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Investigating key components of the facility management of secondary schools in Hong Kong

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Abstract

Purpose – The Hong Kong SAR Government increased its expenditure on education by 13.2 per cent from 1998-1999 to 2002-2003 in order to improve education and upgrade school facilities, despite the fact that the economy was in bad shape. To investigate the current facility management (FM) of secondary schools in Hong Kong, a study of the needs of the end-users (students and teachers) was conducted. The paper aims at identifying major FM components and investigating the relationships between the identified FM components and overall satisfaction with FM in three common locations within secondary schools (classrooms, IT laboratories and libraries).

Design/methodology/approach – A questionnaire survey of 1,472 local students was conducted to evaluate the FM performance of schools, as well as to establish the relationships between the levels of satisfaction with each FM component and overall satisfaction with FM. A number of formal interviews with local students, teachers and professional school designers were also conducted so that the gap between users' needs and designers' considerations could be identified by cross-checking the differences between the data gathered from the questionnaires and the interviews.

Findings – The study revealed that different locations within secondary schools emphasise different FM components (e.g. flexibility, temperature and safety and security in classrooms; seat allocation, density, colour and decoration, technical support and safety and security in IT laboratories; and seat allocation, lighting, temperature and furniture in libraries). Hygiene, natural lighting and sufficient facilities were found to be key FM components in all three locations in secondary schools.

Research limitations/implications – The interviews focussed on two schools only, while the questionnaire was conducted on four schools. However, since the interviewees included end-users (teachers and students) and designers of both schools, we believe that the differential responses to the FM components reflected in the study do not indicate that our results are biased. On the other hand, the study only examined students in Forms 2, 4 and 6. The results might be slightly different if the questionnaires were filled in by all the students in the schools. A study of all students in secondary schools is recommended in order to understand and confirm the requirements of FM from the point of view of end-users.

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Practical implications – Designers need to understand end-users' expectations in the preliminary stage of design in order to enhance learning among students and ensure that school buildings are designed to achieve educational purposes. Some important elements are the arrangement of classroom seats in rows, the avoidance of desk movement in class, the provision of natural lighting, the installation of an adjustable temperature control, the improvement of natural ventilation, the measurement of noise, the installation of a lock for each drawer, the provision of sufficient facilities in each room and the selection of building materials for hygiene purposes. On the other hand, facility managers also need to ensure good hygiene and upgrade technical support, especially in IT laboratories.

Originality/value – This paper identified 13 major FM components and evaluated the relationship between the identified FM components and overall satisfaction with FM. The results indicate that different FM components are emphasised in three common locations within secondary schools (classrooms, IT laboratories and libraries). Designers and facility managers need to understand end-users' expectations in the design stage and the operation stage, respectively, in order to enhance learning among students and ensure that school buildings are designed to achieve educational purposes.

Keywords Schools, Hong Kong, Buildings

Paper type Research paper

Introduction

Statistics from the Education and Manpower Bureau (2003) indicate that total expenditure on education has increased continuously, from HK$48,479 million in 1998/1999 to HK$54,893 million in 2002/2003 (representing a 13.2 per cent increase). Most of this money was spent on improving school facilities. However, solely enhancing school facilities does not lead to end-users' satisfaction.

Theoretically, facilities management (FM) is the process by which an organization delivers and sustains services in a quality environment to meet strategic needs (Alexander, 1996). A quality environment can be improved by space management (Rose, 1994; Clothier, 1996; Edwards, 2000; Senter and Charles, 2002), lighting (Waddick, 1997), colour and decoration, furniture (Clothier, 1996; Michael, 1998) and so forth. These all affect students' self-esteem, participation, interaction, comfort, concentration, mood, fatigue, morale and response (Waddick, 1997; Clothier, 1996; McAndrew, 1993; Senter and Charles, 2002; Pratt, 1994), and subsequently influence their learning behaviours.

