# Using Wireless-enabled Personal Digital Assistants (PDA) to Access Information and Create Communication Patterns: Constructing and transforming knowledge in a Year Seven classroom

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Personal Digital Assistants (PDAs) are mobile wireless communication and organisational devices. PDAs are increasingly being used broadly in Medicine, Nursing, Business and, in a limited fashion, Education (Chan, Chu et al. 2004, p. 3). This chapter presents an overview of the intended Doctoral research to be conducted in a Year 7 classroom where each student and teacher will use a wireless, network enabled, PDA. From a review of the literature related to international research and initiatives exploring learning and mobile technological devices, now commonly referred to as mLearning, a theoretical model will be proposed to guide the study. That model conceptualises the investigation of the transformational potential which the PDAs might have on the communication patterns of students. The model also provides a framework for investigating the ways in which students and teachers in the middle years of schooling access information and use communication patterns to construct and transform knowledge. Teacher pedagogy, peer relationships, group dynamics and the development of learning objects for PDAs will be analysed. The chapter will outline the methodology proposed to be used in the research. A qualitative, interpretive paradigm, mirroring the fluid and dynamic nature of education will be employed (Creswell, 1998). As the research will guide change at the school, the research project involves significant action research and critical theory. As an indication of the future direction for this study now in its early stages, the chapter concludes with a proposal for a pilot study of student use of mobile, wireless technologies in the middle years.

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Earlier investigations undertaken in my research on the use of Personal Digital Assistants (PDAs) in a Year Seven classroom have focused on sub topics such as early adolescents and their experience of schooling, eLearning, mLearning, and school restructuring. This chapter will focus specifically on the use of PDAs as a tool for learning, which is of significance for my thesis as mobile technologies, examples of which are mobile phones, PDAs, laptops, and MP3 players, now commonplace in our society and are particularly prevalent amongst early adolescent learners, the target group of my research.

For the purposes of this chapter, early adolescents are defined as aged 10 – 14 (Carrington, 2006). The availability of mobile technologies, at relatively low cost, has contributed to social change, particularly with early adolescents who use their mobile devices to maintain relationships unbounded by proximity (Peters, 2005). Early adolescents interact with the technology more than previous generations. While 20 years ago, most media was consumed passively, in the last 10 years a higher level of interactivity has evolved in electronic media use. The depth and richness of digital material readily available to the learner, via a PDA offers true flexibility of time, place and pace (Mellow, 2005) and allows for learning that is context specific, contextualised by mediation with peers and mentors, and "just in time, just enough and just for me" (Peters, 2005, p. 1).

This chapter will explore a range of issues in relation to the use of PDAs. To better contextualise the discussion, various definitions and contexts of mLearning will be presented. Subsequently this chapter will present an examination of the particular affordances of PDAs which make them a key mLearning tool. The impact of PDAs on communication and on cognitive function will also be explored. Following the literature review, this chapter presents a new conceptual model which illustrates the development of various forms of communication within a Year Seven classroom, and also provides the preliminary conceptual framework for my doctoral thesis. Furthermore, this framework suggests a transformational model in terms of changes in the ways in which students and teachers access information and use communication to construct new knowledge and transform knowledge. Finally, this chapter will address key questions of my research project including;

1. Does the 'learning mobility' provided by the technology shape the learning of the students?
2. What changes, if any, occurred to information / communication flow in terms of the educational value of this flow?

3. What was the impact of the use of PDAs in terms of peer to peer relationships and peer to teacher relationships?

## Definitions of mLearning

Wireless enabled PDAs belong to a suite of mobile devices with potential educational applications. I have chosen PDA's as the mLearning tool in my research project because, at present, they offer the best combination of mobility and functionality (Keegan, 2005, p. 3), as indicated below in Figure 1. The Literature reviewed focuses on the use of PDA's in Primary and Secondary School Education.

