Evaluation of ‘Sun-safe’: a health education resource for primary schools

M. Hewitt2, S. Denman1, L. Hayes, J. Pearson1 and C. Wallbanks

Abstract

The aim of the study was to assess the effectiveness of ‘Sun-safe’, a computer-based resource designed to promote skin cancer awareness and educate children, aged 10–11 years, about the effects of excessive exposure to the sun and associated skin cancer preventive behaviours. Effectiveness was measured by changes in knowledge, attitudes and behavioural intentions using a self-completed questionnaire. A cluster, controlled evaluation design was used. Twelve schools were randomly allocated to the intervention arms of the study (workbook or computer), with a further four schools acting as controls (no intervention). One school allocated to the computer group had serious technical problems with their computers on the day of the intervention and had to be excluded from the study, leaving six schools in the workbook group and five in the computer group. One class in each of the 15 schools participated. The questionnaire was administered before the intervention, the day after and 6 weeks thereafter. The primary outcome measures were changes in mean scores at 6 weeks. In all, 376 children, 83% of the roll, completed both pre- and 6-week tests. Mixed-model analysis, allowing for pre-intervention score and the cluster effect, showed significant increases in knowledge scores in all three groups [workbook 2.36, 95% confidence interval (CI): 1.66 to 3.05; computer 1.73, 95% CI: 1.00 to 2.46; control 0.93, 95% CI: 0.11 to 1.74], but only the workbook group was significantly better than the control group (1.43, 95% CI: 0.36 to 2.50) and there was no significant difference between the intervention groups (0.63, 95% CI: –0.38 to 1.63). With regard to attitudes, both interventions showed significantly greater increases in scores than the control group, but there was no significant difference between them (workbook 2.37, 95% CI: 1.27 to 3.47; computer 1.92, 95% CI: 0.76 to 3.09; control –0.01, 95% CI: –1.28 to 1.27). Although the mean increases for behavioural intentions scores were small (workbook 0.66, 95% CI: 0.26 to 1.05; computer 1.11, 95% CI: 0.70 to 1.51; control 0.08, 95% CI: –0.37 to 0.52), those for the intervention groups were significantly better than the control group, but were not significantly different from each other. The evaluation showed significant improvements in knowledge, attitudes and behavioural intentions, which were still present 6 weeks after the intervention. This suggests that interventions employing the Sun-safe workbook and computer-based resources could be most usefully put into effect in the week before the start of the summer holidays.

Introduction

The incidence of all skin cancers has increased, in Europe, over the past 20 years (Karlsson et al., 1998; MacKie, 1998). There has been a doubling,
every 10 years, in the incidence of malignant melanoma in northern Europe (Swerdlow, 1984). Recent data suggest small decreases in rates in post-World War II generations in the UK (Severi et al., 2000).

The rising levels of skin cancer have been attributed to increases in exposure to ultraviolet radiation associated with increases in leisure time and the desire to possess a suntan. Improvements in data collection are an additional factor (Marks, 1996). There is a substantial body of evidence showing that solar damage is the major causal factor in all skin cancers [e.g. (Green and Williams, 1993)], that childhood is a particularly vulnerable time for the photo-carcinogenic effects of sun exposure on the skin (Holman et al., 1986), and that prevention and early detection are crucial in reducing morbidity and mortality from skin cancer (Doherty and Mackie, 1988; Jackson, 1995). Much of the current debate on skin cancer prevention is focused on the pattern of exposure to the sun. It has been suggested that intermittent exposure might be riskier than continuous exposure (Finkel, 1998).

Public health strategies for England and Wales have highlighted the need for action in reducing morbidity and mortality associated with excessive exposure to sunlight. The 1992 Government White Paper The Health of the Nation (Department of Health, 1992) included a national target for skin cancer ‘To halt the year-on-year increase in the incidence of skin cancer by 2005’. More recently, Our Healthier Nation (Department of Health, 1998) targets all cancer deaths among those under 65 years for a 20% reduction by the year 2010.