However, past studies concentrated on the development of design and technical aspects of facilities, neglecting the actual needs of end-users (Shohet and Lavy, 2004; Gopalakrishnan *et al.*, 2003; Ahmadi *et al.*, 2000). Therefore, this study aims at investigating the key components of the FM of secondary schools in Hong Kong through an evaluation of the needs and expectations of end-users (teachers and students). The paper identifies major FM components and investigates the relationships between the identified FM components and overall satisfaction with FM in three common locations within secondary schools (classrooms, IT laboratories and libraries). A questionnaire survey of students and interviews with students, teachers and professional designers were conducted, and the resulting quantitative and qualitative data was cross-checked in order to develop recommendations for appropriate FM for secondary schools in Hong Kong, especially in the three specific locations mentioned above. Facility managers can then identify and enhance the most important FM factors to improve the learning environment in secondary schools.

Major characteristics of FM

FM encompasses six main characteristics, they are as follows:

(1) providing a comfortable and effective environment;

(2) minimising use of diminishing resources;

(3) providing quality and cost-effective services;

(4) supporting a dynamic situation;

(5) enhancing organizational effectiveness; and

(6) involving multi-disciplinary activities and management (Alexander, 1992, 1996; Laird, 1994; Then, 1999).

It, thus, aims to provide end-users with a comfortable, effective and quality environment with minimum resources (cost-effective and human services) to enhance organisational effectiveness and successfully implement multi-disciplinary activities.

The scope of FM is extensive, including hard facilities (e.g. seat allocation, density, flexibility, lighting, colour and decoration, noise, temperature, ventilation and furniture) and soft management (e.g. technical support, safety and security, hygiene services and sufficient facilities).

Hard facilities

Space management refers to planning and control of space for personal and team work. It involves personal space and an action zone (Senter and Charles, 2002). An action zone is important to effective teaching and learning processes. Students who sit in the action zone participate more in class, better demonstrate on-task behaviour and attitudes, and reach higher levels of achievement than students who sit outside the action zone. Having sufficient personal space can reduce stress, increase self-esteem, and prevent a sense of being under threat that may develop if an individual is too close to the teacher. In most cases, the invasion of one's personal space by another person is an unpleasant, stressful experience (McAndrew, 1993).

Allocation of seats not only influences the movements of teachers in classrooms, but also induces different behaviours and creates different learning atmospheres among students (Waddick, 1997). For example, seat allocation in rows forms a pattern of authority in which one person, who is superior, speaks to a group of people, who are subordinate. This arrangement encourages eye contact between students and the teacher and limits the interactions between pupils. Alternatively, seat allocation in an island pattern allows student-to-student interactions in a group, which leads to a higher social relationship, and greater communication among students. In sum, the seating arrangement should maximise teachers' mobility and allow greater physical proximity between students and teachers, so as to involve more students in the action (Senter and Charles, 2002; Murdoch, 1998).

The problem of *density* can be expressed in the statement: the more crowded the room, the greater the discontent of students (Rose, 1994). In IT laboratories, computers radiate heat. However, it will have an adverse effect on the interaction between students, if a large distance is placed between computers. They may feel isolated and be less inclined to participate and interact (Clothier, 1996). Hence, although sufficient personal space is often provided in an IT laboratory, students are easily excluded from

the action zone. This reflects the conflict between the action zone and personal space in the classroom. Balancing these two group areas is critical.

Flexibility represents the possibility of making changes easily and quickly with little effort or cost. The physical arrangement of classrooms must be flexible enough; otherwise it cannot be adjusted easily during a class. Flexibility in the classroom can support teaching and learning by making it easier for teachers and students to cope with different teaching and learning activities in different lessons (Edwards, 2000; Senter and Charles, 2002).

Level of luminaries, glare and brightness are used to measure visual comfort. A good *lighting* system can increase the human response level, task performance, productivity, product quality, morale health and the conservation of energy (Park, 1998). Natural lighting should be combined with the artificial lighting system as it can effectively enhance students' academic achievement and morale and, simultaneously, prevent tooth decay and vitamin D deficiency. However, the level of lighting should be around the acceptable range (500 lumen), since excessive brightness can also cause tension and lead to concentration difficulties.

