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Digital storytelling within the Australian mining industry: worker engagement and health literacy indicator effects

Lay summary

This quasi-experimental intervention study sought to test the effectiveness of digital stories featuring mining workers and leading health experts as a workplace health education strategy. The mining industry is a challenging setting for health education due to a range of reasons including productivity targets, workforce diversity and work roster schedules. Workers in the intervention group received a 'toolbox talk' presentation including a digital story. Workers in the control group received the same health information without the digital story, reflecting common health communication practices in the industry. Outcomes of this research demonstrate that digital storytelling was more effective on worker engagement and interactive health literacy, with a promising level of maintenance over a follow-up period. The findings show the benefits of digital storytelling as a worker focused health education strategy for complex industrial settings where time efficient communication methods are required.

Summary

The mining industry is a demanding context for workplace health education due to a range of factors including productivity targets, workforce diversity and work roster schedules. This project investigated the impact of digital story health communication on worker engagement and its effect on interactive and critical health literacy indicators. The study comprised a quasi-experimental parallel time series research design, with control and intervention groups at each of the mine sites (n=2). Workers in the intervention group (n=85) received a 'toolbox talk' presentation incorporating a digital story featuring a mining industry worker and a leading cardiovascular health expert. The control group (n=90) received equivalent health information communicated in a non-narrative manner, reflective of typical practices within the mining industry. A significantly greater effect was evident for worker engagement within the intervention group, with substantial maintenance over the follow-up period, compared with no significant effect at follow-up within the control group. Significant effects on interactive health literacy indicators (n=3) were evident for the intervention group with corresponding lower level or nil effects within the control group. The findings highlight the benefits of evidence-based digital stories as an efficient and efficacious worker-centred health communication strategy for complex industrial workplace environments.

INTRODUCTION

The mining industry is a complex setting for workplace health education and communication, necessitating strategies accommodating a range of contextual factors including the physical and mental demands of work tasks, environmental conditions, organisational work site operations and roster schedules. Toolbox talks are work group presentations that focus on specific health and safety topics. Ideally, they should challenge thinking, practices and behaviours through engagement, two-way communication and active discussion. Despite this, they often transpire as predominantly one-way information delivery (Shannon & Parker, 2012). The majority of Australian mine sites operate 24 hours per day, seven days per week, with substantial pressure to meet production targets. From an operational perspective, health education can be negatively perceived as activity that incurs lost time and economic debt for the employer. Another potential barrier is employer resistance to workplace health promotion and education, believing they should not be interfering with personal lifestyle choices (Goetzel & Ozminkowski, 2008).

The World Health Organization (WHO, 1998, p.4) has defined health education as "…consciously constructed opportunities for learning, involving some form of communication designed to improve health literacy, including improving knowledge, and developing life skills which are conducive to individual and community health." An integral component of this definition, health literacy (HL) has been identified as an outcome of health education and communication (Nutbeam, 2008), an antecedent of health promoting behaviour and a prominent health determinant (Frisch, Camerini, & Diviani, 2011). Interactive health literacy (IHL) and critical health literacy (CHL) are incorporated within Nutbeam's (2000) seminal multidimensional model of HL which reflects a continuum of increasing autonomy and empowerment (Nutbeam, 2008). An educational goal of IHL is the development of personal skills, motivation and confidence to utilise information via a supportive environment that promotes interactive communication (Nutbeam, 2000). Educational goals of CHL include personal and community empowerment, enhanced capacity to actively seek and critically analyse health information, and exerting greater control over health determinants (Nutbeam, 2000).

Planning and evaluation of workplace health education and communication requires an understanding of occupational culture which represents common perspectives, values and norms derived from shared experiences and identity (Antonsen, 2009). Challenges for men's health evident among Australian blue-collar workers include beliefs of invulnerability and a perceived need to be self-reliant and expected stoicism. These cultural and personal factors are particularly strong among workers in higher risk and male dominated mining and construction industries, with greater likelihood of resistance to changes suggested by people outside the organisation (Du Plessis, Cronin, Corney, & Green, 2013; Carlisle & Parker, 2014). This research study reconceived these barriers as potential enabling health determinants through worker involvement in narrative health education, since cultural awareness can add meaning to health communication and strengthen impact (Cullen, 2008; Nielsen-Bohlman, Panzer, & Kindig, 2004; Hansen, 1995). For these reasons, digital storytelling was incorporated within this study as an applied engagement strategy in the mining industry.