Prevention is a key component of public health strategies targeting children and young people. Schools provide an ideal setting in which the majority of children can be reached. Compelling arguments exist for finding appropriate and effective interventions in skin cancer prevention for children. First, children spend more time out of doors that adults. It has been estimated that 80% of a person’s lifetime exposure to ultraviolet radiation occurs before 21 years of age (Banks et al., 1992). Second, the regular use of sunscreen with a sun protection factor (SPF) of 15+ during the first 18 years of life is thought to decrease an individual’s life-time risk of skin cancer by 78% (Stern et al., 1986). Third, lifestyles are often established during childhood. Health-related behaviours are open to influence, particularly in the years before adolescence (Immarino and Weinberg, 1985). With regard to skin cancer-protecting behaviours, by the time they have reached adolescence, many young people fail to comply with recommendations to use sunscreens (Banks and Silverman, 1992).

A recent review of sun-safe educational interventions aimed at young children concluded that they can succeed in improving knowledge levels, and influence attitudes and behavioural intentions. However the designs of most of the studies are non experimental and based on small samples (Hewitt et al., unpublished report).

Skin cancer prevention is not included in Curriculum Guidance 5: Health Education, the guidance issued for schools by the National Curriculum Council (NCC, 1990). Furthermore, recommendations on school policy have yet to be circulated by the Department of Education and Employment. In 1995, the former Health Education Authority in partnership with the Department of Health and the British Association of Dermatologists sent Sun Awareness Guidelines to all schools in England.

The 1995 study by Horsley et al. reported an increase nationally in the proportion of schools beginning to implement sun protection in the year that the guidelines were circulated (Horsley et al., 2000). However, in a recent survey of health education policies in Nottinghamshire schools, only 44% of primary schools and 15% of secondary schools were found to have written procedures and guidance in place for skin cancer awareness (Pearson et al., unpublished report).

There was a dearth of resources for use in skin cancer-related health education in the UK in 1998, when the present research study took place. The ‘Sun-safe’ teaching resource, which is the focus of the present evaluation study, was developed to fill this gap.
Method

The Sun-safe computer-based teaching resource

The core of the teaching resource was an interactive computer program for use by children aged 10–11 years. It was accompanied by teaching notes which were intended as guidance on the content and teaching methods to be used in the introduction of the topic.

The computer program was developed by a commercial company, with input from health professionals who included a Health Promotion Specialist and a Nurse Specialist in Dermatology. It was piloted with children from schools which were not involved in the main study. It is interactive, and uses colour, sounds and movement. The story follows the adventures of a central character ‘Dillo’, the Armadillo. Dillo loses his protective armour and has to learn how to protect himself from the harmful effects of the sun before reaching his final destination, the ‘Sun City’ theme park.

To progress through the program, the children have to correctly answer questions on a searching screen. By answering questions relating to four key sun-safe messages the children collect objects (such as SPF 15+ sun cream) which Dillo can use to protect himself from the sun. Methods of sun protection are reinforced on a second page where the children tick off items on a packing list for Dillo’s sun-safe trip.

Background information pages on tanning and fashion follow, in addition to a screen on the potentially harmful effects of ultraviolet radiation. A second searching screen is presented where users are invited to click on relevant sun-safe objects from a beach scene. Finally, Dillo arrives in Sun City where users apply their knowledge by identifying who is ‘Most at Risk from the Sun’ from a scene of children at a fun park on a hot, sunny day. The program takes approximately 20 min for children to work through.

The Sun-safe workbook

To ascertain the effect of the interactive computer program as a medium for learning, a workbook version of the story was developed, for comparison. The workbook contains the same text and still images from the computer program. It was designed to meet the same objectives as the computer program and requires the same introduction, by teachers, before its use. The broad objectives of the two resources were:

- To clarify key messages on skin cancer prevention.
- To provide information on the effects of ultraviolet radiation on the skin.
- To encourage responsible attitudes and behaviour intentions in relation to skin cancer prevention.

