PREDICTING AUDIENCE SUBSYSTEM AS DETERMINANT OF OUTCOMES OF LEARNER-BASED VIDEO COMMUNICATION SYSTEM DESIGN

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ABSTRACT

The overall purpose of study was to extend theoretical concepts and theories in Science and Technology Studies, that explain difficulties in stabilizing video in learning environments of student society by analysing the audience subsystem of learner-based video communication as the requirement and determinant factor for the functionality of the system design. Mixed methods design involving qualitative and quantitative approaches was employed in analysis of Science and Technology Studies concepts and field survey data on influences of socio-cultural interactive relationships among audiences. The approach profiled the structural identity characteristics of smallholder-farmers and University-student audiences in separate composition models. The structural models represent the respective subsystems of the audience subsystem which secure extraneous audience-related variables that contribute the required system design inputs to the functionality of video. The major findings from theoretical mathematical models of audience behaviours are audience-related contextual factors which determine outcome of the functionality and stability of learner-based video communication by altering the systems design objective through influences of external input variables on functionality of learner-based video communication design as socio-technical artefact. Evaluations of outcome models in linear variable differential equations predict several innovations among audiences. The findings suggest to stakeholders that, the audience-subsystem of video is composed of diverse audience-related contextual factors such as socio-cultural diversity, conflictive relationships, diverse challenges and relative differences in perspectives of audiences which contribute external input variables towards determining the design outcome and stability of learner-based video communication design. The findings imply that, educational class assessments for learners that dwell on adoption of messages from videos may be difficult. The phenomenon requires expanding future research on different students in society in different regions of the world, due to socio-cultural differences and the development of differences between countries.

Keywords: *Predictions, Learner-Based Video Communication, Audience-Subsystem, Requirement Analysis, Systems Design.*

INTRODUCTION

Learner-based video communication includes videos built into development strategies for awareness-raising and advocacy, stakeholder engagement and action, capacity building and problem appraisals, data collection and documentation in which qualitative research techniques are combined with video in recording in-depth interviews and in doing participant observation of focus group discussions and often, for taking visual notes as well as reporting in various fields of research globally and diversely by different stakeholders (Lie & Mandler, 2009; Brown, 2019). For rural development, learner-based videos form part of well-designed communication strategies for change, linking discussions, seminars, instructional manuals or websites with the general intention of persuading audiences to change behavior or actions (Lie & Mandler, 2009). Van Mele and colleagues, for instance, (Van Mele, 2011, 2014; Bentley, Van Mele, Okry, & Zossou, 2014; Bentley, Van Mele, Harun-ar-Rashid, & Krupnik, 2015) employed videos in scaling up sustainable technologies. They also integrate participatory learning and action research with video as video projects. Examples of such learner-based videos reported by Lie and Mandler (2009) include the WARDA Rice Videos, Digital Green in India, Siella Mineral Lick in Ghana, Cocoa videos in West Africa, and CARENAS in Bolivia, among others. Those videos apply causal communication processes that expect direct effects of video on the audience without taking into account the contributions of the audience subsystem as system entity and requirement system design input, towards the output of functionality of video system design as mass communication technology (Enserink et al., 2010). The focus of this paper is on expanding concepts and suggesting methods to calculate the complexity of the process of building a video learning system for students and society, by proposing a scientific calculation method that classifies the complex audience groups of a video learning system. In doing this, a new research direction to solve problems that are mentioned is suggested, using the proposed calculation direction, towards identifying difficulties and obstacles in learner-based video communication.

First, the systems design of current learner-based video communication requires the adoption of messages to change the practices of the audience (Van Mele, 2011; Muilerman & David, 2011; David & Asamoah, 2011; Bentley et al., 2014; Van Mele, 2014). However, this notion contradicts the systems concept in a typical systems model described by Silva and Ferrão (2009) and Enserink et al. (2010) in which the entities represent subsystems that offer design inputs towards the functionality and outcome of the general systems design objective. Consequently, in determining the functionality and outcome of video technology, the inconsideration of contributions of design inputs by the audience-subsystem as a major systems entity in requirement analysis (Enserink et al., 2010; Baxter & Sommerville, 2011; Davis et al., 2014; Kumi & Dzidonu, 2016a) increases the risks of technological failures in video communication (Kumi & Dzidonu, 2015).