*[Insert Figure One Approx Here.]*

*Figure 1. Functionality and mobility in a definition of mobile learning (Keegan, 2005, p. 3).*

Prior to exploring the educational potential of PDAs, it is necessary to define mLearning. There are many variants of the term Mobile or mLearning. Lehner and Nosekabel (as cited in Chen & Kisnhuk, 2005, p.1), define mLearning as "any service or facility that supplies a learner with general electronic information and educational content that aids in the acquisition of knowledge regardless of location and time". Vavoula and Sharples (as cited in Chen & Kinshuk, 2005, p. 1), indicated "three ways in which learning can be considered mobile - learning is mobile in terms of space; it is mobile in different areas of life; it is mobile with respect to time". Traxler and Kukulska-Hume (as cited in Scanlon, Jones, & Waycott, 2005, p. 2) comment that "Mobile learning can be defined as any educational provision where the sole or dominant technologies are handheld or palmtop devices". Keegan (2005, p. 3) narrows the definition of mLearning to devices which can fit in a pocket and defines mobile learning as "the provision of education and training on PDAs / palmtops / handhelds, hybrid mobile devices (devices offering both voice and data features) smart-phones and mobile phones".

## Technical Issues Involving PDA Use

As indicated previously, for this research I have chosen wireless-enabled PDAs as the mLearning tool for my research project. Despite some limitations to their use (primarily related to ergonomic factors, limited educational software and compatibility issues) and considering that the

current alternative is often limited or no access to computers, a PDA is, for school students, a potential quantum leap in computational availability (Soloway, Norris, Blumenfield, & Fisherman, 2001). Klopfer, Squire, and Jenkins (as cited in Naismith, Lonsdale, Vavoula, & Sharples (2004), identify five properties of PDAs that produce unique educational affordances facilitating collaborative mLearning environments:

- *Portability* – the small size and weight of mobile devices means they can be taken to different sites or moved around within a site.
- *Social interactivity* – digital data exchange and collaboration with other learners can happen face-to-face.
- *Context sensitivity* – mobile devices can both gather and respond to real or simulated data unique to the current location, environment and time.
- *Connectivity* – a shared network can be created by connecting mobile devices to data collection devices, other devices or to a common network.
- *Individuality* – scaffolding for difficult activities can be customised for individual learners. To these can be added a further affordance,
- *Price / Ease of Use* - PDAs are simple to use and start quickly 'instant on'; and many are significantly cheaper than desktop or laptop computers.

## Communicating with Mobile Technologies

One of the primary purposes of my research is to determine the extent to which PDAs can facilitate social and "informatic" communication in a Year 7 classroom (Peters, 2005). Mobile technologies have enabled new ways of communicating for example, Short Message Service (SMS), Multimedia Message Service (MMS), and Microsoft Network (MSN). These new communication modes have been rapidly adopted by young people for whom mobile communication is a way of life. Many young people are 'always on' and connected to geographically-dispersed friendship groups in 'tribal communities of interest' (Peters, 2005, p. 3). Nyiri (2002), emphasising the need to facilitate face-to-face interactions, posits a new philosophy of mobile learning that points to mobile technologies as facilitators of an 'innate anthropological need to communicate' (Nyiri, 2002) and identifies the need to communicate as the source from which mLearning emerges.

PDAs facilitate communication, not only through the functionalities mentioned above, but also through their ability to 'beam' information via Infrared, Bluetooth or 802.11 technologies. Sharing information through

beaming is a simple but very compelling activity. The ability to instantaneously share their work with others (and with the teacher) is motivating since children can receive relatively instant feedback on their work (Norris & Soloway, 2004). An important consideration, in understanding the value of beaming, is that there are no cumbersome steps between the physical parties and the act of collaborating. Beaming does not require searching for an email address, remembering an alias, or choosing from a list of contacts. Instead, beaming simply requires that the collaborators are physically near each other, and a beam is initiated through a simple button click or menu selection. Because of this, beaming is often felt to be an 'intimate' action, almost like shaking hands or talking face to face (Vahey & Crawford, 2002). PDAs are devices that can facilitate various modes of communication and their use in a classroom allows them to become part of a complex network of communication. This communication occurs in the same physical space in which students and teachers participate socially and educationally in teaching and learning. Two distinct kinds of participation are occurring at the same time and in the same space: the normal social participation in classroom discussion and the new 'informatic' participation among connected devices (Peters, 2005)

