

PROMOTING EFFECTIVE TEACHING AND LEARNING IN ONLINE ENVIRONMENT: A BLEND OF PEDAGOGICAL AND ANDRAGOGICAL MODELS

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Abstract. The emergence of new technologies has increased access to education. The limitation of face-to-face system in terms of adequate access to education by prospective learners and working class is being challenged by online learning delivery platform. The online teaching and learning environment opens up the access to all forms of education that have been restricted by factors such as school age limit, time, work schedule and other cultural and socio-economic factors. Thus, teaching and learning opportunities are now available both in the physical and online environments for all and different categories of learners – teenagers and adults alike. This paper, therefore, considers blending pedagogical and andragogical models as essential for promoting effective teaching and learning in online environment. The paper is an exposition on ensuring that both the teenagers and the adults are adequately catered for when designing online teaching and learning programmes. It highlights what makes effective teaching, educational delivery models, paradigm changes and roles of teachers/facilitators of learning in online environment among others. The paper concludes that effective teaching strategies help to activate students' curiosity about a class topic, engage students in learning, develop critical thinking skills, keep students on task, engender sustained and useful classroom interaction, and in

general, enable and enhance the learning of course content. It then recommends that facilitators/instructors in online teaching and learning should, as a matter of necessity, acquire skills both in pedagogical and andragogical models of teaching.

Keywords: pedagogy, andragogy, teaching, online environment

Introduction

Teaching and learning are two indispensable pillars in education. No education can take place without effective teaching and learning. The quality of products of every educational endeavour is hinged on how effectively teaching and learning are handled. Also, a major contributing factor to a successful teaching and learning efforts is the environment in which they take place. It is known¹⁾ that learning environments have both direct and indirect influence on student learning, including their engagement in what is being taught, and their motivation to learn. There is no gain saying in the fact that people world over, are used to the traditional classroom environment, which is essentially physical both in terms of material and human resources. According to glossary of education reform¹⁾, teaching and learning environment refers to the diverse physical locations, contexts, and cultures in which students learn. Physical learning environment is synonymous with classroom, which has more limited and traditional connotations of a room with rows of desks and a chalkboard. Physical learning environment gives opportunities for students/learners to learn in varied settings like outside of school locations, and outdoor environments.¹⁾ Physical environment is anywhere teaching and learning take place involving physical contact between the instructors and the learners.

However, the advent of new technologies and Information and Communication Technologies (ICTs) has brought another dimension into the subject of teaching and learning. This dimension is technically referred to as ‘Online Environment’. Online environment basically talks about using gadgets of ICTs for

teaching and learning. This involves the use of internet, computers (desktop, laptop, palmtop, tablet), and all sorts of mobile phones. Hodges²⁾ says that when teaching and learning take place on the World Wide Web (www), it is known as an online environment. The online teaching and learning environment is not limited by time and space. It bridges the gaps of accessibility to education created by physical learning environment such as age limit, time constraint, unavoidable absence of instructor, and distance in space and time.

Consequent upon online environment bridging the gaps of accessibility to education is the opportunities that both children and adults have to access teaching and learning. Much of the studies on what, where, how, and why adults learn as well as how they develop and mature through the lifespan have signaled the need for new approaches to teaching and learning.³⁾ Thus promoting effective teaching and learning in online environment should take into consideration differences in the arts and science of teaching children and adults while designing online teaching and learning materials and programmes. The concern of this paper therefore is to propagate blended pedagogical and andragogical principles with a view to promoting effective teaching and learning that will be all encompassing for both children and adults in online environment.

Conceptual framework

Concepts of pedagogy and andragogy

According to Knowles (1973), pedagogy is simply the art and science of teaching children. Pedagogy is the methods and practices used in teaching children. Pedagogy refers to teaching children or using a style of teaching that is typically related to teaching children; it is teacher centred. It refers to children and the notion of ‘filling their heads while they move towards maturity’.³⁾ Children education involves rote learning with teacher acting as ‘mister-know-it-all’ and children as receptive tank into which information (educational content) is deposited without a choice as per the need for such information. It is found³⁾ that many sites are designed in a pedagogical, teacher centred perspective,

where the students are being “filled” with information. Pedagogy is based on a teacher’s methods of disseminating knowledge to a student, who is dependent solely on the teacher’s methods and understanding. Pedagogy makes use of lectures, assigned readings, drills, quizzes, note memorizing, and examinations writing as its teaching strategies (Holmes & Abington-Cooper, 2000). Pedagogy is a system in which the teacher controls the learning experience for children, and much of what is taught is based on rigid curricula.