Requirement analysis of the major systems entity maps the audience sub subsystem variables that secure design inputs to the audience subsystem. This involves construction of composition models of the audience subsystem based on the structural features of known video communication designs. One well known design involves communication processes in which cocoa videos show technical knowledge to smallholder-farmers-audience in Video Viewing Club methodology in rural communities (David, 2006). Another design involves University-student-audience settings where students receive lectures from video presentation technologies. In these designs, video shows constitute mass communication strategy and tool towards learning by the various audience groups which expect

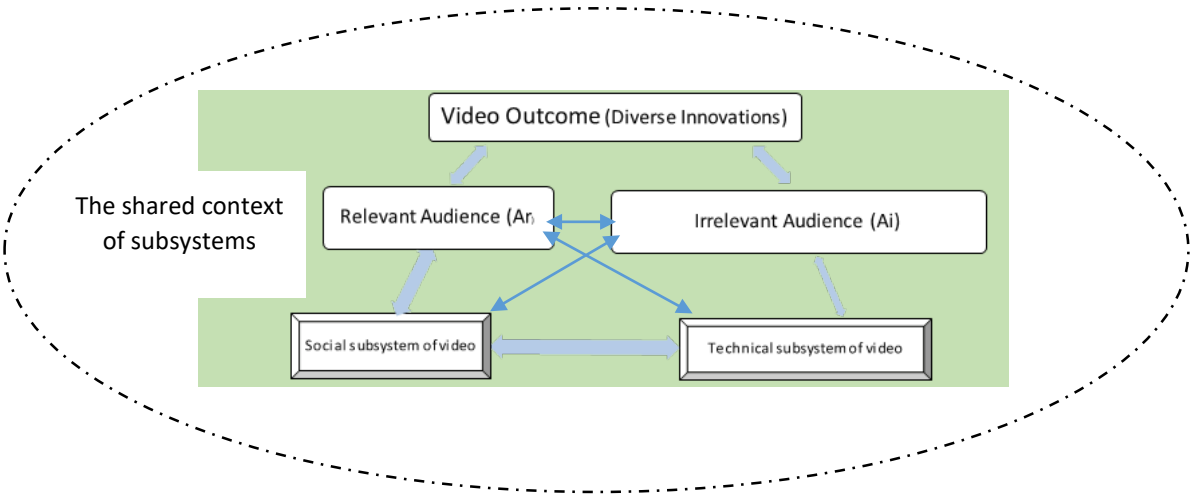
change in reality as outcome. This implies that the set systems design objective for learner-based video communication is to engage the audience as a uniform social group with videos towards changing the practice of the audience as learners. Figure 1 illustrates this phenomenon in a flow diagram which describes the current uses of learner-based video communication as a mass communication tool that expects direct effects of video on the audiences (David & Asamoah, 2011; Bentley et al., 2015). It becomes clear that, causal flow of information in video communication disregards the contributions of design inputs by the constituents of the audience subsystem which offers requirement design input variables towards determining the functionality and outcome of the systems design (Enserink et al., 2010; Baxter & Sommerville, 2011; Davis et al., 2014). The paper pays attention to the contributions of design inputs by the constituents of the audience subsystem.

Source: Concept based on Literature Review and Field Survey Data, 2017.

Figure1: Flow diagram illustrating current concept of learner-based video communication as mass communication tool that expects direct effects of video on the audiences.

Second, the causal designs of video disregard interactive behaviours of the audience-subsystem which offer the major requirement systems design input towards determining the systems design output of video. The reason is, causal designs do not support analysis of interactivity between systems design components (Enserink et al., 2010; Baxter & Sommerville, 2011; Davis et al., 2014). Moreover, the causal flow of information in current video communication plays down interactive communication relationships between video and the audiences as major entities in video technology (Kumi & Dzidonu, 2015). Such can be evaluated in the Systems Model Approach (SMA) (Enserink et al., 2010). In the SMA, the entities of the systems design represent subsystems that offer design inputs towards the functionality and outcome of the general systems design objective (Enserink et al., 2010; Kumi & Dzidonu, 2017b). Hence, the paper debunks the causal communication relationships between video and its audiences by applying the SMA, Social Construction of Technology (SCOT) and Socio-technical Systems principles and Interactions theory in Science and Technology Studies (STS) as well as governance and social networks concepts in organisational studies to explore the structural attributes of video communication towards obtaining insights on interactions between audience-related factors as well as relative interactive social network structures and processes that contribute design inputs towards requirement analysis of video communication systems design.