## Human / PDA Interaction

The use of PDAs, owing largely to the mobility and portability of the devices, can increase collaborative learning, independent learning and communication amongst students. They can help 'normalise' the use of ICT in learning and facilitate the integration of technology into classrooms as another tool for learning (Becta, 2004). PDAs are changing the educational experience of students and at the same time the tools are also changing the ways students perceive the values and limitations of the technology (Swenson, Young, McGrail, Rozema, & Whitin, 2006). This human / tool interaction is a central aspect of socio-cultural theory (Wishart, McFarlane & Ramsden, 2005, p.7), which claims that all human action is,

> Mediated by tools which may include technologies and artefacts such as the PDA or desktop computer; semiotic systems such as language including diagrams; social interactions such as those between student and class or student and class teacher and institutional structures such as school ICT policy.

A key component in the successful and innovative use of PDAs, therefore, is the user of the device as the success or otherwise of any technology is determined as much by the nature of the tool-user as by the nature of the tool.

> Technology does not adhere in particular objects but, rather, objects acquire technological essence only when specific people envision, approach, or otherwise act toward those items as a means of accomplishing something (Prus & Mitchell as cited in Schlosser, 2002, p. 408).

Further illustrating the implications of human / computer interaction, Norman (as cited in Stead, Sharpe, Anderson, Cych, & Philpott, 2006) and Shneiderman (as cited in Stead et al., 2006) believe that the Personal Computer (PC) presents several barriers to use since, as a device, it lacks flexibility and is overly complex and difficult to use. Consequently, PC users spend more time learning about the computer than using it. In contrast, handheld technologies do not feel overwhelming, intimidating, and overly functional to users; handhelds are an educationally appropriate technology (Norris & Soloway, 2004) and resemble more closely the flexible, mobile and to a certain extent 'user friendly' technologies afforded by the digital lifestyle outside the school gates (Leadbeater, as cited in Stead et al., 2006). Riley (1997) believes that ubiquitous computing, or as he labels it 'calm technology', is a paradigm shift where technology becomes virtually invisible in students' lives. Instead of having a desktop, or laptop, the technology they use will be embedded in their environment (Riley, 1997). As this research project progresses, a thorough analysis of the socio-cultural implications of the systematic use of PDAs will also be explored. These include individual, communication/task and technology characteristics, modalities of mobility and context (Sarker & Wells, 2003, p. 37).

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## Wireless Enabled Communication – A Transformational Model:

The focus of this chapter now shifts to an examination of a new conceptual model of wireless enabled classroom communication and knowledge formation. My conceptual model illustrates the development of various forms of teacher – student and student-student communication within and beyond a primary school classroom and provides the preliminary conceptual framework for my research. This conceptual framework hypothesises a transformational model in terms of changes in the ways in which students and teachers access information and use communication to construct and transform knowledge.

A classroom can be conceptualised as a potentially rich communication environment where the nature of communication can be used to facilitate social relationships and also for the transmission of knowledge. The conceptual model of classroom communication has been structured into four stages (See Figures 2 – 5). Stage One and Stage Two are adapted from Branson's (2006) Models of Instruction, whereas Stage Three and Stage

Four, building on Branson's Model, are my contribution. In Stages One, Two and Three, all communication and information transmission occurs within the defined Physical and Intellectual Space of a classroom where the flow of information is primarily mediated by the teacher. Stage Four denotes a transformational change to the patterns of communication used in most classrooms.