Both resources were designed for use in class-based topic work. Topic work is a common approach to teaching and learning in UK primary schools. It involves children, singly, in pairs or groups, working on different tasks over specified periods of time.

Evaluation

Design

The study was a controlled evaluation of two comparable teaching resources. Effectiveness was measured in changes in levels of knowledge, attitudes and behavioural intentions. This part of the study is the subject of the present paper. The study also included a survey of teachers to ascertain their views on the acceptability and appropriateness of the intervention. It also incorporated focus group interviews of children to explore their understandings of the possible effect of exposure to the sun, and their knowledge and attitudes to preventive behaviours. Data from the survey of teachers and focus group discussions will be the subject of a separate publication. The evaluation was undertaken in primary schools in the setting of the classroom.

Sample

An a priori sample size calculation was performed based on data from previous studies and by using the formulae given by Machin and Campbell for clustered designs (Machin and Campbell, 1996).
The calculation was performed using knowledge score as the primary outcome measure. For 80% power to detect, at the 0.05 level of significance, a useful difference in knowledge between the intervention groups, from 60 to 65%, with a standard deviation of 15% and intra-cluster correlation of 0.01, the required sample size was 191 pupils per group. With an average class size of 32, this would require six classes in each group.

The list of 179 state maintained primary and junior schools located within the boundaries of Nottingham Health District was arranged in random order, and schools were contacted and asked to participate in the intervention part of the study. This process continued through the random list until the required 12 schools had agreed to participate. Subsequently, additional schools from the list were contacted to provide four schools willing to act as controls. These schools participated in the testing only.

One class from each of the participating schools took part in the study. Classes of Year 6 pupils and mixed classes of both Year 5 and 6 pupils were eligible to take part. Participation was conditional on a teacher contact attending a briefing session, at the local health promotion specialist centre, prior to the introduction of the resources into the schools. Consent by the headteacher was a requirement. Additionally, each school had to possess at least two Acorn computers (model A3020). Schools were excluded if they were already involved in a project covering the same topic. Those that took part were given a book token.

The schools which were willing to participate in the intervention were stratified according to their geographical location, to ensure a balance between urban and rural schools. Analysis of the urban/rural stratification showed a strong association with average school performance based on the Year 6 annual assessments (SATs). The urban schools had scores lower than the LEA average and the rural schools had scores higher than the LEA average. Using computer generated random numbers, the schools were allocated to use either the resource incorporating the workbook or the computer program.

### Outcome measures

The primary measures assess children’s knowledge, attitudes and behavioural intentions. A review of the literature highlighted the lack of a valid and reliable questionnaire to use with the children in the study. Therefore, the first step in the evaluation project was to design a valid and reliable questionnaire to measure these variables.

Traditional psychometric techniques were used to develop the questionnaire (Streiner and Norman, 1990). Factor structure (or item analysis) was used to develop Likert-type rating scales. Iterative pilot work established the face and content validity of the questionnaire. Test–retest and internal consistency were used as measures of questionnaire reliability.

The questionnaire was developed in four sections. The first section covered the sex of the respondent, date of birth, and skin, hair and eye colour. The second section measured behavioural intentions and children are asked to indicate their intent (always, sometimes, never) against the following separate sentence stems ‘When I am out in the sun this summer I will...wear a long sleeved shirt, try to get a good sun tan, try to avoid sun burn, look for a shady area to play in, make sure that I have sun cream on’.

The third section was designed to measure knowledge and comprised written statements which the children were asked to mark True or False. The items covered the effects of the sun, e.g. ‘It is possible to burn in minutes in the mid-day sun’, and issues related to protection, e.g. ‘Swimming in water protects the skin from sunburn’, ‘Too much sun can cause wrinkles’. The fourth section measured attitudes and comprised statements, for example, ‘Having a suntan is the sign of a good holiday’, with which the children were asked agree or disagree.