Colour involves three dimensions: hue, saturation and brightness. Hue is a function of the wavelength of the light reflected from the stimulus, while saturation indicates the amount of white light in the colour. Brightness refers to the intensity of the light coming from the coloured stimulus (McAndrew, 1993). Colour establishes a pleasing and visually appealing environment for productivity (Senter and Charles, 2002). Higher brightness and saturation resulting in a pleasing environment at as an effective medium to motivate students, as it makes it easier to hold their attention and increases their response level.

Decoration in the classroom consists of students' work, bulletin boards, plants, posters and so forth. Displaying students' work can motivate them and help them develop their self-esteem. It provides a model by which other students can acknowledge their success. Furthermore, decoration is also able to influence students' mood and creativity (Senter and Charles, 2002). In a decorative environment, knowledge seems more interesting and attractive to students (Pratt, 1994).

Noise is a psychological concept that is defined as unwanted sound and is considered a source of stress (McAndrew, 1993; Rose, 1994). It needs to be controlled as it can negatively affect students' performance. Excessive noise can reduce the tolerance of other stressors and affect the motivation of students (Rose, 1994). Furthermore, intermittent and unpredictable noise has to be dealt with since it can have a sudden impact on task performance.

Temperature affects the thermal comfort of human beings. A cold temperature reduces manual dexterity, tactile sensitivity and motivation levels, and increases reaction time. However, a room with a slightly cool temperature leads to more effective learning (McAndrew, 1993; Clothier, 1996). The ambient temperature, which refers to the air temperature in the immediately surrounding environment, is directly affected by the air-conditioning system, the warm bodies of the students and the level of natural light in the room. In modern classrooms and IT laboratories, the number of computers must be considered when designing the air-conditioning system since heat from machines and monitors can drastically alter the temperature (Clothier, 1996; Michael, 1998). A static environment must be kept in order to avoid any physical or attitudinal problems. An effective temperature also refers to an individual's perception of

the ambient temperature and is strongly influenced by the humidity of air (McAndrew, 1993). High humidity is negatively correlated with vigour and other positive moods. It not only has a negative effect on people's health and comfort, but also on their efficiency (Pratt, 1994; Rose, 1994). Thus, both humidity and temperature influence human beings emotionally and physically, and can subsequently affect their productivity.

Natural *ventilation* was mostly designed for the educational institutions in Hong Kong before the 1990s. Due to today's serious air pollution, the design of both natural ventilation and the air-conditioning system has been changed. Poor ventilation induces poor indoor air quality resulting from airborne contaminants, such as volatile organic compounds, suspended particulates or microbial particles, which can cause illness and diminish learning potential greatly (Friday and Cotts, 1995; Waddick, 1997).

Quality *furniture* can ensure comfort and enhance the interaction between students and teachers in the learning environment (Rose, 1994), especially in IT laboratories. Well-designed furniture (computers, chairs, keyboards, monitors, etc.) allows students to work together and establish social relationships without affecting the effectiveness of the equipment. For example, an adjustable armchair allows the height of a chair to be adjusted, thus facilitating users' comfort. Sufficient space is also required to allow students to take notes in an IT class (Clothier, 1996; Michael, 1998).

Soft management

The core activities of soft management include technical support for equipment, cleaning, and safety and security. Response times and levels of complaint are the key dimensions of the quality of services (Alexander, 1993a, b, 1996).

Technical support is critical in schools since information technology needs equipment stability. The indicators of technical support include waiting time, service quality and maintenance plan (Michael, 1998). Service quality refers to the effectiveness of technical help, while the waiting time for technical help affects the circulation of lessons. A prompt diagnosis of the user's problem and a quick decision are required. A maintenance plan emphasizes troubleshooting problems, both anticipated and non-anticipated. Waiting time, service quality and maintenance plan are all inter-related. A good maintenance plan reduces waiting time and improves service quality. Therefore, maintenance is considered as a key indicator of technical support services. It is of crucial importance to schools, especially in IT laboratories.