Storytelling is a natural form of communication that has been extensively used throughout the ages to convey a wide range of knowledge and skills (Haigh & Hardy, 2011; Hinyard & Kreuter, 2007). Within the health promotion field, narrative communication has been described by Houston et al. (2011, p.687) as a "*…form of persuasive communication used in health education that solicits actual stories or narratives from the target population to motivate behaviour change in others.*" Humans gain knowledge and meaning from experiences and learning is a social process supported by shared individual perspectives (Vygotsky, 1978; Bruner, 1996). Stories allow us to make sense of theoretical information or unfamiliar situations via shared experiences enabling vicarious learning (Haigh & Hardy, 2011; Schunk, 2008). Digital stories are brief and dynamic multimedia presentations which can include embedded text, video, still images and narrative soundtracks (Gazarian, 2010; Rossiter & Garcia, 2010). They provide an opportunity to share captivating accounts of experience from a personal perspective (Gubrium, 2009). Personal stories are well suited to digital media, because they allow for the combination of emotion with evidence-based information in a way that is more easily understood by the audience (Osborne, 2005). In doing so, digital stories are capable of functioning as tools for empowerment, with potential to reduce barriers to effective engagement such as age, cultural background, attention deficit and reading ability (McLellan, 2006; Osborne, 2005).

The digital story concept was proposed to key stakeholders within the mining company as a potential mechanism for communication efficiency, consistency and effectiveness. Implementation of the digital story health education strategy within toolbox talks would enable it to be tested against more traditional non-narrative communication methods. It was envisaged that digital stories could draw on workplace culture in a positive way, allowing industry workers to share their experiences leading to greater engagement across the workforce. Including end-users in co-creation of solutions and prioritising local culture has been identified as a fundamental HL principle for effective health promotion activity (World Health Organization, 2015). The aim of this study was to evaluate the impact of a digital story embedded communication strategy on worker engagement and its effect on interactive and critical health literacy indicators in the mining industry. This aim was supported by the following research questions. Can a digital story health education strategy facilitate greater engagement than a non-narrative comparable method, and if so, is the effect maintained with time? Can health education via a digital story generate positive effects on interactive and critical health literacy indicators in the mining industry?

METHODS

Ethical clearance was granted by the QUT Human Research Ethics Committee. The purpose, requirements, confidentiality, voluntary nature of the research and option to withdraw were communicated with participants in writing and verbally reinforced. Return of questionnaires and other documentation were accepted as indications of consent to participate.

Digital story development

A considerable challenge associated with digital story research projects is the recruitment and retention of storytellers (Gubrium, 2009). This study proactively addressed this by presenting a rationale for the digital story communication strategy to key stakeholders within the mining company, active engagement of site personnel to gain support, and provision of recruitment posters and information flyers with examples to encourage worker participation. Prospective stories were reviewed to determine their suitability for application within the mining industry and three workers were selected (two male and one female). The digital storytellers completed a pre-filming template to enhance confidence and story articulation during filming. The potential benefits of incorporating photographic images were explained and storytellers were encouraged to provide personal photographs aligned with their discussion points. Leading researchers and academics were concurrently recruited to feature in the digital stories to facilitate the inclusion of validated information and their own evidence-based messages. All digital storytellers and specialised health experts completed an image consent form granting permission for the inclusion of video footage and photographs in the completed digital stories.

The digital stories were filmed and edited by a professional video production company in consultation with the researchers. A semi-structured interview guide included in the [Supplementary Appendix] served to enable subject familiarisation, background information, unpacking the health story and reinforcement of health messages. The interview guide questions and statements were contextualised and elaborated upon during the interviews, in concordance with the health topics, circumstances and discussion points raised by the interviewed mining workers. Semi-structured interview guides were also utilised during filming of the specialised health experts, however their composition varied depending on the health focus. They included questions directly aligned with the discussion points from the corresponding mining worker interview to enable the production of a cohesive digital story. Storytellers and specialised health experts were asked to preview the edited digital story and provide feedback, as an assent and quality control mechanism. Upon completion of the three digital stories, one was selected as the first to be utilised at the mine sites. This digital story incorporating a cardiovascular health theme was the focus of this research study.