The approach enables evaluation of the suitability of video communication in student learning. Figure 2 illustrates interactive communication relationships between structural components of video and the audiences as major subsystem variables, as well as relevant and irrelevant audiences which contribute design inputs to the audience subsystem to yield innovative outcomes in video.



Source: Concept based on Literature Review and Field Survey Data, 2017.

Figure 2: The context of video illustrating interactive communication relationships between structural components of video and the audiences as major subsystems.

LITERATURE REVIEW

Causal notions of technology development seem to ignore influences from audiences and "irrelevant social groups and individuals in the wider social organisation" (Klein & Kleinman, 2002) as sub subsystems that feed the audience subsystem in the general system design of video as socio-technical artifact (Davis et al., 2014; Kumi & Dzidonu, 2016a). In this paper, the audience, made up of either 'relevant' or 'irrelevant social groups or individuals interacting with a wider social organisation' (Klein & Kleinman, 2002), constitutes sub subsystems that are required to feed the audience subsystem in the general system design of video as socio-technical artifact (Davis et al., 2014; Kumi & Dzidonu, 2016a). Under such conditions, the relationship between the socio-technical structure of video communication system design, including the wider social organisation and social networks of audiences determine actions, activities, workspaces, work practices and consequently the behaviors of the audience in the design (Viller & Sommerville, 2000; Martin & Sommerville, 2004; Sørenson & Torfing, 2009; Feenberg, 2010; Baxter & Sommerville, 2011; Davis et al., 2014). This phenomenon implies that, audience behaviors generate diverse functionalities and corresponding outcomes of video communication system design that contradict previous works by Muilerman and David (2011); David and Asamoah (2011); Bentley et al. (2014); Van Mele (2014). Previous works by the authors report on effective and efficient transfer of information from video to audiences without facilitation by experts, did not account for influences of the shared contextual factors in the environment of audiences and video, on functionality and outcome of video.

Insights on audience–related factors are offered in theories in Science and Technology Studies or Society and Technology Studies (STS): Social Construction of Technology (SCOT) theory (Klein & Kleinman, 2002), Socio-technical Systems principles (Feenberg, 2010; Baxter & Sommerville, 2011; Davis et al., 2014), Interactions theory (Wagner, 1994) as well as concepts on governance and social networks in organisational studies (Scott, 2017; Kumi & Dzidonu, 2017a). These were ignored in the analysis determining relative interactive social network structures and processes. (Feenberg 2010; Baxter & Sommerville, 2011; Davis et al., 2014) have criticised the focus on causal relationships in technological artifacts. Mapping

of interactions (Calker, Berentsen, Romero, Giesen, & Huirne, 2006) of audience subsystem variables was supported in the critique.

Emphasis is placed on the audience subsystem that identifies relevant variables to predict the functionality and outcome of video from interactive communication relationships between the structural components of video and the audiences. The shared contextual factors in the environment of the audiences and video were considered by paying attention to influences of the 'irrelevant audiences' in social organisation which contribute external design inputs to the audience subsystem towards the functionality of video to yield innovative outcomes (Kumi & Dzidonu, 2017a, 2017b). Since, the audience-related factors are sub subsystems that largely influence the behaviours of the audience subsystem (Calker et al., 2006, Scott, 2017, Kumi & Dzidonu, 2017a), those suggest the systems design requirements that determine the functionality and outcome of the system design (Enserink et al., 2010). This implies that, the behaviours of the audience sub subsystems cannot be ignored in the determination of the functionality of the general systems design (Kumi & Dzidonu, 2015). Hence, in requirement analysis of functionality of video (Kumi & Dzidonu, 2016a), the first objective is to map the structural characteristics of the audiences (Scott, 2017) as the required sub subsystems of the audience subsystem. The approach guides analysis of the contributions of design inputs by the audience subsystem towards the functionality and outcome of video as requirement in the SMA (Enserink et al., 2010). The analysis focuses on interactive communication relationships between structural components of video and the audiences (Kumi & Dzidonu, 2015), and are evaluated in the SMA (Enserink et al., 2010). In the SMA, the entities of the systems design constitute subsystems that offer design inputs or variables towards determining the functionality and outcome of the general systems design objective (Enserink et al., 2010, Kumi & Dzidonu, 2017b).