The *security* system safeguards the property against loss due to bad weather, fire or theft. In recent years in Hong Kong, the amount of equipment in schools, such as computers, printers, scanners and projectors, for teaching and learning purposes has increased. They all must be placed under high security since electronic equipment has a high resale value (Geisert *et al.*, 1990).

Safety is an important consideration in educational environments (Pratt, 1994). Any sloppy connections of cables and wires may result in accidents and injuries. No equipment or furniture should hurt users. The seating plan must be arranged to provide safety and comfort (McKenna & Co., 1993; Michael, 1998).

Students spend much of their school lives in classrooms, IT laboratories and libraries. Although students' actual achievement behaviours are relatively unaffected by the physical environment, non-achievement behaviours such as attendance, class

participation and satisfaction are likely to be affected by it. Students in unattractive classrooms experience more feelings of fatigue and discontent.

Research methodology

A questionnaire survey of secondary school students was used to investigate the level of the FM satisfaction components on overall satisfaction with FM. In order to cross-check the data collected in the questionnaire survey, interview surveys were also conducted of the end-users (teachers and students) to identify their needs and their level of satisfaction with the current facilities. To understand the overall picture of the FM of secondary schools in Hong Kong, a further interview survey of building professionals was carried out to obtain the design criteria for current secondary school designs.

The questionnaire included 13 components of FM satisfaction and overall satisfaction with FM. In order to investigate in more detail the 13 FM satisfaction components and the overall satisfaction with FM of the schools, three sets of tailor-made questions were designed for classrooms, IT laboratories and libraries, which were the places where students were considered to spend most of their time during the school day. The questionnaire was written in Chinese rather than English in order to eliminate problems stemming from the language barrier. The respondents' responses provided numerical scores expressing their level of satisfaction with FM. The weighting range was from 1 to 5, where 1 indicated "unsatisfied" and 5 "satisfied". Since the targeted respondents in this survey were secondary school students in Forms 2, 4 and 6, a five-point scale was used instead of a seven-point scale to simplify the questionnaire for the lower-form students.

The questionnaire survey was conducted in 2002 at four secondary schools in Hong Kong. Of the 600 classroom questionnaires, 960 IT laboratory questionnaires and 960 library questionnaires distributed, 474, 543 and 455, respectively, were completed effectively, representing a respective response rate of 79.0, 56.6 and 47.4 per cent.

Results

Questionnaire survey

In multiple regression, the values of overall satisfaction with FM in each location (dependent variable) are estimated from those of two or more other variables (the independent variables $F_1, F_2, \ldots, F_{13}$). To express the usefulness of regression equation, the multiple correlation coefficients, ranging from 0.00 to 1.00, and symbolized by the letter R, is calculated. It describes the degree of relationship between the criterion variable (Y) and the set of predictor (X) variables (Kinnear and Gray, 1995).

The results concerning the relationships between the satisfaction level for each FM component and the overall satisfaction with FM in the classrooms, IT laboratories and libraries were obtained separately from three multiple regression equations (refer Table I). The results of R^2 (0.430, 0.533 and 0.459) indicate the key FM components for the three secondary school locations.

The different variables involved in the three equations for overall satisfaction with FM in classrooms, IT laboratories and libraries explain 43.0, 53.5 and 45.9 per cent of the total variance of FM satisfaction, respectively. Hygiene (F_{12}), lighting (F_4) and sufficient facilities (F_{13}) are common variables that influence the overall satisfaction in