*Stage One and Stage Two* are essentially the same in that they both reflect the oral traditions of instruction where the transfer of information from teacher to student is the primary pattern of communication. The teacher, in Stage One, uses her/his knowledge and experience and selects the information to be conveyed to the class. In Stage One, successful teaching has occurred if the information distributed to the students is subsequently returned to the teacher via a variety of testing mechanisms. The individual learning needs of the students are only a secondary consideration at this stage. (See Figure 2)

[*Insert Figure Two Approx Here*]

*Figure 2. Oral tradition - Adapted from Branson (2006)*

*Stage Two* differs only slightly from Stage One with the teacher again using her/his knowledge and experience to select the information to be conveyed. Stage Two recognises that students are not homogenous and some attempt is made to tailor teaching methods to accommodate the individual learning needs of the students. Both Stages One and Two are largely teacher centred/controlled and subject/discipline centred and employ an objectivist/directed instruction paradigm. (See Figure 3)

[*Insert Figure Three Approx Here*]

*Figure 3. Current Predominant Teaching paradigm – Adapted from Branson (2006)*

*Stage Three* occurs through the use of aggregation devices such as Classroom Performance System (CPS), Qwizdom, Turning Point, Hyper-interactive Teaching Technology (H-ITT) or Personal Response System (PRS). Aggregation devices allow multiple users to answer multiple choice questions electronically. These responses are then collated and can be used to provide immediate feedback to the group or to facilitate further discussion (Refer to Figure 4)

[*Insert Figure Four Approx Here*]

*Figure 4. Aggregation-Device Enabled Learning Space – Larkin (2006)*

Although the teacher is still largely responsible for determining the flow of information, a significant feature of Stage Three is the bidirectional flow of information that allows the teacher to gather responses from all students instantaneously. In this stage the teacher delivers certain information, usually to the whole class, and then receives almost immediate feedback from the group. This information can then be used to modify the teaching sequence. The aggregation systems currently in use can only be used to provide limited feedback to multiple choice type scenarios. Although the devices can be set to display user information, that is, respondents name or designated student number, they do not facilitate peer to peer communication of data.

*Stage Four* is enabled via the ubiquitous deployment of Wireless Mobile Devices. In the case of my conceptual model, these devices are PDAs, capable of accessing Digital Information (e.g., files or the Internet) wirelessly via a school network. They are also capable of communicating this information wirelessly to any other PDA (or wireless device) in the classroom or nearby surrounds. As stated earlier, because of their 'relative advantage' (Robyler, 2005, p. 52) in terms of lower cost, greater sense of personal ownership, mobility, and security, PDAs, rather than laptops or tablets, are the wireless device most efficacious to use at the current stage of technological development. (See Figure 5)

[Insert Figure 5 Approx Here]

*Figure 5. Wireless-Enabled PDA Learning Space – Larkin (2006)*

The Stage Four model displayed in Figure Five demonstrates the potential to transform communication and information patterns in and beyond the classroom. The first transformation is that the walls of the classroom cease to be a barrier to knowledge and information and become merely a physical barrier. In Stages One – Three, the teacher is the prime determinant of what knowledge is allowed into the classroom and how it will be shared. Although classrooms can currently operate in a similar way to Stage Four, the use of wireless enabled PDA's facilitates the availability of digital information to the students at any time and in any space thus

complementing the teacher as a source of information in the classroom. This is a significant change from the previous three stages, where a key component of the teacher's role was transmission of knowledge, and has enormous implications for the pedagogical role of the teacher in what has previously been a largely instructionist model of education.

The second transformation which occurs at Stage Four relates to the fundamental communication patterns occurring in the classroom. In the previous three stages, the teacher is the focus of the majority of communication activities in the classroom. Communication is primarily teacher to whole class; individual student to the teacher; occasionally student to class; and only very rarely sanctioned student to student communication. When direct student to student communication occurs, it is likely to be largely non-educational in nature. My research will determine whether, and to what extent, the use of PDA's fosters 'informatic' communication between the students (Peters, 2005).