The applicability of learner-based video communication to a systems design is that, video technology constitutes the technical, the contextual, the social and audience components as major subsystems which contribute design inputs towards the system design (Kumi & Dzidonu, 2016b). Consequently, video requires the outputs of all the subsystems as contributions towards determining its functionality as socio-technical artifact (Calker et al., 2006; Davis et al., 2014; Kumi & Dzidonu, 2017a). Hence, composition models of the audience subsystem are constructed to unveil the contributions of the audience subsystem to the general video system design, using audience-related factors as variables that predict outcome of the general systems design objective (Kumi & Dzidonu, 2017a). This approach renders video an open process that produces different outcomes from requirement analysis of its functionality (Klien & Kleinman, 2002; Baxter & Sommerville, 2011; Davis et al., 2014) and thereby contributes to research works in STS as well as theoretical and practical reviews on video uses including class assessments from learner-based video approaches. Third, in determining the functionality and outcome of video system design, there is the need to consider influences of the different aspirations (Leeuwis, 2004; Kumi, 2013a), variations in audience competencies (Müller, 2008; Feenberg, 2010; M. A. Kumi & Kumi, 2012; Kumi, 2012), diverse meanings and varied interpretations of events by audiences (Müller, 2008; Hebinck, Fay, & Kondolo, 2011; Kumi, 2012, Kumi 2013a; Bentley et al., 2015), as well as the different problem definitions of events by individuals and groups (Hebinck et al., 2011; Kumi, 2012; Kumi 2013a; Bentley et al., 2014). The profiles and influences of diversity in audience characteristics are examined as sub subsystems of the audience subsystem on video communication system design, as socio-technical artifact (Viller & Sommerville, 2000; Waterson, 2005; Martin & Sommerville, 2004; Baxter & Sommerville, 2011; Davis et al., 2014; Kumi & Dzidonu, 2016a). This approach answers Bentley et al. (2014) who questioned the effectiveness of functionality of video, by focusing on influences of the audience subsystem on video technology that are located within the boundary of video systems design. Hence, this paper defines the boundaries (Walker, 2000:13) based on description of the structure of the audience subsystem (Enserink et al., 2010) by including the actions,

activities, workspaces, work practices and social relations as sub subsystems (Feenberg, 2010; Baxter & Sommerville, 2011, Davis et al., 2014; Scott, 2017), towards generating additional functionalities and corresponding outcomes of video communication system design. In doing this, the approach contradicts previous works by David and Asamoah (2011), Bentley et al. (2014) and Van Mele (2014) which assert that, videos transfer information to audiences effectively and efficiently in causal relationships even without facilitation by experts. To explain the contradictions, the paper predicts the interactive ability of learner-based video communication system design using methods of calculating the complexity of the process of building video learning system for students and society. This is achieved using the structure of a known video design. In this design, the audience comprise dynamic institutional social actors and networks which compromise exchanges of resources and provisions in the forms of finances, authority, knowledge, people, information, relations, emotions and social capital in series of interdependent interactive relationships and engagements (Gaventa, 2005). The audience also engage in transactions in arrangements and partnerships, governance mechanisms, alliances, forums, and advisory boards or task forces which give rise to diverse significations in deliberations among social actors (Hajer, 2006). The phenomenon serves as potential avenues that allow different actors to influence application and uses of knowledge acquired in video (Kumi, 2013) to result in the construction of different meanings of the same artifact by society due to differences in life worlds of audiences (Leeuwis, 2004; Kumi, 2007). This could cause conflicts, confusion and misunderstanding of issues and events among social actors (Van Bueren et al., 2003). Hence, the influences of sub subsystems in the audience subsystem which contribute requirement external design input, towards determining the general functionality and outcome are required to be examined (Enserink et al., 2010), towards evaluating the suitability of learner-based video communication in student learning.

METHODOLOGY

Mixed methods was employed (Bernard, 2011). Literature search and field surveys described relationships between system variables. Qualitative studies profiled structural identity characteristics of audiences and STS concepts to identify audience-related factors that determine the functionality of video by mapping the composition of the audiences from theoretical concepts in literature search and field studies to define the audience subsystem (Klein & Kleinman, 2002; Scott, 2017). Theoretical composition models of the audience subsystem show relative interdependent and interactive social network structures and processes in video communication in addition to flow diagrams that define relationships between structural system design inputs and outcome of information flow in video communication as a socio-technical artifact (Calker et al., 2006; Davis et al., 2014; Kumi & Dzidonu, 2017). Quantitative studies provided field survey data on socio-cultural interactive relationships among audiences and structural characteristics of audiences as required sub subsystems of the audience subsystem. Mathematical models on inputs of audience sub subsystem were developed as linear variable differential equations (Gelb & Vander Velde, 1968) based on the definition of the boundaries and description of the structure of the audience subsystem as sub subsystems towards determining the outcome of the systems design. Influences of finances, authority, knowledge, people, information, relations, emotions and social capital in series of interdependent interactive relationships and engagements, as well as transactions in arrangements and partnerships, governance mechanisms, alliances, forums and advisory boards or task forces which give rise to diverse significations in deliberations among social actors contributed ‘noise’ (Wood, 2009)