Eq.	Independent variables	Unstandardised coefficients		t	Sig.	R	R^2
		B	Std. error				
Classrooms							
1	Constant	0.694	0.199	3.499	0.001	0.656	0.430
	F_{12} – Hygiene	0.167	0.044	3.775	0.000		
	F_7 – Temperature	0.158	0.043	3.694	0.000		
	F_3 – Flexibility	0.106	0.047	2.261	0.025		
	F_{13} – Sufficiency	0.122	0.038	3.233	0.001		
	F_4 – Lighting	0.140	0.048	2.941	0.004		
	F_{11} – Safety and security	8.902×10^{-2}	0.042	2.109	0.036		
IT laboratories							
2	Constant	0.386	0.154	2.498	0.013	0.730	0.533
	F_{13} – Sufficiency	0.187	0.030	6.250	0.000		
	F_4 – Lighting	0.110	0.033	3.362	0.001		
	F_{10} – Technical support	0.133	0.033	3.967	0.000		
	F_{12} – Hygiene	0.137	0.033	4.099	0.000		
	F_5 – Colour and decoration	0.166	0.034	4.894	0.000		
	F_1 – Allocation	0.101	0.031	3.268	0.001		
	F_2 – Density	2.249×10^{-2}	0.011	1.992	0.047		
	F_{11} – Safety and security	5.961×10^{-2}	0.030	1.984	0.048		
Libraries							
3	Constant	0.506	0.228	2.223	0.027	0.678	0.459
	F_{13} – Sufficiency	0.223	0.048	4.689	0.000		
	F_4 – Lighting	0.134	0.051	2.645	0.009		
	F_{12} – Hygiene	0.124	0.043	2.869	0.005		
	F_7 – Temperature	0.146	0.052	2.825	0.005		
	F_9 – Furniture	0.115	0.048	2.393	0.018		
	F_1 – Allocation	0.122	0.053	2.300	0.022		

Table I.
Regression models for overall satisfaction with FM in three locations

the three specific locations in secondary schools. Temperature (F_7) affects the overall satisfaction with FM in both classrooms and libraries, while safety and security (F_{11}) affects it in classrooms and IT laboratories. Flexibility (F_3) is another component that influences the overall satisfaction with FM in classrooms, while allocation of seats (F_1), density (F_2), colour and decoration (F_5), and technical support (F_{10}) are the components that affect overall satisfaction with FM in IT laboratories.

Interview survey

In order to fully understand the results of the questionnaire survey, face-to-face interviews with design team members (including project managers, architects and building services engineers), teachers and students of Hong Kong secondary schools were also conducted. A total number of 19 interviewees were selected from a secondary school built in 2000 (a millennium school) and another one built in the 1960s (a traditional school) that had not been improved. Both schools were visited by the researchers before the formal interviews were conducted.

The comments made by the respondents (designers, teachers and students) about the 13 FM components are summarised in Table II. In general, they believed that the physical environment influences (both positively and negatively) students' learning process.

Facilities components	C	Quest. IT	L	Comments made by respondents
F_1 – Allocation		√	√	Basically, sufficient space in a room allowed a better seat allocation *It is interesting that the designers generally rejected the traditional seat arrangement in rows, while most of the teachers and students preferred to arrange the seats in rows in the classroom.*
F_2 – Density		√		All the respondents commented that if a room has a high density, it reduces the width of the aisle between desks. A narrow aisle generated a safety problem and prevented teachers from arranging some activities amongst students
F_3 – Flexibility	√			*The designers believed that students feel annoyed when they have to change the physical setting by moving desks. All the respondents (teachers, students and designers) considered that moving desks was a waste of time.* However, all the respondents still preferred a flexible classroom setting
F_4 – Lighting	√	√	√	*In general, the students did not believe that natural lighting could support their academic achievement and personal health,* while some of the teachers and all the designers considered that lighting had a positive impact on education Both the designers and the teachers generally accepted that natural lighting can increase students' attention and, subsequently, support their academic achievement However, there was disagreement between the end-users (teachers and students) and the designers. *The designers considered that more windows with sufficient lighting were provided in new schools (e.g. skylights in libraries), but the end-users did not think this was the case.*
F_5 – Colour and decoration		√		None of the respondents believed that colour and decoration could enhance students' academic achievement
F_6 – Noise				*Most of the designers commented that the noise level for each new school is measured at a preliminary development stage, but the end-users did not believe this was so. Some end-users considered that noise from adjacent areas disrupts teaching.*
F_7 – Temperature	√		√	Most of the respondents agreed that a slightly cold temperature could lead to more effective learning in class, while all of them felt that end-users should be able to adjust the temperature in each location