The wireless functionality of the PDAs facilitates a wide variety of communication patterns. These various patterns of communication have been diagrammatically expressed in the Stage Four model using a variety of bi or uni directional, coloured arrows. In the Stage Four model individual students are depicted as Student One (S1), Student Two (S2) etc. This coding is necessary to convey the myriad of communication patterns that can occur. By analysing the communication patterns available in the classroom it is evident that the teacher is able to communicate to all students at once or to a sub-group of students if she/he chooses (e.g., orange arrows to S16, S19, S17 and S10). The teacher can communicate in a two-way dialogue with one student (e.g., yellow arrow to S7); send but not receive information from a student (e.g., dotted white line to S11); or communicate with students in all areas of the school (e.g., S16).

The fundamental and crucial difference in Stage Four, as compared to its previous iterations, is the communication options open to the student. A student can choose to communicate to all other students at once; a sub group of students (e.g., black arrows between S2, S3, S12, S17 and S20); or a one to one dialogue with a specific student (e.g., red arrow S11 – S18). Students can also communicate from inside the classroom to other students outside of the classroom, from outside of the classroom to students in the room or outside of the classroom to other students outside of the classroom (e.g., S3 – S12). Inter-classroom communication is also possible (e.g., pink arrows from S16). Should the student choose to do so, they can temporarily disable their communication facility and work on their own (e.g., S6). As mentioned previously, a primary aim of my research is to explore not only the

availability of various communication patterns but also the educational richness of these patterns.

## Suitable Research Paradigm:

This research project adopts the interpretive, qualitative paradigm (Cohen, Manion, & Morrison, 2002). The features of this paradigm are reflect my educational beliefs which incorporate concepts of individual learning styles, life long learning and quality relationships. As this research project progresses a specific research methodology, based on the qualitative paradigm, will be developed.

The current educational landscape appears to be dominated by systemically quantitative measures; for example, Year 3, 5 and 7 tests, A-E rating scales, Core Skills test, and mandatory reporting frameworks. They appear to be based on the principle that if you weigh a cow regularly it will gain weight. The qualitative paradigm, in contrast, focuses on the individual and better reflects the value of subjective rather than objective knowledge. This paradigm mirrors the fluid, dynamic nature of teaching and learning. It allows me, as a deputy in the school and the primary researcher in the project, to be involved with the students and teacher in the project rather than just a dispassionate observer and recorder of events. Although I have some theories, gathered from a substantive literature review, regarding the potential educational benefits of PDA usage, the interpretive paradigm is also open ended affording the opportunity to engage with the teacher and students and to reflect upon what occurs (Creswell, 1998). As the Deputy Principal, I have a practical interest in this research as it will be used to guide future educational change at the school.

The qualitative paradigm identifies that people are not primarily subjects of the research and recognises that the rich social interactions that occur between individuals and groups of individuals is a valuable source of information. This paradigm allows me to investigate what happens in a classroom without disrupting its integrity. It recognises that the education of the student is of paramount importance and that my research should enhance this educative process.

The need for exhaustive qualitative data is replaced by ‘thick descriptions’ of a particular situation. This allows the reader some measure of ‘generability’ to their particular situation. Howe (2003) argues for the appropriateness of a bi-paradigm approach. Consequently, whilst the primary focus of my research will be on interpreting the interactions between student and student and students and the teacher, the opportunity exists for qualitative measures such as surveys and triangulation tools to be employed.

These will be used to situate my particular situation as relatively indicative of other similar situations.

## *Initial Planning:*

The research project will investigate the impact of PDAs in a Year 7 classroom in terms of the nature of information and communication flow, student learning and student teacher relationships. The research will guide further decision making in terms of an expansion of the use of PDAs across other classes and year levels within the school. The project will take place over a ten week school term and will be conducted at Marymount Primary School.

