

Les collèges représentent un environnement idéal pour aborder la question de la performance énergétique à l'occasion de la rénovation (énergétique) d'un bâtiment scolaire. Traiter les questions de performance énergétique en classe offre de belles opportunités de sensibiliser les élèves et les étudiants. Cela peut influencer leur comportement et mener à un changement d'habitudes. Il n'est cependant pas

facile d'en évaluer les effets au moyen de l'enquête par questionnaire, d'autant plus qu'il existe peu de travaux sur le sujet (Madge et al. 2012).

Nous présentons ici les résultats d'observations effectuées dans quelque 50 établissements secondaires. Au cours d'un projet-pilote, nous avons développé un questionnaire standard pour les élèves et les lycéens (âgés de 10 à 18 ans), ainsi que pour les enseignants, afin de mesurer leur perception de la qualité de l'air des salles de classe. La thématique centrale tourne autour de la

comparaison entre la situation nouvelle et l'ancienne. Il s'agit d'un questionnaire papier, qui se remplit à la main en 15 minutes. Il est conçu pour pouvoir être compris par les élèves sans avoir besoin d'être expliqué de manière individuelle. Par ailleurs, nous avons constaté que le questionnaire pour les enseignants doit être nettement différent de celui des élèves.

La coordination s'est avérée compliquée étant donné le nombre de parties prenantes: pour lancer l'opération, on a besoin de l'administration, du directeur du collège et en partie des parents. Pour effectuer l'enquête, on a besoin du secrétariat, des enseignants, des élèves, en partie de l'administration, du directeur ainsi que du technicien. Nous prenions contact avec les établissements en envoyant un courriel avec une copie de la lettre de soutien du Ministère, une lettre pour la direction et les enseignants, ainsi que, dans quelques cas, une lettre pour les parents demandant leur consentement à l'enquête. Les résultats de l'enquête sont transmis aux établissements concernés à titre de remerciement pour leur participation. La saisie des questionnaires a été confiée à un intervenant externe.

Le taux de retour est de 65 %. Quelques questionnaires ont été exclus de l'analyse après contrôle, notamment en raison d'un taux élevé de non réponses (parfois plus de 70 %). Il a également été procédé à des contrôles de cohérence, notamment pour dépister les élèves qui n'auraient pas pris l'enquête au sérieux.

Étant donné les particularités du projet, la sélection des établissements ne pouvait pas être faite de manière aléatoire, et l'allocation des élèves au groupe testé ou au groupe témoin n'a pas non plus été aléatoire. Il n'est donc pas exclu que la constitution de l'échantillon présente quelques biais, mais nous pouvons néanmoins estimer que tant que l'échantillon que le groupe témoin ne diffèrent pas significativement de la population mère sur les points les plus importants.

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## CHALLENGES WITH EVALUATION OF SCHOOL PROJECTS IN THE CONTEXT OF ENERGY EFFICIENT REFURBISHMENT

### ACCOMPAGNER LES PROJETS SCOLAIRES DANS LE CONTEXTE D'UNE RÉNOVATION EFFICACE ÉNERGÉTIQUEMENT – UN DÉFI PARTICULIER

#### Introduction

Conducting surveys in schools is a challenge which has been the subject of social research for a long time. The focus is usually on educational attainment, but in this study we examined the social science aspects of the energy refurbishment process in several schools. Our experiences with school surveys may help other researchers who work with schools. Challenges arose in the handling and administration of the survey: 1) in the communication process: finding the right contact person; 2) in the organisation of the survey: defining the age of the target group and ensuring the questionnaire can be understood without personal explanation; and 3) in data entry: supervising the external data entry. Further challenges arose concerning the content and presentation of the survey: 1) content: defining the structure and type of questions; 2) presentation: defining the length of the questionnaire; and 3) data quality: detecting error sources especially for the target group. The purpose of the studies was to obtain resilient results on the acceptance of new energy related technologies in the building sector. These results should provide guidance for politicians, decision-makers, school administrators and planners.