(*continued*)

Table II.
Summary of the comments made in the interviews (including the results of the questionnaire)

Facilities components	Quest. C	IT	L	Comments made by respondents
F_8 – Ventilation				All the respondents considered that ventilation is very important as it can affect students' concentration and health. Most of the teachers and all of the students and designers preferred natural ventilation in the winter *The designers all reported that the standard school design is based on natural ventilation, but none of the end-users believed this was so. All the designers also believed that air-conditioners could reduce the noise from outdoors, but only a few end-users agreed.*
F_9 – Furniture			√	There was no doubt that the furniture should match the facilities installed and that the teacher's desk should be designed for the installation of computer equipment Most of the teachers and designers commented that the choice of furniture should be decided on by the school and that the size of the budget was the major constraint against the improvement of furniture. *However, no students agreed with these statements.*
F_{10} – Technical support		√		Most of the end-users (teachers and students) did not think that the IT technical support was doing well. The main reasons given were poor communication between technicians and users, and the fact that it takes a very long time to rectify non-critical failures However the designers did not agree with these comments
F_{11} – Safety and security	√	√		All the respondents agreed that safety in IT laboratories was important because of the valuable cables and electronic devices *All the end-users commented that students are not allowed to leave their belongings in drawers for security reasons, but all the designers felt that this was not the case.*
F_{12} – Hygiene	√	√	√	All the end-users commented that the school should be cleaned every week, while none of the designers had anything to say about hygiene
F_{13} – Sufficiency	√	√	√	*There was a great gap in perception between the end-users and the designers in regard to this variable. All the end-users believed that the provision of sufficient facilities was based on budget and discipline, that there was an insufficient number of projectors in schools, and that installing computers in each classroom was one way of improving the IT systems in schools. However, the designers generally disagreed with these comments. They considered that the facilities were sufficient.*

Table II.

Note: *Comments* in italics indicate that the end-users (teachers and students) and the designers had different opinions

The end-users (teachers and students) and designers had different opinions about 7 of the 13 FM components. The design team members explained that there was a standard design for secondary schools in Hong Kong and that amendments would be made to each project based on specific requirements and limitations. However, the end-users' expectations may not always be met due to regulations (Schedule of Accommodation, Fire Safety (Buildings) Ordinance, etc.), the size of the approved budget, the site limitations, the space available and so forth. In addition, the *sufficiency* and quality of the facilities and *furniture* (F_{13} and F_9) provided are dependent on the size of the approved budget. Therefore, conflict may arise from the differences between the end-users' needs and the designers' considerations.

Although all the respondents agreed that *ventilation* is an important component that can affect students' concentration and health, the end-users did not believe that their schools were designed based on natural ventilation or that the design could reduce the noise from outdoors. The end-users also recommended that designers measured the *noise* level at the preliminary development stage to enable them to eliminate disruptions to teaching and learning.

Sufficient *space* and *lighting* in a room allows a better seat allocation and provides a comfortable learning environment. However, the end-users still commented that there was insufficient lighting in the new school, that they did not want to leave any belongings in their lockers, that they preferred to arrange seats in a traditional row rather than in a group format and that they did not want to move the desks during class because it was a waste of valuable teaching time. The end-users comments reflected that the designers ignored the *security* of storage facilities and misunderstood the disadvantage of *flexibility* in classes. The end-users were also not satisfied with the design of natural lighting.

The teachers, students and designers made similar comments about density, temperature, and colour and decoration. If a room has a high density, it reduces the width of the aisles between desks; and a slightly cold temperature can lead to more effective learning in the class. It was interesting that none of the respondents believed that colour and decoration can enhance students' academic achievement as this contradicted the finding of previous studies, mentioned above, that colour and decoration can stimulate students' learning motives. Further study on the impact of colour and decoration in secondary schools is thus recommended.