from respective sub subsystems and extraneous variables to the audience subsystem.

FINDINGS AND DISCUSSION

Definition of the audience subsystem in the systems design

Description of the relationship between design entities secured the status of the audience in the system and hence the definition of the audience subsystem. In the definition, relevance was given to external attributes as 'noise' from characteristic contexts of video-shows and influences of the wider social structural organisation.

Profile of structural identity characteristics of audiences

Structural characteristics of audiences identified from smallholder farmers and University students, presents sub subsystems that contribute to the audience system towards the functionality and outcome of video in the SMA. This represents combination of variables derived from the social, economic, political and cultural identity characteristics of viewers in Table 1. Table 1 profiles categories of social structural characteristics of audiences relative to cultural functions and social action to unveil sub subsystems of the audience subsystem.

Table 1: Profile of social structural characteristics of farmer-audience by category, as sub subsystems N=150

Category of audience	Profile of Smallholder-farmer audience
By function and social action	Land Owners, Input Suppliers, Local Credit Providers, Knowledge Providers, Produce Buyers, Farmer-Creditors, Spraying Machine Operators, Machine Repairers
By work practices	Sharecroppers, Annual, Shared or Fixed Contract Laborers, Caretakers, Resident Farmers, Migrant Farmers, Poor Farmers, Women Farmers, Absentee Farmers

Source: Field Survey Data, 2016

Audience-related factors that determine the functionality of video

Audience-related factors that determine the functionality of video are influences of finances, authority, knowledge, people, information, relations, emotions and social capital in series of interdependent interactive relationships and engagements, as well as transactions in arrangements and partnerships, governance mechanisms, alliances, forums and advisory boards or task forces on audience society which give rise to diverse significations in deliberations among social actors. The factors contribute 'noise' as extraneous variables towards determining outcome by altering the systems design objective.

Theoretical composition models of the audience subsystem as major systems design entity

Field survey data on socio-cultural interactive relationships among audiences revealed diversity among audiences. Table 2 profiles categorized audience networks relative to the role, and crop-sharing arrangements, kind of institution, location and gender that represent sub subsystems in the context of the audience subsystem. The diverse factors generate design inputs towards influencing the functionality of video as external variables from sub subsystems in the shared social environment of video and its audience subsystem.

Table 2: Profile of Audience as Sub Subsystems of the Audience Subsystem in a Learner-Based Video Communication System Design

Category of Farmer- audience networks by:				
Role	**Functions, Social Actions and Crop-Sharing Arrangements**	**Institution**	**Location**	**Gender**
Opinion Leaders	Sharecroppers,	Farm Owners	Resident Farmers	Women Farmers
Adopters of Innovations	Annual Laborers	Land Owners	Absentee Farmers	Poor Farmers
Knowledge Brokers	Caretakers	Farmer-Creditors	Migrant Farmers	Marginalized
Record Keepers	Resident Farmers	Financial Assistants	-	Rich Farmers
Farm Managers	Migrant Farmers	Annual Laborers	-	-
Land Owners	Poor Farmers,	Fixed Laborers	-	-
Sharecroppers	Women Farmers,	Shared Laborers	-	-
Contract Farmers	Absentee Farmers	machine repairers	-	-
Contract Laborers	Annual Laborers	Chain-saw operators	-	-
Farm Supervisors	Fixed Laborers	-	-	-
Caretakers	Shared Laborers	-	-	-
Farmer-Creditors	-	-	-	-

