semester. The traditional approach performs better in the groups with a size less than 25 students.
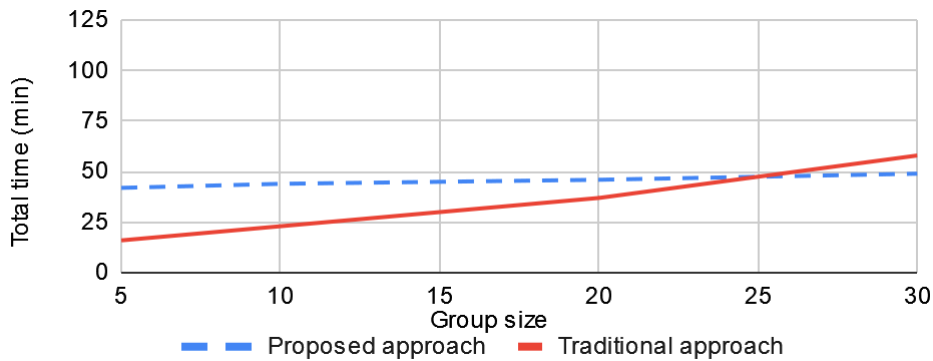

Fig 9. Total time spent by teacher for attendance check in different group sizes (creating a new form, 7 lessons, face-to-face mode). Lower is better.

Let's look at the scenario, where the proposed approach in face-to-face mode performs its best (compared to the traditional approach): the attendance form is already created and used for other groups, 14 lessons/semester, attendance checks are initiated on every lesson. In this case the proposed approach dominates in groups with more than 7 students. The proposed approach provides a significant decrease in total time spent for attendance check in big groups of students (>25 students). Nevertheless, the traditional manual filling is still faster for small groups.
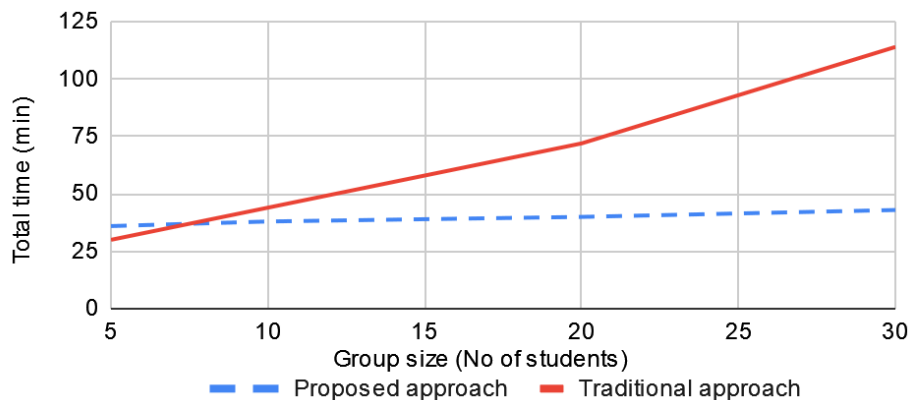

Fig. 10. Total time spent by teacher for attendance check in different group sizes (using existing form, 14 lessons, face-to-face mode). Lower is better.

The proposed approach can be used in an online environment. We do not have actual data to compare the online modes of the traditional approach with the online mode of the proposed approach. Below we compare two equivalent scenarios for the proposed approach (14 lessons, existing form) in different modes of education: face-to-face and online. We see that the proposed approach in online mode performs faster than in face-to-face environment. The point is, that in online mode the teacher sends the link directly to the students in the room chat. In face-to-face the students have to enter the link manually or use additional applications to scan the QR-code. In bigger groups there is a higher possibility to meet a student who had never entered direct links to browsers before and/or scanned QR-codes. This is the reason the processing time in face-to-face environments increases with the size of the group. The same students receive clickable links in E-Learning platforms, which does not provoke the problems mentioned above.
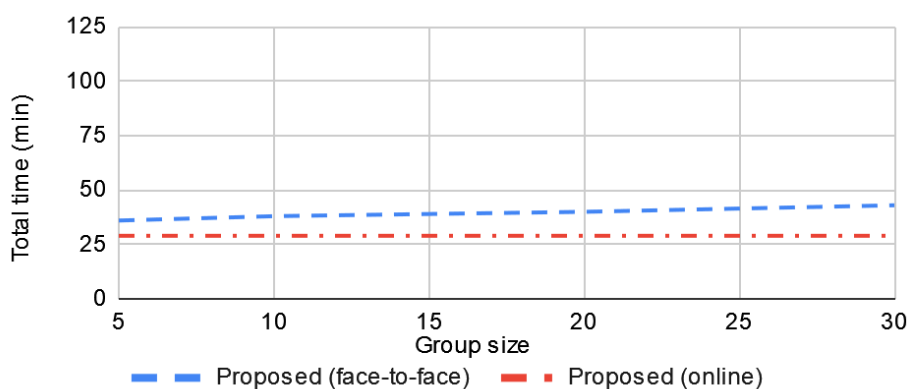

Fig 11. Total time spent by teacher for attendance check in different group sizes (using existing form, 14 lessons, face-to-face vs online mode). Lower is better.

CONCLUSIONS

After the tests of the proposed approach we can make some conclusions on its performance compared to the traditional approach. The resulting table is presented below.

Table 2. Best cases for using traditional and proposed approaches.

	Traditional approach	Proposed approach
Group size	Smaller groups (<10 students)	Bigger groups (>20 students)
Number of groups for the same course	1-3 groups	>3 groups
Meeting schedule for sub-groups	Sequential, parallel	Sequential
Learning mode	Face-to-face learning	Face-to-face, online, blended
Attendance check frequency	Random, ocasional	Every meeting
Number of meetings	1-15	>15

DISCUSSION

Some of the decisions made in the particular system could be objects for discussions. For instance, the form is set to receive responses from any visitor (no sign-in required), including receiving many responses from the same device. It opens the space for vulnerabilities (signing

remotely, sending anonymously many incorrect entries from one device). It means that the teacher cannot be sure that the received responses represent the actual students in the room. Thus initiating an additional roll call may be needed.

This choice (allow any user to fill the form without explicit limits) is made taking in account the following factors for the particular environment:

- The traditional attendance has the same vulnerability: the received list with the student's names might not represent the actual people in the room. Therefore, an additional roll call might be required in case the teacher has any doubts on the list's accuracy. In this context the proposed approach performs at least at the same level of accuracy as the traditional approach;
- No response is counted until the teacher approves the record (adding the number of the lesson and hours attended)
- The authentication requirement to the form may decrease the duplication and some other issues, but it would bring new issues (much slower signing process on the guest's side; forbidden access for the students with no Google account; students cannot access the same form unless the teacher deletes their responses from the previous lesson). At the same time the vulnerabilities would not be fully covered (students can still use several accounts to fill the form many times; students may share their account information; the student can sign in remotely without being in the room; etc.)
- If a student is not able to fill the form (physical disability, lack of device with internet access, etc.) it is acceptable for another student to fill the form for that student.
- Additional signs could point on incorrect filled responses (timestamp is outside the time range of the lesson, the count for duplicate responses in column G)

Some of the interesting features regarding form distribution have not been tested in this environment yet. For example, the link can be recorded on a NFC tag, so the students can open the form after touching the tag with their smartphones. Another untested feature is tracking entrance and exit actions of each student. It can be completed by adding a field "action type" in the form, pre-filling the form with one of the two action options, saving the link with pre-filled data and sharing these links separately. For instance, the moderator can place an "entrance" link outside the room and "exit" link inside the room.

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