Study design

A quasi-experimental parallel time series study design, including intervention and control groups at each of the open cut and underground mine sites (n=2) was implemented. Distinct advantages of quasi-experimental research include authentic, setting focussed investigation and corresponding ecological validity, while still controlling as many threats to internal validity as possible (Rovai, Baker, & Ponton, 2014; Thomas & Nelson, 2011). A parallel research design was selected as a control mechanism for potential confounding variables associated with differences between work sites.

The intervention group received a multimodal cardiovascular health education presentation incorporating a digital story of 9 minutes 19 seconds duration. The control group received equivalent health information communicated in a non-narrative manner, reflective of typical Occupational Health and Safety (OHS) communication within the mining industry. A brochure summarising key messages of the presentations and recommendations for seeking further information or advice from health professionals was provided to both participant groups. A core set of presentation slides were prepared as a standard resource for the intervention and control groups. They included an elaboration of the key information and messages identified within the distributed brochure, and stimuli for interactive discussion. All health education presentations and resources were delivered by the researcher, to ensure consistent application and avoid the introduction of a confounding variable that could emerge with different presenters.

Data collection was managed via the Health Communication Questionnaire (HCQ), a 53-item instrument previously validated and evaluated as a reliable measure of worker engagement and indicators of IHL and CHL within the mining industry (Shannon & Parker, 2020). In addition to demographic and worker engagement data, the HCQ incorporates three sub-scales representing IHL indicators and two sub-scales representing CHL indicators. The former includes *'Responding to health information provided by others'* (1-RHI), *'Discussing health at work, home or with friends'* (2-DH), and *'Seeking health information'* (3-SHI). The latter includes *'Achieving control over personal health'* (4-ACP), and *'Helping others improve or maintain health'* (5-HO). The five HL indicators and associated items reflect constructs associated with IHL and CHL from Nutbeam's (2000) multidimensional model of HL. Item responses were provided via a 60 mm visual analogue scale (VAS) which enabled participants to rate their level of agreement with the corresponding statements. HCQ data collection occurred at three time points; Baseline (T1) data two weeks prior to the health education presentations, Impact (T2) data immediate post-presentation and Follow-up (T3) data eight weeks post-presentation. The independent variable for this research study was exposure to the digital story communication strategy. Dependent variables measured by the HCQ included worker engagement along with HL indicators captured by the five HCQ sub-scales previously listed.

Sample size calculation is necessary for considering the resource implications for conducting the research whilst determining the number of participants required for sufficient statistical power (Fitzner & Heckinger, 2010). Required sample size was calculated using the following formula (Battistutta, 2007).

$$\text{Required sample size} = (21.0 \text{ x } SD^2) / (M_1 - M_2)^2$$

Pilot HCQ data produced a combined mean of 1604.07 mm for the HL associated items with standard deviation (SD) of 330.69 mm. An expected post intervention mean difference of 170 mm was selected as the target and this represents ability to detect a change of 5 mm on the 60 mm VAS for each HCQ item. This mean difference is greater than the variability established for all HL items during HCQ reliability testing. The calculated sample size of 79.46 was rounded up to 80 participants required for each group. An inflation factor of 1.69 representing a minimum seventy percent response rate (1.3) and a seventy percent follow-up rate (1.3) was applied to allow for potentially incomplete time series data. This resulted in an initial target sample size of 135.2, rounded up to 136 participants per research group necessary to reach or exceed the minimum requirement of 80 participants per group for 90% power, with significance of .05 and a type I error of 5% (Battistutta, 2007). The applied power level exceeds targets of .80 typically reported in quantitative behavioural science research and .90 is more commonly set as a target for clinical research (Fitzner & Heckinger, 2010).

A criterion-based site selection process was undertaken to ensure that research group profiles were reflective of the industry workforce, potential confounding variables could be controlled and required sample sizes could be met. Results from a large OHS climate survey data set incorporating the mining industry partner organisation sites (n=18) were reviewed (Parker & McLean, 2012). Applied selection criteria included; (i) typical range of workforce categories, (ii) sufficient personnel to meet the required sample size, and (iii) equivalent demographic and OHS climate survey profiles. Upon identification of suitable sites (n=3), key stakeholders from the industry partner organisation were consulted to determine whether operational constraints and production schedules could facilitate the timely delivery of each stage of the study. This led to the selection of two sites located in regional Queensland, including an open cut coal mine and an underground metalliferous mine. Each were continuous mining operations with even time rosters and predominantly fly-in fly-out (FIFO) personnel.