Source: Field Survey Data, 2016

In Table 3, Student audiences relative to student-learning arrangements profiled different socio-economic, cultural and socio-political roles which represent sub subsystems of the audience subsystem. The profile suggests that, video could offer individual satisfaction for learning and provide avenues for individuals to share resources, perspectives and exhibit innovations. However, complexity in diversity of social structure of student-audiences coupled with diverse challenges faced could result in conflictive relationships towards generating additional sub subsystems. The complex diversity could encourage interactions among social networks of students to result in re-definitions of the same event in video, which could either enhance or prevent individual audience adoption of the same video messages (Kumi, 2014; Kumi & Dzidonu, 2015a). To explain the phenomena, individual-differences theory of communication, which recognizes the composition of audience as individuals who react to communication in their own ways rather than as duplicate automatons is employed. This implies that, individual students are expected to exhibit selective exposure, perception and retention of video, such that, no matter what the message is intended, some of the audience should receive another, and migrate towards communications whose scope, tone, and messages are in agreement with their own opinions and interest. So the audience are expected to avoid communications they do not agree with (Shelton, 2004). This partly explains why David and Asamoah (2011) recorded no significant differences in the outcome of video uses in training farmers. This suggests to stakeholders that the contribution of the audiences in determining the functionality and outcome of video is the socio-cultural diversity of audiences which generates conflictive relationships that present diverse challenges to audiences. Hence, video might not be appropriate for educational class assessments of culturally diverse individuals. Moreover, video class assessment should not require adoption of messages due to differences in perspectives and subjectivity in answers from examinees.

Table 3: Structural Characteristics of University student-audiences. N=77

Category of audience	Profile of University Student-audience
By function	Accounts Officer, Teacher, Secretary, Trader, Health Officer, Field Technician, Banker, Administrator, Fire Officer, Regular Student, Weekend Student, Photographer, Sobolo Producer, Purchasing Clerk, Cook
By social action	Opinion Leader, Single Parents, Deacons, Assemblymen, Youth Leader, YPG Member, Class Leader, Choir Member, Female Student, Male Student, Married Students, Single Students, Mothers, Fathers, Hostel Room Mate, Service Leader, Singer, Footballer
By learning practices	Regular Student, Weekend Student, Female Student, Male Student, Class Leader, Group Leader, Group Study Mate, Mature Students

Source: Field Survey Data, 2016

Structural characteristics of audiences as required sub subsystems of the audience subsystem

The audience subsystem is defined by the entities which represent sub subsystems that feed the audience subsystem with design inputs towards the functionality and outcome of the general design objective in data flow model. In Figure 3, 'heads' represent contributions from audience sub subsystems and depict variables contributed from the shared contexts of relevant and irrelevant audiences towards yielding innovative outcomes. In the diverse contexts of audiences, influences from different members contribute considerable audience related factors as intervening or extraneous variables. This means that, the audience-related external variables contribute additional system design inputs towards altering expected functionality and design objective of the system. This phenomenon allows creation of potential platforms for innovations by audiences. The innovations of audiences represent diverse outcomes of the same systems design due to effects of the extraneous variables on the design objective. This renders learner-based video communication ineffective as mass communication tool in student environments.