A second technique, ‘draw and write’ (Williams et al., 1989), was used to measure the children’s knowledge and behavioural intentions. Details of the methods and results of this part of the study will be presented elsewhere. In summary, the questionnaire comprised three scales on knowledge, attitudes and behavioural intentions, two
invitations to ‘draw and write’, and an initial section to obtain demographic information. The questionnaire is available from the authors.

Reliability of the questionnaire

A pilot study confirmed good internal consistency of the questionnaire. Common-factor analysis revealed that the 11 attitude items were unidimensional with good internal consistency (Cronbach’s $\alpha = 0.62, 0.73$ and $0.83$ at pre-test, post-test 1 and post-test 2, respectively). The five-item behavioural intention scale was also unidimensional and had good internal consistency (Cronbach’s $\alpha = 0.82, 0.90$ and $0.84$ at pre-test, post-test 1 and post-test 2, respectively). The 14-item knowledge scale fared less well (Cronbach’s $\alpha = 0.38, 0.32$ and $0.48$ at pre-test, post-test 1 and post-test 2, respectively). A low coefficient $\alpha$ indicates that the items on the scale do not belong to the same conceptual domain.

Evaluation process

The lessons were taught and supervised by the teachers, in the presence of a researcher. The researcher acted as observer and administered the tests. Following a short, standardized introduction by the teacher, the children were asked to complete the test (referred to in the lesson as a quiz). They were asked not to confer. Children with reading difficulties were encouraged to seek help from the teacher or the researcher. The help did not extend to explanations of the meaning of the terms used in the test. The time taken to complete the questionnaire ranged from 20 to 45 min. On finishing, the children were given a word search task to complete, whilst the others finished off their questionnaires.

The intervention utilized the resource allocated to the group. It commenced with an introduction delivered by the teacher, which centred on the meaning of key words that would help the children work through the resource, workbook or computer program: armadillo, protection, ultraviolet radiation and filter.

The evaluation was undertaken under normal classroom conditions. As the resources were developed for use in topic work, the class teacher selected pairs of children who would work together on the allocated pupil resource. Poor readers were paired with readers for peer support. The children rotated, in pairs, to work through the resource allocated to their class. When not working on the resource, the children worked on other activities which were not related to health education. The researcher observed the children working on the resources, intervening only where there were technical problems experienced with the computers.

The day after the pre-test and intervention, the teachers went through the answers to the questions in the workbook and the computer program with the children, as they would do under normal classroom conditions. The first post-intervention test was administered in the same lesson and following the reinforcement of learning. The second post-intervention testing took place 6 weeks later. All tests utilized the same questionnaire. Schools designated as control schools completed the tests at the same points in time as the intervention schools. At the end of the evaluation project a small gift was given to each child participating in the research.

Statistical analysis

Scores were created to measure knowledge, attitudes and behavioural intentions. For the analysis, the primary outcome measures were the scores in the tests 6 weeks after the intervention.

For knowledge, each question answered correctly scored 1 point. Wrong, not sure or missing responses scored 0. Thus the maximum score from the 14 knowledge questions was 14. For attitudes, a strongly favourable response (strongly agree or disagree as appropriate) scored 2 points, a favourable response (agree or disagree as appropriate) scored 1 point and any unfavourable or missing response scored 0. The 11 attitudinal statements gave a maximum score of 22. For the behavioural intentions score, strongly favourable intentions (always or never as appropriate) scored 2, favourable intentions (sometimes) scored 1 and other or missing responses scored 0. The five behaviours investigated resulted in a maximum
score of 10. For each of these three scores, the score was not calculated if more than two of the elements were missing.