Participants

Both research sites operated a roster managing four work crews, with two work crews from each site assigned to the intervention group and two to the control group. A total of 461 workers were employed at the two mine sites according to company data. Although staff numbers were consistent during the 10-week data collection period, mine site staff profiles may change, presenting difficulties in completing all three data collection stages. Reasons for variability include transient sub-contract workers hired for on-demand work tasks; workers commencing after baseline data collection; workers transferring to another site before completion of testing; and absence during one or more of the data collection stages due to annual leave, illness or injury. A per protocol method was applied to control these factors, limiting analysis to participants who completed all three stages of data collection (Parker & Berman, 2003). This involved matching participant responses based on provided demographic data and assigning a unique participant identification code. After completion of this cross matching and coding process, the total sample size was 175 participants, including a control group (n=90) and an intervention group (n=85). A demographic and work profile summary for the two research groups is presented in Table 1 and is consistent with previous research in the mining industry (Parker & McLean, 2012).

[insert - **Table 1**. Participant demographic profile – here]

Data analysis

HCQ data was managed and analysed using SPSS software version 21 (IBM Corporation, New York, US). HCQ items associated with worker engagement and HL indicators were entered as scale measures using a digital calliper and direct spreadsheet upload. Estimated marginal means beyond the neutral mid-point of the continuous 60 mm HCQ VAS reflect greater positive worker response approaching the 60 mm end point and greater negative worker response approaching the 0 mm end point. Demographic and other HCQ items were entered as nominal and ordinal measures. Pre-analysis data management included reverse scoring for negatively phrased HCQ items (n=9), searching for missing data, checking for extreme univariate outliers, and tests of normality, homogeneity of variance and sphericity (Rovai, Baker, & Ponton, 2014; Allen & Bennett, 2012).

Normality, homogeneity of variance and sphericity are assumption-based criteria that should be met when comparing the same dependent variable measured at multiple time points via one-way repeated measures analysis of variance (ANOVA). Repeated measures ANOVA statistics are sensitive to violations of these assumptions when the research groups are unbalanced (Keselman, Algina, & Kowalchuk, 2001). Similar sized control (n=90) and intervention (n=85) groups were evaluated during this study. The normality criterion assumes normal distribution of the dependent variable. Potential violations were assessed via Levene's Test of Equality of Error Variances using SPSS outputs and significance < .05 indicates normality violation. Small to moderate violations are generally tolerable; however, major violation may require use of the non-parametric Friedman two-way ANOVA (Allen & Bennett, 2012; Thomas & Nelson, 2011). Homogeneity implies similar variability for each set of values and was evaluated via Hartley's F_{max} Test. F_{max} can be manually calculated via the following formula:

$$F_{max} = \text{largest sample variance} / \text{smallest sample variance}$$

where largest sample variance is the largest SD squared and smallest sample variance is the smallest SD squared. Calculated F_{max} values < 10 denote homogeneity. Repeated measures ANOVA is sensitive to large homogeneity of variance violations but can tolerate small and moderate violations (Tabachnick & Fidell, 2007; Allen & Bennett, 2012). Sphericity represents equal variability in the differences between combinations of groups (Allen & Bennett, 2012). Potential violations were assessed via Mauchly's Test of Sphericity using SPSS. Significance < .05 indicates sphericity violation and the corresponding action is to review and report Huynh-Feldt or Greenhouse-Geisser epsilon (ε) adjustments. An ε value > .75 is ideal for repeated measures research studies (Rovai, Baker, & Ponton, 2014).

Following normality, homogeneity of variance and sphericity criteria assessment, SPSS was used to conduct one-way repeated measures ANOVA to investigate time, group and interaction effects. An alpha level of .05 was applied for all statistical tests. Further insights into time and group effects at the interval level were determined through Cohen's *d* and Pearson correlation coefficient *r* calculation. Cohen's *d* and Pearson's *r* scores were compared with conventional effect size values to evaluate outcomes as either not significant (ns), or significant at small, medium or large levels of effect.

RESULTS

The researchers were responsible for all on-site data collection and response rates of 90.24% at Baseline (T1), 86.12% at Impact (T2) and 85.25% at Follow-up (T3) were achieved for this study. These strong response rates were gained through systematic correspondence strategies including proactive discussion of the potential value of the research with site management and Health, Safety, Environment & Training (HSET) personnel to foster support, and pre-visit awareness raising via posters and information flyers for workers.