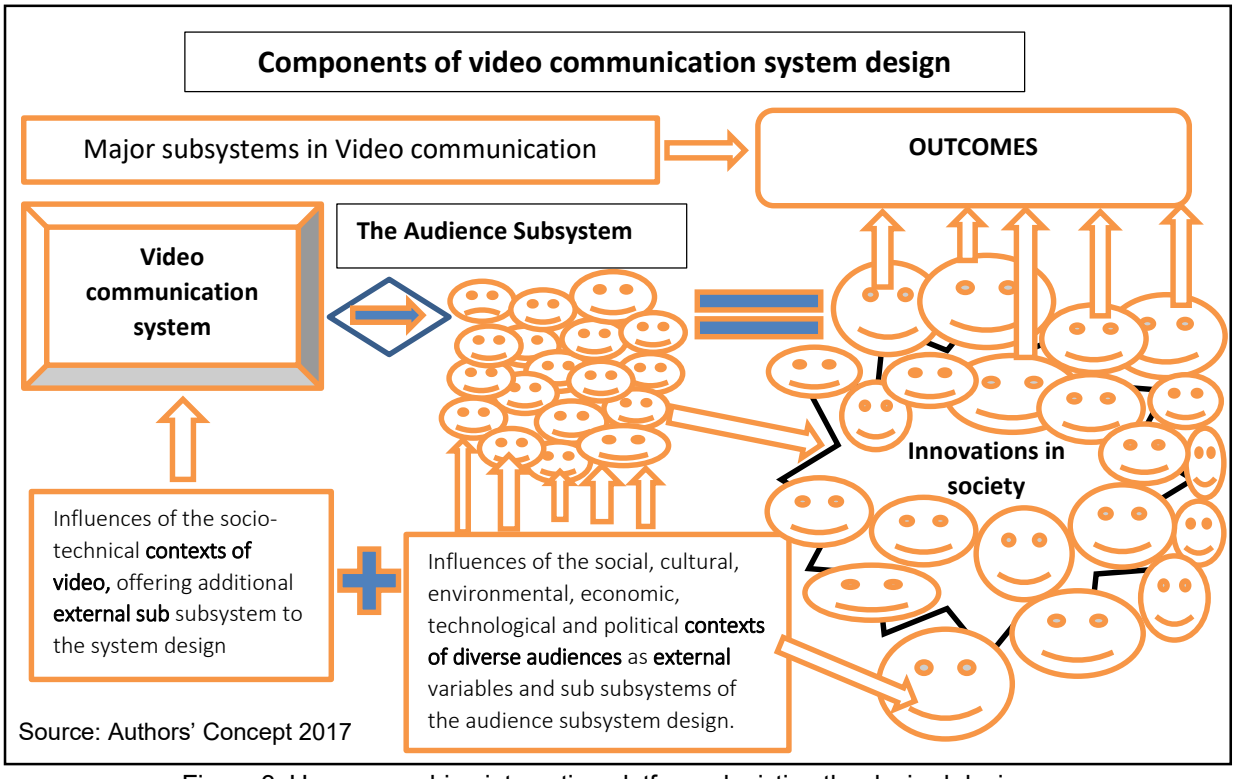


Figure 3: Human-machine interaction platform, depicting the desired design of video communication system

Evaluating the audience behaviour in interactive mode

Mathematical models of relationships between audience sub subsystem variables based on linear variable differential equations were derived from the definition of the boundaries and description of the structure of the audience subsystem towards determining the outcome of video systems design.
Where *A* ∝ social organisational experiences of different groups of audiences A1, A2, A3, A4, …… the contribution of sub subsystems to the audience subsystem is presented in the model as follows:

$$A \propto (A1, A2, A3, A4\ldots\ldots\ldots\ldots\ldots\ldots)$$

$$A = K\,(A1, A2, A3, A4\ldots\ldots\ldots\ldots\ldots\ldots) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(i)}$$

K is a constant that changes with time t, due to continually changing contextual challenges faced by the audience in a dynamic society.

The model for specific group of audience, A1, is given by:

$$A = K\,(A1) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(ii)}$$

The model (ii) represents requirement contribution of specific audience subsystem of a system design In instances of desired system behaviours, the aspects of design inputs that feed the audience subsystem constitutes sub subsystems such as: (1) audience category (u_1), (2) diverse characteristics of audiences (u_2), (3) the different aspirations (u_3), (4) different choices of members (u_4), (5) different cropping/learning needs of individuals and groups (u_5), (6) diverse innovativeness (u_6), (7) various structural profiles of the social, economic, political, cultural, environmental, economic and technological identity characteristics of viewers among others. Then, the functionality of one category of audience sub subsystem, A1, is represented by:

$$A1, (u_1, u_2, u_3, u_4, u_5 \text{ and } u_6\ldots\ldots\ldots\ldots) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(iii)}$$

Substituting for the different values of A1, A2, A3, A4 …….. the functionality of the model *A*….(i) becomes:

$$A=K\,[(u_1 + u_2 + u_3 + u_4 + \ldots.)1, (u_1 + u_2 + u_3 + u_4 + \ldots.)2, (u_1 + u_2 + u_3 + u_4 + \ldots.)3, (u_1 + u_2 + u_3 + u_4 + \ldots.)4, (\ldots\ldots\ldots)] \quad \ldots\ldots\text{(v)}$$

Evaluating the audience behaviours in dynamic mode

The dynamic model of the relationship between video and its audience subsystem is:

$$\frac{\omega V}{\omega t} = f\,[A(\acute{\imath}) + A(\tilde{\imath}) + V(t)] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(vi)}$$

The model (vi) predicts that, behaviours of both relevant and irrelevant members of society $A(\acute{\imath}) + A(\tilde{\imath})$ contribute system design inputs towards functionality of the audience subsystem of a given video system design at any given time, *V*(t), where;

$A(\acute{\imath}) = \text{Relevant Audience (audience closely associated with video design)}$