In order to allow for the cluster effect in the study design, (Rice and Leyland, 1996), the changes in scores in the three groups (workbook, computer and no intervention) were compared using a mixed-model analysis of variance, allowing for the pre-test score and a random class effect nested within the study groups. Where the analysis showed significant differences between the study groups, the differences between specific groups were investigated using least-squares means to adjust the group means to the mean pre-test value. In calculating 95% confidence intervals (CI), Bonferroni correction was used to adjust the level of significance for multiple testing and the standard errors were based on the group error mean square which included the random class effect from the mixed-model analysis of variance. Standardized residuals were examined to ensure that the conditions for the use of the methods were satisfied. The analyses were carried out using SPSS for Windows release 9.0 and SAS for Windows release 6.12.

**Results**

**Response**

To obtain the required 12 schools for intervention arms of the study, a total of 49 contacts had to be made with schools, giving an unbiased estimated response rate of 11/48 = 23%. Of the 37 schools declining the invitation to participate from the outset: four were unable to attend the briefing, 18 were unable to give the time commitment required, four were not interested in participating, 10 did not respond to the initial approach by the project team, and one school had a major sun awareness week planned and was excluded from the project. Six contacts were required to obtain the required four control schools.

In total, 376 children from the 454 on roll completed both the pre-intervention test and the 6-week post-intervention test—a response rate of 83%.

**Knowledge**

In all, 374 (82%) children, 142 in the workbook group, 128 in the computer group and 104 in the control group, satisfactorily completed the knowledge sections for both pre-intervention and the 6-week post-intervention tests. The pre- and post-intervention mean scores and the crude mean increases in knowledge scores are shown in the first part of Table I. The pre-intervention scores were similar for the three groups, being in general around 8 out of 14 (57%). The increase following intervention was highest for the workbook, 2.66 (76%), and lowest for the control group, 0.70 (62%), with the computer group having an intermediate increase, 1.72 (69%). When the results for the different classes were examined (Figure 1) it was seen that there had been the expected ‘cluster effect’ due to the design of the study, with wide variation in the mean increases for different classes within the study groups.

The mixed-model analysis of variance showed significant differences between the groups (P = 0.014) in the increase in knowledge scores, after adjusting for pre-intervention scores and the effect of the class randomization. The analysis also confirmed that the increases were significantly inversely related to the pre-intervention scores (−0.58 per unit increase in pre-intervention score, P = 0.0001) and that there was significant variation between classes (P = 0.0005).

The specific nature of the differences between the groups was examined using the adjusted means from the mixed-model analysis (Table I). The 95% CIs for the adjusted means indicate that all three groups showed significant increases in knowledge, with none of the CI containing zero. The workbook group showed a significantly larger increase in knowledge score than the control group (95% CI: 0.36 to 2.50), but was not significantly better than the computer group, which occupied a position between the other two groups, being not significantly different from either of them.

When the results for the individual questions were examined it was seen that in general there had been improvements in almost all questions for
Table I. Crude and adjusted analyses of knowledge scores pre-intervention and at 6 weeks post-intervention

<table>
<thead>
<tr>
<th>Study group</th>
<th>Workbook (n = 142)</th>
<th>Computer (n = 128)</th>
<th>Control (n = 104)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unadjusted analysis: mean ± SD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pre-intervention</td>
<td>7.65 ± 2.27</td>
<td>8.23 ± 2.07</td>
<td>8.54 ± 2.22</td>
</tr>
<tr>
<td>post-intervention</td>
<td>10.31 ± 2.01</td>
<td>9.95 ± 2.27</td>
<td>9.25 ± 2.24</td>
</tr>
<tr>
<td>increase</td>
<td>2.66 ± 2.44</td>
<td>1.72 ± 2.13</td>
<td>0.70 ± 1.91</td>
</tr>
<tr>
<td>Adjusted analysis: mean (95% CI)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>increase</td>
<td>2.36 (1.66, 3.05)</td>
<td>1.73 (1.00, 2.46)</td>
<td>0.93 (0.11, 1.74)</td>
</tr>
<tr>
<td>comparison with computer</td>
<td>0.63 (–0.38, 1.63)</td>
<td>1.43 (0.36, 2.50)</td>
<td>0.81 (–0.29, 1.90)</td>
</tr>
</tbody>
</table>

*Adjusted for pre-intervention knowledge score, inter-class variation and multiple testing.