Digital story engagement

Levene's Test of Equality of Error Variances produced significance values of .134 to .208, indicating normal distributions. Hartley's F_{max} Test value of 3.82 indicated homogeneity of variance. Mauchly's Test of Sphericity revealed a W value of .996 and significance levels greater than .05 established the assumption of sphericity, therefore ε adjustments were not required. Results of the ANOVA Test of Between-Subjects Effects for worker engagement highlighted significant differences between groups and a large effect size (ES), $F(1, 150) = 28.083$, $p < .001$, $\eta_p^2 = .158$. The repeated measures ANOVA Test of Within-Subjects Effects for worker engagement reflected significant differences between time periods with a medium

ES, $F(2, 300) = 22.096$, $p < .001$, $\eta_p^2 = 0.128$, and a significant time and group interaction with medium ES, $F(2, 300) = 11.613$, $p < .001$, $\eta_p^2 = .072$.

To gain further insights into interval level engagement effects, ES comparisons were made by calculating Cohen's d and Pearson correlation coefficient r values as reported in Table 2. Descriptive effect sizes were based upon a widely applied index of conventional levels for small, medium and large effect sizes, as stipulated by Cohen (1992). The results demonstrate significantly greater engagement at T2 (Impact) with the digital story communication method (*M* = 49.11 mm, *SD* = 8.11), than the comparable non-narrative communication method (*M* = 34.27 mm, *SD* = 14.51). This was reflected by a large ES observed between T1 and T2 for the intervention group in contrast with a small ES for the control group. Estimated marginal means declined between T2 (Impact) and T3 (Follow-up), however the rate of decline was greater in the control group (*M* = 33.07 mm, *SD* = 13.70) than the intervention group (*M* = 39.53 mm, *SD* = 13.48). A medium ES was observed between T1 and T3 for the intervention group and no significant effect for the control group.

[insert - **Table 2**. Effect size comparisons: worker engagement and health literacy indicators across time intervals for control and intervention groups – here]

Digital story impact on interactive and critical health literacy indicators

Levene's Test of Equality of Error Variances produced significance values of .071 to .951, indicating normal distributions. Hartley's F_{max} Test value of 2.81 indicated homogeneity of variance. Further data screening included Mauchly's Test of Sphericity with W values of .956 to .994 and significance levels greater than .05 confirming the assumption of sphericity, therefore ε adjustments were not required.

After satisfying the criteria for normality, homogeneity of variance and sphericity, one-way repeated measures ANOVA Test of Within-Subjects Effects for HCQ sub-scales was conducted. Significant differences and a large ES were evident between time periods for sub-scale 1-RHI, $F(2, 178) = 18.146$, $p < .001$, $\eta_p^2 = .169$. A significant time and group interaction with medium ES was observed for sub-scale 1-RHI, $F(2, 178) = 9.322$, $p < .001$, $\eta_p^2 = .095$. Further insights into interval level health literacy indicator effects were gained by calculating Cohen's d and Pearson correlation coefficient r values as reported in Table 2.

Stronger IHL indicator results were observed for 1-RHI at T2 (Impact) with the digital story communication method ($M = 46.88$ mm, $SD = 7.47$), than the comparable non-narrative communication method ($M = 38.96$ mm, $SD = 8.41$). A large ES was observed for 1-RHI between T1 and T2 for the intervention group in contrast with a small ES for the control group. Other significant IHL indicator results include small effect sizes within the intervention group for HCQ sub-scale 2-DH between T1 and T2, T1 and T3, and for sub-scale 3-SHI between T1 and T3. In contrast, no significant effects were observed for the same sub-scales and time points within the control group. No significant effects were evident for the remaining interval comparisons, as reported within Table 2.

DISCUSSION

Health communication engagement, as captured by the HCQ, represents worker perceptions of beneficial workplace health education prompting them to think about their own health. The application of digital story health communication in these workplace settings achieved substantially greater workforce engagement (large ES) at the time of health education delivery (T2) than equivalent non-narrative health education (small ES). Furthermore, a high degree of maintenance was observed for the intervention group, with a medium ES evident for engagement after an eight-week follow-up period (T3), contrasting with no significant effect for the control group. These outcomes highlight the immediate and continuing impact of digital stories as an efficacious strategy for gaining worker attention and prompting self-reflection.