$A(\tilde{\imath}) = '\text{irrelevant audience}'(\text{people in the wider social organisation})$

$V(t) = \text{kind of video system design at a specific time (t)}$

Given that $(t) = [0, 6\text{years}]$, For $(t) = 1$,

a) The model for the audience ***without previous experience*** (0) with video communication is: $\frac{\omega V}{\omega t} = f\ [(A(\acute{\imath})(1), A(\tilde{\imath})(1), V(1-0)]$ ..... ……..……..(vii)

The model (vii) predicts behaviours of the different kinds of audiences $A(\acute{\imath})(1), A(\tilde{\imath})(1)$ who watch or experience video for the first time or without previous experience with any kind of video.

b) The model for the audience **with previous experience** (1) with video communication is:

$$\frac{\omega V}{\omega t} = f\ [A(\acute{\imath})(1), A(\tilde{\imath})(1), V(1+1)] \quad \text{..... ……..... (viii)}$$

The model (viii) predicts behaviours of different kinds of audiences *A*(ŕ)(1), *A*(ĩ)(1) who have gained first time experience (1), with a kind of video design *V (1+1).*

Six years after experiencing or associating with video communication $(t-6)$, the behaviours of audience-related design inputs from sub subsystems are described as follows:

$\frac{\omega V}{\omega t} = f\ [A(\acute{\imath})(t), A(\acute{\imath})(t-6), A(\tilde{\imath})(\acute{\imath})(t), A(\tilde{\imath})(t), A(\tilde{\imath})(t-6), V(t-6)]$ ..... (ix)

where, $A(\acute{\imath})(t) =$

$\text{Relevant Audience at specific time, closely associated with video design}$

$A(\tilde{\imath})(t) =' \text{irrelevant audience}' \begin{pmatrix}\text{people in the wider social organisation of a given} \\ \text{society at specific time}\end{pmatrix}$

$A(\tilde{\imath})(\acute{\imath})(t) = \text{mix of relevant and irrelevant audience in society at any time}$

The model (ix) predicts that: The audience–related variables:

$A(\acute{\imath})(t),\ A(\acute{\imath})(t-6),\ A(\tilde{\imath})(\acute{\imath})(t),\ A(\tilde{\imath})(t),\ A(\tilde{\imath})(t-6)$ either singly or in diverse combination, constitute required sub subsystems that offer design inputs that determine functionality and outcome of video communication, even after 6 years of experiencing video by audiences. This implies that, the audience subsystem continuously determines stability of the video systems design in its social environment in the long run.

CONCLUSION

The paper examined the contribution of the audiences towards determining the functionality and outcome of video by describing the relationship between design entities and gave relevance to external attributes as 'noise'. The audience contributes to the functionality through categories of socio-cultural structural characteristics of audiences as sub subsystems of the audience subsystem, and audience-related factors contribute 'noise' as extraneous variables towards determining outcome and altering the systems design objective. This paper determined the structural characteristics of audiences in order to guide analysis of the contributions of the audience subsystem towards functionality and outcome of video as requirement in the SMA. This makes it applicable to learner-based video communication as a systems design composition to determine outcome of the general systems design objective. Constructing theoretical composition models of the audience subsystem as major systems design entity revealed diversity among audiences which represents sub subsystems that generate design inputs towards influencing the functionality of video as external variables. This renders video inappropriate ineffective as mass communication tool in student environments to be employed for educational class assessments of culturally diverse individuals and class assessment that require adoption of messages due to differences in perspectives and subjectivity in answers from examinees. Evaluation of the audience behaviours in the SMA using scientific calculations demonstrate that, relevant and irrelevant members of society A(ŕ)+A(ĩ) together contribute system design inputs towards functionality of the audience subsystem of a given video system design at any given time. Hence, audience–related variables: A(ŕ)(t), A(ŕ)(t-6), A(ĩ)(ŕ)(t), A(ĩ)(t), and A(ĩ)(t-6) either singly or in diverse combination, constitute required sub subsystems. Evaluation of theoretical mathematical models indicate that the audience subsystem continuously determines functionality of leaner-based video communication system design.

The scientific calculation method for classifying complex audience groups of video learning system suggests a new research direction in solving problems in learner-based video communication. The findings reveal concepts on interdependencies in social relations, interactions and social networks as well as user relationships with technological artifacts and suggest methods of calculating the complexity of the process of building video learning system for students and society.

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