Recommendations

Facilities management involves multiple approaches to provide a quality environment with the least resources in order to facilitate and support the organisational operation and to fulfil end-users' requirements. The questionnaire survey of students reflected the needs and expectations of students (end-users), while the formal interviews revealed background information regarding the 13 FM components in both traditional and millennium schools in Hong Kong. Recommendations for FM, based on the results of this study, for the three different locations are given below.

Classrooms

The study indicated that flexibility, lighting, temperature, safety and security, hygiene and sufficient facilities are major FM components that influence the overall satisfaction with FM in classrooms. Designers need to plan for sufficient natural lighting, a flexible

classroom layout, an adjustable temperature level, lockable drawers, good hygiene, and a sufficient number of computers and projectors in classrooms.

Seat allocation, density, noise, ventilation and technical support were all mentioned by the respondents in the interviews, but they did not affect the overall satisfaction with FM of the students. Perhaps, the performances of these components are stable and they basically satisfy the current requirements of Hong Kong students.

IT laboratories

Eight FM components affected the overall satisfaction with FM in the IT laboratories: seat allocation, density, lighting, colour and decoration, technical support, hygiene and sufficient facilities. The importance of natural light, hygiene and sufficient facilities in IT laboratories cannot be ignored by designers. Since IT laboratories are not used for traditional teaching purposes, designers need to rearrange the allocation of seats, reduce the density of students' seating pattern, and review the colour and decoration of IT laboratories in order to ensure safety, improve visual comfort, motivate creativity and enhance learning among students. Technical support and hygiene activities are currently implemented by end-users, but it is recommended that designers further reconsider their choice of building materials in order to create a hygienic environment in schools (e.g. neat finishes, air-conditioning, double glazing, etc.). Schools, on the other hand, need to employ individual facility managers and provide formal FM and computer training courses for them so that they can learn to identify specific duties of teachers (educators) and technicians (technical supporters).

Libraries

Seat allocation, lighting, temperature, furniture, hygiene and sufficient facilities are the main FM components that affect the overall satisfaction with FM in libraries. Since light, hygiene and sufficient facilities are the key FM components in all three locations, designers must pay attention to these components in secondary schools. Sufficient natural lighting, an adequate number of computers and good hygiene are needed to establish a comfortable and stress-free atmosphere where students can read and search for information. A cool temperature and attractive furniture can enhance secondary students' study in libraries.

It was an interesting finding that noise and ventilation have no impact on the overall satisfaction with FM in all three locations. The interviews revealed that the end-users (teachers and students) did not generally like the current designs of noise barriers and the ventilation system in secondary schools. It is recommended that designers review the current noise barrier designs (walls, partitions, windows, etc.) and window-type air-conditioners.

Conclusion

In recent years, the Hong Kong Government has substantially increased investment in basic education (from 1998 to 2003, there was a 13.2 per cent increase), including in the hard and soft facilities of the operational process. FM emphasises operational management for the realization of end-users' requirements. To understand end-users' expectations of FM in schools in Hong Kong, this paper identified 13 major FM components and evaluated the relationship between the identified FM components and overall satisfaction with FM.

Based on an empirical survey of 1,472 secondary students in four secondary schools in Hong Kong and a series of formal interviews with end-users (teachers and students) and designers from two of the schools, the study revealed that different locations within secondary schools emphasise different FM components (e.g. flexibility, temperature, and safety and security in classrooms; seat allocation, density, colour and decoration, technical support, and safety and security in IT laboratories; and seat allocation, lighting, temperature and furniture in libraries). Hygiene, natural lighting and sufficient facilities were found to be key FM components in all three locations in secondary schools.

Designers need to understand end-users' expectations in the preliminary stage of design in order to enhance learning among students and ensure that school buildings are designed to achieve educational purposes. Some important elements are the arrangement of classroom seats in rows, the avoidance of desk movement in class, the provision of natural lighting, the installation of an adjustable temperature control, the improvement of natural ventilation, the measurement of noise, the installation of a lock for each drawer, the provision of sufficient facilities in each room and the selection of building materials for hygiene purposes. On the other hand, facility managers also need to ensure good hygiene and upgrade technical support, especially in IT laboratories.