Ethical approval will be sought from the University hosting this study. As the research project will not touch on highly sensitive issues such as gender, race or religion, ethical clearance should be straightforward. In determining this clearance, two ethical issues need to be considered. Firstly, power differentials arise due to my position in the school and due to the fact that one class may be seen to be benefiting at the expense of other classes. Care will need to be taken throughout the research to minimise this power differential as it may 'skew' the results and also potentially damage relationships between the researcher and other members of the community. Secondly, as the students attend the school for a 'quality education' it is imperative that the research does nothing to hinder the delivery of such an education.

## *Research Design and Methodology:*

As stated previously, the project will investigate whether the ubiquitous use of a PDA impacts on student learning, teacher pedagogy, and communication patterns. Specific questions will be addressed in the research and can be classified as significant research questions or organisational questions.

Significant research questions include

- Does the 'learning mobility' provided by the technology shape the learning of the students?
- What changes, if any, occurred to information/communication flow in terms of educational value?
- What was the effect of the use of PDAs in terms of peer to peer relationships and peer to teacher relationships?

- Does ubiquitous access to a PDA translate into marked improvement in student outcomes?

Organisational questions include

- Do any school structures (timetabling, ICT usage policies, access to Internet resources, and level of technical support) need to be modified to make best use of the technology?
- Which model of PDA/Operating system will be most effective in my particular learning context?
- Are peripheral devices (extendable keyboards, data projectors, wireless printers) needed to support the use of PDAs?
- Will the 'Class' or 'Ownership' model (Vahey & Crawford, 2002) be employed in terms of PDA distribution?
- Does the teacher need significant instruction on the use of PDAs prior to their deployment?

I intend to use a mixed method research approach and both qualitative and quantitative methodologies will be employed. To ensure the 'representativeness' of the class/teacher, I will survey all Marymount Year 7 students and all Year 7 teachers prior to the study. I will also survey a selection of other Year 7 Gold Coast students and teachers from both State and Non-State schools. Whilst not allowing generalisation on a macro scale, it will allow me to make some comparisons between the students in this study and students in general. Prior to the major research project I will complete a pilot study. This will allow me to determine any technical infrastructure issues that I need to resolve.

### *Data Gathering and Analysis:*

In terms of data gathering instruments, a variety of tools will be used. As mentioned previously I will survey all staff and students in Year 7 at Marymount and at other Gold Coast schools. Students and the teacher in the research project will also complete surveys at the beginning, during and at the completion of the project. Students and the teacher will be interviewed by me and a guest interviewer and the results will be coded for later analysis. Tools such as Leximancer, NVivo or NUDIST will be used to assist in this analysis. Digital usage data will be collected from the PDAs using specifically designed software. This usage data will assist in determining the educational nature of the student communication. Observation by me, the teacher and a guest observer will also occur throughout the project. A self-

reflection anecdotal journal will also be kept by all participants in the study. Stimulated recall will also be used with the participants in the study.

Validity and reliability issues are often a concern in primarily qualitative studies (Cohen et al., 2002). These issues will be minimised by a number of control measures.

- The presence of guest interviewers / observers to allow correlation of data.
- My knowledge and experience as an educator of Middle Years students.
- The purpose of the study is not to make broad generalisations. Rather the intent is to report what I have found using "thick descriptions" which provides readers with enough data to relate this to their own situation.
- My interpretations will be checked for validity by the subjects of the research.

### *Reporting:*

At the conclusion of the research project the results will be reported back to various recipients including-

- The University, as partial requirement of a doctoral degree.
- The Marymount School Community.
- Brisbane Catholic Education as they may wish to use information from this project to direct further change.
- Various educational publications.

## *Conclusion:*

This paper has outlined a detailed proposal for a study into the use of wireless enabled PDA's in a Year 7 classroom. Based on an extensive review of current literature in the domains of mLearning, PDA's in education, human / computer interaction and communication it confirmed by belief that a research project investigating the impact of PDA's on the quality of communication in a classroom is a worthwhile enterprise. A preliminary model outlining the development of this classroom communication patterns was proposed and initial intentions in terms of methodology, data gathering and analysis, ethical issues and reporting were outlined. Further papers will outline in detail the conceptual framework, methodology and data analysis techniques that will be employed in the actual research project.