Fig. 1. Inter-class variation in increases in knowledge scores 6 weeks post-intervention.

both workbook and computer groups, but only random shifts with no discernible trend in the control group. One notable exception to this was the question relating to vitamin D, which showed no evidence of improved knowledge for either of the intervention groups. This item of knowledge was not covered in the teaching package.

Attitudes
The attitude sections of both the pre- and 6-weeks post-intervention tests were completed successfully by 368 (81%) children, giving valid scores for analysis (139 workbook, 125 computer and 104 control). The pre-intervention scores were similar for the three groups, being of the order of 10 out of 22 (Table II). The crude mean increases in score were 2.39 for workbook, 1.78 for computer and –0.01 for control. As for the knowledge scores, there was considerable variation between classes within the study groups.

When analysed adjusting for the pre-intervention scores and the class effect, the differences between the study groups were significant ($P = 0.0087$). The increases were also significantly related to the pre-intervention scores ($-0.39$ per unit increase in pre-intervention score, $P = 0.0001$) and there was significant inter-class variation ($P = 0.0013$).

Examination of the 95% CI for the least-squares means (Table II) showed significant increases for the two intervention groups, but not for the control group. Both intervention groups showed significantly greater increases in attitude score than the control group, but there was no significant difference between the two intervention groups (mean difference 0.45, 95% CI: –1.15 to 2.05).

Examining the changes in the responses to the individual attitude statements, there was a general tendency for favourable changes to have occurred in all attitudes in the two intervention groups, while the control group showed an even balance of favourable and unfavourable changes. The statements regarding the importance of skin protection and that this was the individual’s responsibility showed generally favourable responses in all groups at the pre-intervention test. The statements
Table II. Crude and adjusted analyses of attitude scores pre-intervention and at 6 weeks post-intervention

<table>
<thead>
<tr>
<th>Study group</th>
<th>Workbook (n = 139)</th>
<th>Computer (n = 125)</th>
<th>Control (n = 104)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unadjusted analysis: mean ± SD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pre-intervention</td>
<td>9.82 ± 3.17</td>
<td>10.41 ± 3.14</td>
<td>9.86 ± 3.31</td>
</tr>
<tr>
<td>post-intervention</td>
<td>12.21 ± 3.76</td>
<td>12.19 ± 3.59</td>
<td>9.85 ± 3.58</td>
</tr>
<tr>
<td>increase</td>
<td>2.39 ± 3.60</td>
<td>1.78 ± 3.13</td>
<td>–0.01 ± 3.08</td>
</tr>
<tr>
<td>Adjusted analysis:* mean (95% CI)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>increase</td>
<td>2.37 (1.27, 3.47)</td>
<td>1.92 (0.76, 3.09)</td>
<td>–0.01 (–1.28, 1.27)</td>
</tr>
<tr>
<td>comparison with computer</td>
<td>0.45 (–1.15, 2.05)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>control</td>
<td>2.38 (0.70, 4.06)</td>
<td>1.93 (0.21, 3.65)</td>
<td></td>
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</table>

*Adjusted for pre-intervention attitude score, inter-class variation and multiple testing.

showing the most unfavourable attitudes were those relating to cancer, which was not seen as a problem by many of the children, with approximately 50% of the intervention groups still giving negative responses after the intervention, despite small shifts in the right direction.

**Behavioural intentions**

The analysis of changes in behavioural intentions was based on scores from 348 (77%) children who satisfactorily completed the relevant sections of the pre- and 6-weeks post-intervention tests (125 workbook, 123 computer and 100 control). The pre-intervention scores were of the order of 6 out of 10, with the workbook group having a slightly lower mean that the computer group (Table III). The mean increases were less than 1 for all groups, with a particularly low mean, 0.09, in the control group.