One obvious limitation of this study is that the interviews focused on two schools only. However, since the interviewees included both end-users (teachers and students) and designers of both schools, we believe that the differential responses to the FM components reflected in the study do not indicate that our results are biased. Moreover, the study only examined students in Forms 2, 4 and 6. The results might be slightly different if the questionnaires were filled in by all the students in the schools. A study of all students in secondary schools is recommended in order to understand and confirm the requirements of FM from the point of view of end-users.

References

Ahmadi, M., Helms, A.M. and Ross, T.J. (2000), "Technological developments: shaping the telecommuting work environment of the future", *Facilities*, Vol. 18 No. 1, pp. 83-9.

Alexander, K. (1992), "Quality managed facilities", *Facilities*, Vol. 10 No. 2, pp. 29-33.

Alexander, K. (1993a), "Delivering the facilities services", *Facilities*, Vol. 11 No. 6, pp. 24-7.

Alexander, K. (1993b), "Identifying and managing facilities needs", *Facilities*, Vol. 11 No. 3, pp. 18-21.

Alexander, K. (1996), *Facilities Management: Theory and Practice*, E. & F.N. Spon, London.

Clothier, P. (1996), *The Complete Computer Trainer*, McGraw-Hill, New York, NY.

Education and Manpower Bureau (2003), *Education Statistics*, Education and Manpower Bureau, Hong Kong.

Edwards, C.H. (2000), *Classroom Discipline and Management*, 3rd ed., Wiley, New York, NY.

Friday, S. and Cotts, D.G. (1995), *Quality Facility Management: A Marketing and Customer Service Approach*, Wiley, New York, NY.

Geisert, P.G., Mynga, K. and Futrell, M.K. (1990), *Teachers, Computers, and Curriculum: Microcomputers in the Classroom*, Allyn and Bacon, Boston, MA.

Gopalakrishnan, B., Weng, L. and Gupta, D.P. (2003), "Facilities design using a split departmental layout configuration", *Facilities*, Vol. 21 No. 3, pp. 66-73.

Kinnear, P. and Gray, C. (1995), *SPSS for Windows Made Simple*, Erlbaum, Hove.

Laird, S. (1994), "Total facilities management", *Facilites*, Vol. 12 No. 13, pp. 25-6.

McAndrew, F.T. (1993), *Environmental Psychology*, Brooks/Cole, Pacific Grove, CA.

McKenna & Co. (1993), "Healthy and Safety: 1993", *Facilities*, Vol. 11 No. 7, pp. 11-17.

Michael, S.O. (1998), "Best practices in information technology (IT) management: insights from K-12 schools' technology audits", *The International Journal of Educational Management*, Vol. 12 No. 6, pp. 277-88.

Murdoch, K. (1998), *Classroom Connections: Strategies for Integrated Learning*, Eleanor Curtain, Armadale, Victoria.

Park, A. (1998), *Facilities Management: An Explanation*, 2nd ed., Macmillan, Basingstoke.

Pratt, D. (1994), *Curriculum Planning: A Handbook for Professionals*, Harcourt Brace College Publishers, Fort Worth, TX.

Rose, J. (1994), *Human Stress and the Environment: Health Aspects*, Gordon and Breach Science Publishers, Philadelphia, PA.

Senter, G.W. and Charles, C.M. (2002), *Elementary Classroom Management*, 3rd ed., Allyn and Bacon, Boston, MA.

Shohet, I.M. and Lavy, S. (2004), "Development of an integrated healthcare facilities management model", *Facilities*, Vol. 22 No. 5, pp. 129-40.

Then, S.S. (1999), "An integrated resource management view of facilities management", *Facilities*, Vol. 17 No. 12, pp. 462-9.

Waddick, J. (1997), "Physical considerations in the development of a computer", *British Journal of Educational Technology*, Vol. 28 No. 1, pp. 69-71.

Further reading

Smith, M. (1996), *Interiors Management: A Guide for Facility Managers*, UpWord, New York, NY.