On the other hand, andragogy is the ‘art and science of helping adults learn’ (Knowles, 1973). Historically, andragogy is said to have been originally formulated by a German teacher by name, Alexander Kapp, in 1833. Kapp argues that ‘adult education requires special teachers, methods and philosophy, and he uses the term andragogy to refer collectively to these special requirements’.⁴⁾ Andragogy, therefore, generally refers to teaching of adults, but it is more focused on what adults learn versus what they are being taught.³⁾ Thus, according to Knowles (1980), the goal of adult education should be self-actualization. Therefore, Knowles (1980) suggests that the learning process should involve the whole of emotional, psychological, and intellectual being. Andragogy, succinctly put, can be said to be the methods and practices used in facilitating adult learning. So adults’ teaching and learning programmes should be designed with the notion that adults have control over much of their learning experience.

Knowles’ assumptions about adult learning

The following assumptions about adult learning postulated by Knowles are very germane to effective teaching and learning in online environment. These are: (1) *Self-concept*: as a person matures his self-concept moves from one of being a dependent personality toward one of being a self-directed human being; (2) *Experience*: as a person matures he accumulates a growing reservoir of experience that becomes an increasing resource for learning; (3) *Readiness*

to learn: as a person matures his readiness to learn becomes oriented increasingly to the developmental tasks of his social roles; (4) *Orientation to learning*: as a person matures his time perspective changes from one of postponed application of knowledge to immediacy of application, and accordingly his orientation toward learning shifts from one of subject-centeredness to one of problem-centredness; (5) *Motivation to learn*: as a person matures the motivation to learn is internal (Knowles, 1984).

Following the above enumerated Knowles' assumptions about adult education, Knowles (1973) distinguishes between the pedagogical and andragogical approaches to designing and operating adult educational programs by comparing his andragogical model with pedagogical model. According to Holmes & Abington-Cooper (2000), the pedagogical model is a content model concerned with the transmitting of information and skills in which the teacher decides in advance what knowledge or skill needs to be transmitted, arranges this body of content into logical units, selects the most efficient means for transmitting this content (lectures, readings, lab exercises, films, tapes, for example), and then develops a plan for presenting these units in some sequence.

On the contrary, the andragogical model is concerned with providing procedures and resources for helping learners acquire information and skills. In this model, the teacher (facilitator, change-agent, consultant) prepares a set of procedures for involving the learners in a process that includes: (a) establishing a climate conducive to learning; (b) creating a mechanism for mutual planning; (c) diagnosing the needs of learning; (d) formulating programme objectives (content) that will satisfy these needs; (e) designing a pattern of learning experiences; (f) conducting these learning experiences with suitable techniques and materials; and (g) evaluating the learning outcomes and re-diagnosing learning needs (Holmes & Abington-Cooper, 2000).

In addition to the above assumptions about adult learning, Knowles (1984) identifies the following six principles of adult learning: (1) adults are internally motivated and self-directed; (2) adults bring life experiences and

knowledge to learning experiences; (3) adults are goal oriented; (4) adults are relevancy oriented; (5) adults are practical; (6) adult learners like to be respected.

These assumptions, when combined with principles related to teaching and learning process, can offer the adult educator an understanding of the inter-relationship between adulthood and learning. Thus, the mission of adult educators is to assist adults to develop their full potential, and andragogy is the teaching methodology used to effectively do and achieve this end (Holmes & Abington-Cooper, 2000). Knowles (1980), views that the teacher is a facilitator who aids adults to become self-directed learners. Therefore, the importance of self and self-directedness are primary considerations when teaching adult learners.³⁾

Blending pedagogy and andragogy principles

Gilen⁵⁾ opines that when discussing teaching and learning concepts the words pedagogy and andragogy can both be used, though they refer to very different areas of teaching and learning. While the concepts of andragogy and pedagogy relate to two different types of learners, adults and children, respectively, the concepts do intertwine as the nature of learning is a sliding scale from self-directed to teacher-directed. Some children may learn under more self-directed concepts and some adults may learn under more teacher-directed concepts. Ultimately education needs to be tailored to the audience (the students/learners) to ensure that it achieves the required outcome.