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Tables and figures for the document are located below

Figure One

| **Functionality** | | **Mobility** | | |
|---|---|---|---|---|
| **Computers** | **Laptop Computers** | **PDA's Handhelds Palmtops** | **Smart Phones** | **Mobile Phones** |
| ← **E-LEARNING** → | | ← **M-LEARNING** → | | |

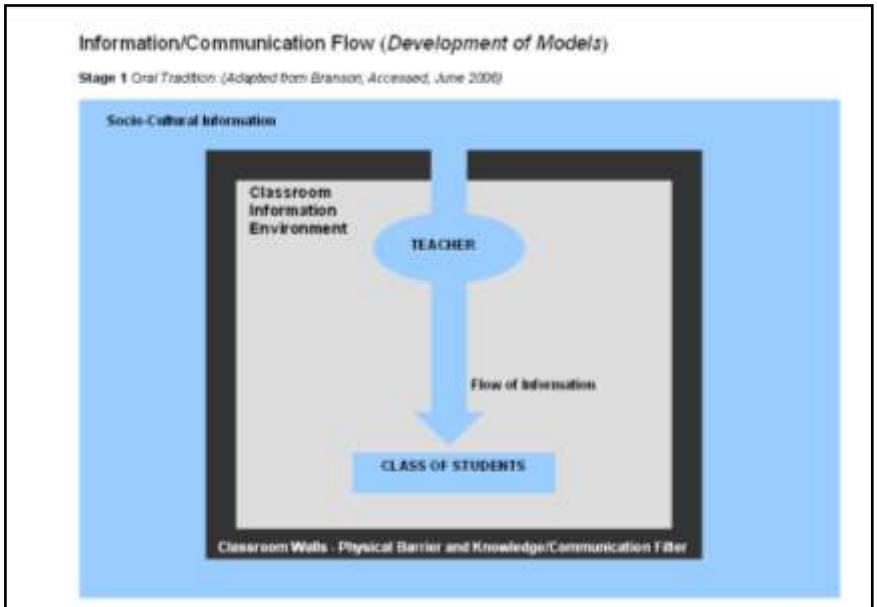



Figure 2

Figure 3

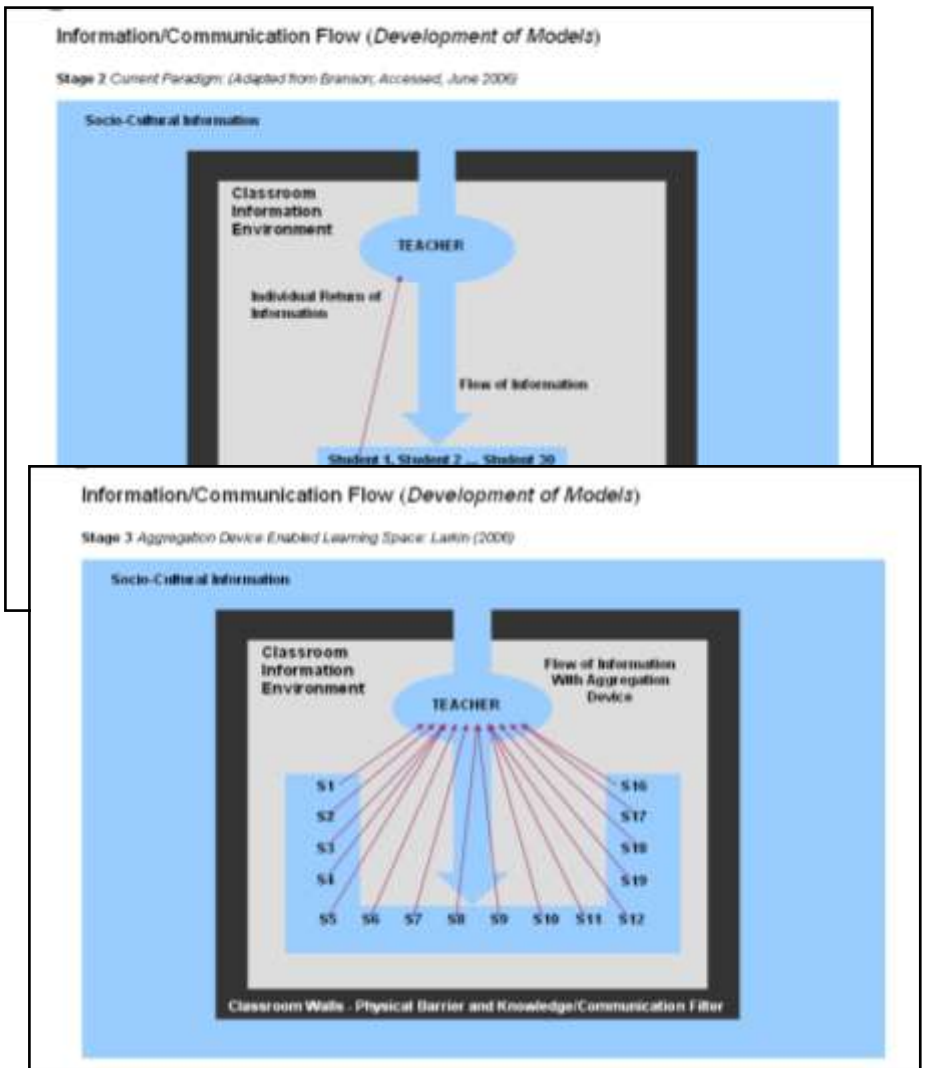