A large ES at impact stage (T2) for the intervention group and a small ES for the control group was also evident for the first interactive health literacy (IHL) indicator, '*responding to health information'* (1-RHI). This emphasises additional benefits of workplace digital story health communication including consideration of co-worker health and motivation to improve or maintain personal health. It was not surprising that no significant effect was evident for 1-RHI at follow-up (T3) for both groups due to the short-term construct orientation of associated questionnaire items. Interestingly, small effects at impact (T2) and follow-up (T3) were observed within the intervention group for the second IHL indicator, *'discussing health at work, home or with friends'* (2-DH) in contrast with no significant effect at either stage in the control group. These findings demonstrate greater readiness and participation in health-related discussion among the workforce following digital story health education. A small ES was also evident for the third IHL indicator, *'seeking health information'* (3-SHI) at follow-up (T3) in contrast with no significant effect in the control group. This reflects greater confidence, resourcefulness and action to seek health information following increased interactive health communication.

These are promising outcomes for the context, given the previously identified barriers for men's health evident among Australian blue-collar workers. They include beliefs of invulnerability, a perceived need to be self-reliant, expected stoicism and reluctance to seek help which are particularly strong in the mining and construction industries (Du Plessis, Cronin, Corney, & Green, 2013). The findings are also encouraging for conducting workplace health education in complex settings, as mining toolbox talks often compete with other cognitive foci for workers including shift briefings, task requirements, production target pressure, fatigue and isolation from family.

According to Nutbeam's (2000) multidimensional model of health literacy, critical health literacy (CHL) is of highest order within a hierarchy of increasing autonomy and empowerment. No significant group level effect on CHL indicators, '*achieving control over personal health'* (4-ACP) and *'helping others improve or maintain health'* (5-HO) was observed among intervention or control treatments. Further research could determine whether CHL effects are evident at a group level following consecutive health education activities or implementation of a longer follow-up time scale. Despite this, CHL indicators were evident among the digital storytellers and an interesting account of their lived experiences will be shared via our upcoming qualitative study publication.

This research was conducted in complex industrial settings where implementation is challenging due to work production pressures, workforce diversity, remote location of operations, demanding work roster schedules and worker fatigue. Despite this, high response rates exceeding 85% were achieved through effective engagement of key company stakeholders, site management and the workforce to provide a clear rationale and establish trust. Project communication included pre-visit awareness raising posters, work crew meetings, reinforcement of key messages during site visits and follow up reporting to the workforce. Other strengths include a parallel research design with control and intervention groups at each site to address potential confounding variables and systematic evidence-based evaluation of workplace health communication utilising an instrument validated within the mining industry.

Despite the strengths of a parallel research design, a potential limitation is the possibility of participant interaction across the two health communication treatment groups during the intervention period. This was controlled via a work crew allocation process which utilised roster cycles and crew locations to create physical separation. Another potential limitation was the possibility of work crew profile changes occurring with a time series research design, however this was effectively managed via a per protocol method limiting analysis to workers present for all three data collection stages and an inflation factor to ensure minimum sample sizes were achieved. A limitation of digital story health communication is the inability for workers to directly ask the storytellers questions at that point in time, which can be achieved when a guest speaker visits individual work sites. This could potentially be addressed by implementing a question and answer process over time, with direct feedback provided by the storyteller to complement the feedback and two-way discussion that was enabled by the health education facilitator in this study.

CONCLUSION

The workplace has been identified as an important setting for health promotion, however there is a need for greater evidence-based planning and more comprehensive and effective evaluation methods (Egger, Spark, & Donovan, 2013). This is the first known study to objectively measure the impact of digital story health communication on workforce engagement and health literacy indicators within the Australian mining industry. Use of digital stories as a workplace health communication strategy requires investment of additional time and resources, however these costs are outweighed by the range of benefits identified by this study. The inclusion of digital stories within toolbox talks led to significantly greater workforce engagement and positive IHL effects at the point of health education delivery and over time, as measured by the HCQ instrument. Nutbeam's (2000) educational goal of IHL; to develop personal skills, motivation and confidence in a supportive environment promoting interactive communication was fulfilled.

The findings support the rationale for application of digital stories as a strategy for engaging workers via persuasive and authentic personal accounts from people with a shared perspective, in combination with verified health information from specialised health experts. Outcomes demonstrate that digital stories offer a valuable health communication solution for industrial workplaces. They are a mechanism for efficiency, enabling health information to be concisely delivered in an engaging manner. Digital stories also support consistency of health information which is important for multi-site workplaces where a range of HSET personnel are involved in the delivery of toolbox talks. This project has demonstrated the value of co-creating health education resources with workers for health communication effectiveness and the importance of evidence-based evaluation and planning. Future research could include more mining sites to enable demographic sub-group comparison, investigation of factors across work and home environments, and application in other industries.