Although the mean increases were small, the mixed-model analysis of variance showed significant differences between the groups \((P = 0.0027)\), with a significant effect of pre-intervention score \((-0.55\) per unit increase in pre-intervention score, \(P = 0.0001)\) but no significant inter-class variation \((P = 0.23)\).

The detailed investigation of the adjusted means, showed significant increases for the two intervention groups, but not for the control group (Table III). In contrast to the knowledge and attitude scores, the computer group showed a bigger increase in behavioural intentions score than the workbook group, but as for the other two scores, this difference was not significant.

The changes observed in the individual intentions showed a similar pattern to the attitudes and knowledge, with general improvement in the intervention groups and random change in the control group. Avoidance of sun burn and use of sun cream were the behaviours most favoured, even before intervention. The biggest change was seen for not trying to get a good tan. The least favoured behaviour was the wearing of a long-sleeved shirt.

**Discussion**

It is recommended that a combination of qualitative and quantitative methods are used to evaluate health promotion interventions which consist of several components (Campbell *et al.*, 2000). We used a combination of methods to evaluate the ‘Sun-safe’ computer-based teaching resource. The quantitative part of the study was experimental in design. Cluster randomization was used, with schools randomly allocated to the two intervention arms of the study, utilizing a computer or work-book-based resource. The control schools, i.e. those which did not participate in the intervention, were self selected. This means that the design did not
Evaluation of ‘Sun-safe’

Table III. Crude and adjusted analyses of behavioural intentions scores pre-intervention and at 6 weeks post-intervention

<table>
<thead>
<tr>
<th>Study group</th>
<th>Workbook (n = 125)</th>
<th>Computer (n = 123)</th>
<th>Control (n = 100)</th>
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</thead>
<tbody>
<tr>
<td>Unadjusted analysis: mean ± SD</td>
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<tr>
<td>pre-intervention</td>
<td>5.91 ± 1.76</td>
<td>6.71 ± 1.72</td>
<td>6.19 ± 1.79</td>
</tr>
<tr>
<td>post-intervention</td>
<td>6.69 ± 1.99</td>
<td>7.60 ± 1.45</td>
<td>6.28 ± 1.70</td>
</tr>
<tr>
<td>increase</td>
<td>0.78 ± 2.13</td>
<td>0.89 ± 1.51</td>
<td>0.09 ± 1.64</td>
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<tr>
<td>Adjusted analysis: mean (95%CI)</td>
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<tr>
<td>increase</td>
<td>0.66 (0.26, 1.05)</td>
<td>1.11 (0.70, 1.51)</td>
<td>0.08 (–0.37, 0.52)</td>
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<tr>
<td>comparison with computer</td>
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<td></td>
</tr>
<tr>
<td>control</td>
<td>–0.45 (–1.02, 0.12)</td>
<td>1.03 (0.43, 1.63)</td>
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</tbody>
</table>

*Adjusted for pre-intervention behavioural intentions score, inter-class variation and multiple testing.

adhere totally to a randomized controlled trial. However, the similarities in the baseline test results between the three groups suggest that bias due to group differences was minimized in the study. Given the challenges in applying experimental designs to evaluations in the setting of the school, the study design was as robust as possible to demonstrate causality.

The use of experimental methods to evaluate health promotion interventions is controversial (Speller et al., 1997). However, it was deemed appropriate in the present study. The interventions were constructed so that they were as short as possible, to take into account the limited time tabling space available in schools to teach the topic. The objectives were clearly focused and the input required by teachers simple enough to make standardization across the schools possible. There were no other activities in skin cancer prevention underway in the schools, either in the curriculum, wider school environment or the community, before or during the Sun-safe project, which could have had a bearing on the results. This enabled us to attribute any changes observed to the interventions with greater certainty. Furthermore, it was possible to address the ethical issues surrounding the non-intervention schools satisfactorily by providing them with the resource after the official period of the study.