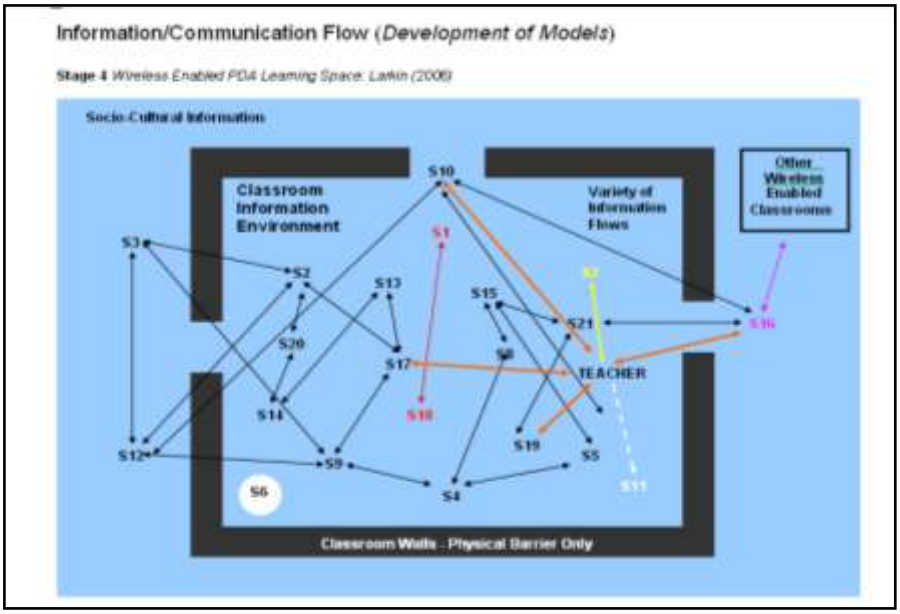



Figure 4

Figure 5


Information/Communication Flow (Development of Models)
Stage 4 Wireless Enabled PDA Learning Space: Larkin (2006)
Socio-Cultural Information
Classroom Information Environment
Variety of Information Flows
Other Wireless Enabled Classrooms
S10
S1
S3
S2
S13
S15
S21
S16
S20
S17
S8
TEACHER
S14
S18
S19
S5
S12
S9
S6
S4
S11
Classroom Walls - Physical Barrier Only