#### Data

The background for this article is experience from school projects which focused on the perception of the indoor quality of classrooms in the context of energy efficiency. Examples include the renovation of the whole school building or the installation of single innovative technologies such as LED lighting. In total we gathered empirical cross-sectional data from: 50 schools (different school types), about 10,000 students, more than 500 teachers. Our main research questions were: Do the students and teachers perceive the new situation to be better than the old one? How do students and teachers cope with the automatic control mechanisms of, for example, the lighting or ventilation? Do teachers integrate the topic of energy efficiency and technological innovation into their lessons? (window of opportunity) Do the students discuss the topic at home and behave more energy efficiently in their everyday life after the school refurbishment? (spill over effect).

#### Questions Asked

The target group in the research project were students from grade 5 to grade 12 (10-18 years old) and their teachers. The research object was the class room in which the respondents were sitting as well as their opinion and activities regarding energy saving. These aspects define the framework for the questionnaire, its content and its presentation. Content of questionnaire: we used the insights of a pilot study to develop a standard questionnaire for students and teachers on the classroom situation. Depending on the dimension of the refurbishment, certain questions were added. The main questionnaire consisted of structured questions with given answer categories. Some questions required an open answer, for example asking about opinions on disturbance factors or energy saving activities. To address our main research question about the comparison of the new situation against the old situation we took the rating of the old situation as a reference scenario. The ideal case was to question students in the old as well as in the new situation and compare the results of both surveys. In some cases, however, this was not possible because the refurbishment had taken place before the survey started. In these cases we had to ask retrospective questions about the old situation, and responses to these are subject to uncertainty. An extra questionnaire was designed for teachers. This gave us valuable insights for two reasons: 1) the teacher's knowledge of the school's past can lead to more differentiated observations and evaluations; the longer they work in a school, the more they can recount; 2) the teachers may take the questionnaire more seriously and have a better understanding of the importance of the supporting research. Presentation of the questionnaire: some teachers of the pretest obviously hadn't followed the instructions on how to fill out the questionnaire or, even worse, may not have read it. This led to several problems: 1) a student filled out the questionnaire for teachers until he came to questions he could not answer; and 2) a teacher forgot to fill out an extra sheet with important information concerning control variables. We simplified the surveys that followed by requesting a single questionnaire from the teachers which was clearly distinguishable from that of the students

(e.g. different colour). Concerning the structure of the questionnaire we didn't apply branching (we felt it would be too complicated and error-prone) and the questionnaire was designed to take no longer than 15 minutes. We limited the content to 4 pages which could be printed on a DIN A3-format and be folded).

### Organisation of school surveys

Challenges with the organisation of school surveys include the content and presentation of the questionnaire, together with the process of cooperation with the schools.

**Survey Methodology:** online-surveys could have been used since computers are available in more than 80% of the schools in Germany<sup>2</sup>. Despite this we decided to use a paper survey. The main reason for this decision was that the survey had to be undertaken in a classroom which had been refurbished. We also wanted to understand the students' behaviour in normal classrooms, rather than specialist rooms for computer tasks or chemical experiments. In Germany students generally spend most of the day in one classroom, just leaving for special lessons with specialist equipment. These two restrictions made it impossible to do an online survey.

An excel file was compiled from the data by an external data management company. This was cost effective but could be a source of errors. This is why the provision of explicit instructions and continuous communication and supervision throughout the process are imperative. There has to be one contact person who is charged with managing and monitoring the whole research process.

**Recruiting Schools:** getting schools to take part in a survey could be an onerous task<sup>3</sup>. Luckily we had the support of the Federal Ministry of Education and Research, as the study was funded by the ministry. The fact that the refurbishment was funded might have motivated the schools to cooperate.

The organisation of the survey becomes more complicated with the involvement of more people: school administrators, the head of school, the secretary and maybe others. Necessary contacts need to be identified at the beginning.

First we called the school administrator who had previously been informed about the study, by letter, from the Federal Ministry of Education and Research. The second contact was the head of school and the collaboration of both contacts was indispensable to the start of the survey. The project was explained in detail and the context factors were settled. Our research team could not be physically present during the survey so we were dependent on the schools conducting the survey without personal support from ourselves. The advantage of this procedure was that the schools were free to choose when they did the survey (within a time frame) and how exactly to organise it. Once the principal had agreed we usually had to contact the secretary (who received and returned the parcel with the questionnaires) or a responsible teacher, as a supervisor, to administer the survey in the school. The time frame of the survey was bounded by holidays and vacation and its success depended on the motivation of every single person involved: School administrator, head of school and partly parents for collaboration. Secretary, teachers, students and party school administrator, head of school and technicians for realisation. We offered each school their survey results as an incentive, to provide them with information on their own situation.