The main finding in the study was that the computer-based resource successfully influenced knowledge levels, attitudes and behavioural intentions in skin cancer prevention. Research has shown that the way in which information is presented to children affects the response and learning of the target population (David and Williams, 1987). The use of animation in a multi-media environment has previously been found to enhance children’s comprehension and recall of health-related information (Large et al., 1996). The present study has shown that the medium can also influence the development of positive attitudes and behavioural intentions in skin cancer prevention.

The increase in mean scores for knowledge in the control group suggests that the control group was also exposed to information on skin cancer prevention. It is also possible that the completion of a second and third questionnaire without an intervention was sufficient to increase knowledge levels in the control group, a finding also noted by Hemalainen and Keinanen-Kiukaanniemi (Hemalainen and Keinanen-Kiukaanniemi, 1992). It is important to note, however, that the increase observed was smaller than for either of the intervention groups, further supporting the evidence that the resources had a beneficial effect.

It has been suggested that the effectiveness of computer-based resources such as Sun-safe is associated with: their use of animation, sound and interaction; the choices they provide for the user;
and the opportunities they provide for users to work at their own pace. However, in the present study, the level of effectiveness achieved by the use of the workbook resource, which was similar if not slightly superior to the computer-based resource, suggests that the computer-based resource does not confer any advantages in educational outcomes over the printed material, in health education targeting skin cancer. If similar images are used and children are engaged in learning at their own pace then any advantage to be gained in the use of sound, movement, interaction and choice is equalized by other qualities inherent in the printed material. The specific value of each of the resources was not ascertained in this evaluation study, but it is probable that they differed and that their effect evened out across the two resources.

In assessing the relative merits of the resources evaluated, it is also important to assess any other benefits gained from their use, in addition to the educational objectives. Although not reported here, the computer program was more enjoyable for children to use than the workbook, and fostered familiarity with the use of computers and skills in using the keyboard.

Mean scores mask the strengths and weaknesses of a resource in meeting a wide range of educational objectives. Thus, the analysis in the present study incorporated change at the level of individual questionnaire items. This showed that there were only two knowledge items in which improvements had not occurred, post intervention. Of these, the statement ‘the ozone layer protects us from too much ultraviolet light’, with which the children were expected to agree, was covered by the resource. This was a complex issue for the children to understand in such a short health education lesson, and would benefit from further explanatory detail in the package and additional interaction with the teacher.

The second knowledge item which showed no improvement after the intervention related to the skin manufacturing vitamin D. Information on vitamin D did not appear in the resources and therefore change had not been expected. This finding, and the improvements noted in other knowledge related areas, adds further weight to the evidence that the resource was effective.

Previous studies have shown that the length of the intervention in skin cancer education is associated with the duration of the effect (Peters and Paulussen, 1997). Short-term outcomes can be expected with brief interventions, such as those evaluated in the present study. The second test after the intervention in the evaluation of Sun-safe was administered at 6 weeks, which is the approximate length of the school holidays. The results suggest that interventions employing the Sun-safe workbook and computer-based resources would be most usefully put into effect in the week before the start of the holidays.

Finally, it is now accepted that health education interventions are most likely to succeed if they are supported by strategies in the school environment and the community (Denman, 1999). The absence of these additional strategies in the study schools at the start of the project was an important factor in demonstrating causality with respect to the resources under investigation. Indeed, the schools were actively discouraged from implementing additional interventions during the study period. Nevertheless, it was clear to the study team that an expansion of strategies was to be a natural progression for the schools involved in the project. It is possible, therefore, that the positive effects observed in the application of the resources would be further enhanced, if a wider approach is used at the outset. Thus our recommendation would be that the Sun-safe computer and workbook-based resources are invested in for use in health education, but that it is part of a wider ‘health-promoting school’ strategy incorporating measures in the school environment and targeting parents and the wider community.

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References


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