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Table 1. Participant demographic profile

	Control group (n=90)	**Intervention group** (n=85)
Gender		
Male	92.20 % (n=83)	94.10 % (n=80)
Female	7.80 % (n=7)	5.90 % (n=5)
Age range	18 – 66 years (*M* = 40.26, *SD* = 10.91)	20 – 65 years (*M* = 40.81, *SD* = 11.74)
Job categories		
Operator / vehicle driver	68.9% (n=62)	62.8% (n=54)
Maintenance	11.1% (n=10)	20.4% (n=17)
Drill and blast	14.4% (n=13)	6.0% (n=5)
Project operations	5.6% (n=5)	9.6% (n=8)
Other	0.0% (n=0)	1.2% (n=1)
Time working in industry	0.08 – 42.58 years (*M* = 8.21, *SD* = 9.14)	0.17 – 42.00 years (*M* = 6.82, *SD* = 7.94)
Time working at current mine site	0.08 – 8.67 years (*M* = 1.89, *SD* = 2.10)	0.08 – 7.50 years (*M* = 1.72, *SD* = 1.80)
Country of birth		
Australia	86.8% (n=78)	88.2% (n=75)
New Zealand	11.0% (n=10)	4.7% (n=4)
Scotland	1.1% (n=1)	1.2% (n=1)
Papua New Guinea	1.1% (n=1)	0.0% (n=0)
Malta	0.0% (n=0)	1.2% (n=1)
Canada	0.0% (n=0)	1.2% (n=1)
Germany	0.0% (n=0)	3.5% (n=3)
Main spoken language		
English	100.0% (n=90)	100.0% (n=85)
Other	0.0% (n=0)	0.0% (n=0)
Aboriginal or Torres Strait Islander (ATSI) identification		

Yes	6.7% (n=6)	3.5% (n=3)
No	93.3% (n=84)	96.5% (n=82)
Highest level of schooling completed		
Year twelve or equivalent	33.7% (n=30)	42.4% (n=36)
Year ten or equivalent	59.6% (n=54)	51.8% (n=44)
Year eight or equivalent	5.6% (n=5)	2.4% (n=2)
Year seven or below	1.1% (n=1)	3.5% (n=3)
Highest qualification		
Certificate	24.0% (n=22)	31.8% (n=27)
Diploma	5.6% (n=5)	8.3% (n=7)
Bachelor degree	1.1% (n=1)	2.4% (n=2)
Nil	69.3% (n=62)	57.5% (n=49)

Table 2. Effect size comparisons: worker engagement and health literacy indicators across time intervals for control and intervention groups

Measure	**Interval**[a]	**Group**	**Cohen's *d***	**Pearson's *r***	**Effect size**[bc]
Engagement	T1 & T2	Control	.186	.093	Small
		Intervention	1.569	.617	Large
	T1 & T3	Control	.110	.055	ns
		Intervention	.590	.284	Medium
1-RHI	T1 & T2	Control	.352	.173	Small
		Intervention	1.347	.559	Large
	T1 & T3	Control	.155	.077	ns
		Intervention	.075	.037	ns
2-DH	T1 & T2	Control	-.089	-.045	ns
		Intervention	.291	.144	Small
	T1 & T3	Control	.009	.004	ns
		Intervention	.201	.100	Small
3-SHI	T1 & T2	Control	.021	.011	ns
		Intervention	.166	.083	ns
	T1 & T3	Control	.011	.006	ns
		Intervention	.241	.119	Small
4-ACP	T1 & T2	Control	-.172	-.086	ns
		Intervention	-.077	-.039	ns
	T1 & T3	Control	-.113	-.056	ns
		Intervention	.003	.001	ns
5-HO	T1 & T2	Control	-.040	-.020	ns
		Intervention	.107	.053	ns
	T1 & T3	Control	-.085	-.043	ns
		Intervention	.015	.008	ns

[a]T1 = Baseline (-2 weeks), T2 = Impact (0 weeks) & T3 = Follow-up (+8 weeks).
[b]Conventional ES values for d: small = .20, medium = .50 & large = .80 (Cohen, 1992).
[c]Conventional ES values for r: small = .10, medium = .30 & large = .50 (Cohen, 1992).
ns. Not significant.