The information sent to the schools by email included the letter from the ministry, an information sheet for the head of school and teachers (background of the study, description of research team, contact information for questions, details of conduction) and sometimes a letter of consent for parents.

### Data Quality

Some error sources can be eliminated by data quality checks. The data file used for the analysis in this report underwent limited data editing because of plausibility checks which are detailed below. Even then we had to be aware of some uncertainties because of data quality issues.

**Response rate:** in the case of the LED-project we had a population of 56 schools out of which 33 schools participated (59 % response rate). Non-response-bias could be a problem because schools who are less engaged in the topic may not have participated in the survey. We sent out 6,789 questionnaires of which 4,430 were returned complete. This response rate of 65 % is very good, considering average response rates of 36 % for studies that utilise data collected from organisations<sup>4</sup>. Reasons for a low response may be that some teachers lack time or are less motivated than the head of school who originally agreed on the participation.

**Missing Data:** some questionnaires returned had very high rates of missing data (over 70 %) and were therefore excluded from the analysis. The reasons for missing data could be a conscious refusal to answer a question, missing information, lack of competence to provide a qualified answer, indecisiveness or a lack of position/opinion on a topic<sup>5</sup>.

Apparently wrong answers: certain questions can lead to extreme or unrealistically high or extreme low values which arise from just a few participants<sup>5</sup>. It is very important to check for, and eliminate, runaway values because they can lead to falsification, for example, of the mean value. They are most easily recognised by box-plots. The best correction is to set a runaway value as a missing value.

Another case was the systematic answering of the questionnaire. If a student apparently chose, for example, the first answer every time, this led to inconsistent answers within a questionnaire because different order of positive answer categories.

The inspection of crosstabs of variables which are not compatible (e.g. new students at the school answering retrospective questions about the old situation) can detect apparently wrong answers. The researcher has to decide case by case whether an answer is correct or whether both answers need to be classified as missing<sup>6</sup>.

Data error can also occur with data entry. Imputation was performed on missing or apparently wrong answers regarding variables needed for weighting or exclusion of cases, for example classroom number, grade or the built environment. Apparently wrong answers in this case were detected by comparing cases within a group (within a class) and within the whole dataset. Imputation was only used for variables whose content could be unmistakably developed from the grouped dataset.

**Questionnaire effect:** there are two kinds of questionnaire effects: 1) effects arising from asking about a specific topic (Hawthorne-Effect<sup>7</sup>), for example whether light is important for the classroom atmosphere; we found that light was rated less important in the second questionnaire which could be the effect of repeated questioning; and 2) effects related to the sequence of questions.

**Retrospective questions:** the present serves as a benchmark to determine attitudes towards a comparable past, and participants might have a theory of what improvement should occur by retrofitting, for example they might rate the old and the new lighting accordingly<sup>8</sup>. This relationship between the present and the past could lead to a bias in answering of retrospective questions, even if we keep the reference period short i.e. to a maximum of six months. To identify the extent of the bias, we analysed differences in the old and new state rating from retrospective questions and direct past-present questioning. According to the data, there are significant differences between the groups: respondents who had to evaluate the past situation always gave it a lower rating than current situations.

**Open questions:** open ended questions should help us to understand the answers a little better. They also helped us to sort out students who obviously didn't take the questionnaire seriously, and were an indicator for implausible answers. Problems with these questions were illegible handwriting and incomprehensible answers. In these cases information was lost.

**Selection bias:** because of the character of the research project the selection of schools for the survey was purposive rather than random. In addition, the assignment of the students to the control and the treatment group was not random. The possibility of sampling and selection bias therefore cannot be excluded. We assume, however, that both the sample from the basic population as well as the control from the treatment group do not differ significantly in terms of demographic or socio-economic characteristics or other factors which may confound any attempt to make comparisons between the two groups<sup>9</sup>.

### Conclusion

Experiences from the school projects led to improvements in the realisation and management of the surveys and to reliable results regarding the evaluation of new energy related technologies, especially of LED lighting. This should help other researchers in this field.

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