Blending the two concepts, Knudson (1980) suggests the term humanagogy, which is pedagogy and andragogy combined. According to Knudson, humanagogy represents the differences as well as the similarities that exist between both adults and children as learning human beings. Knudson (1980) then emphasizes that both the pedagogical and andragogical approaches have something to offer in teaching and learning processes. He reiterates that they are at the same time opposites and complements and are equally necessary for ensuring effective teaching and learning. Andragogy assumes that adults already

have a significant amount of knowledge, are capable of making ‘educated’ choices in their learning experiences and learn best when ‘the teacher’ or facilitator uses a combination of teaching styles, some of which may be pedagogical in nature.³⁾ Thus, because of the divergence from a pedagogical approach, the educator must not be restricted from presenting the adult with alternative ways of interpreting the world or of creating new personal and collective futures. Thus, Wang (2015) emphasizes that teachers need to be well versed in both pedagogical and andragogical principles so that they know which philosophy to apply in terms of helping mature learners learn in the traditional classroom or in virtual environments.

What make teaching effective

Teaching is an interaction between two groups or sets of people—the learners and the teachers. The teacher, a perceived expert in the chosen field of knowledge, transfers the body of the knowledge to the learners. This superiority/inferiority relationship between the teacher and learner is being underplayed in the thought of constructivism which sees teachers and learners as active participants, collaborators in the quest for creation of knowledge. So, teaching is interaction between the instructors and learners towards creation of knowledge and ‘production’ of desirable traits, skills, attitude and aptitude towards creation of observable change in behaviour which is the product of teaching and learning. However, the changes are not restricted to the learners, the interaction also produces changes in the teachers. Encounter within the process of teaching, feedback from the learners, and societal expectations make the teacher to look inwards and critically analyses his methods where he needs to effect changes.

For any teaching and learning activities that take place in an online environment to be considered effective, they need to blend pedagogical and andragogical principles with a view to ensuring that both children and adults learners actually learn what they desired to learn. Coe et al.⁶⁾ say that effective teaching

and learning is that which lead to improved students' achievements using outcomes that matter to future success. However, in the case of adult learners, effective teaching and learning should be that which lead to improved learners' achievements using outcomes that matter to their immediate success. Coe et al.⁶⁾ reiterate that to determine the effectiveness of teaching, it must be checked against the progress being made by students/learners. Active learning involves students that are engaged in more activities than just listening.⁷⁾ They are involved in dialogue, debate, writing, and problem solving, as well as higher-order thinking such as analysis, synthesis, and evaluation.

Teaching is effective when a teacher is able to achieve the teaching objective and by extension assist the learners to overcome learning difficulties. This calls for commitment and skills on the part of the teachers. Teaching is effective when learning has taken place. Effective teaching is the one that provides maximum opportunities for all learners to learn. It also provides the necessary learning environment and learning experiences that enable all students to learn through making meaning from experience.⁸⁾ In this case, learner is the principal focus of the interaction. If learners have learnt effectively, of course, it will positively affect the society and undoubtedly, the national objectives will be attained.

The opinion of scholars on these teaching issues are stimulating and revealing. Tiberius & Tipping (1990) identified twelve principles of effective teaching and learning: (i) teacher's knowledge of the subject matter; (ii) active involvement of the learners; (iii) interaction between teachers and students; (iv) students taken learning responsibility; (v) understanding of the fact that there are many needs to learning; (vi) expect more and you will achieve more; (vii) learning is enhanced in the atmosphere of cooperation; (viii) material use for learning purpose must be meaningful; (ix) both teaching and learning are enhanced by descriptive feedback; (x) know that critical feedback is only useful if the learner has alternatives to pursue; (xi) time plus energy equals learning - there is no short cut; (xii) experience usually improves teaching.

According to Smittle (2003) idea of principles of effective teaching are as follows: (i) commitment to teaching underprepared students; (ii) demonstrative good command of the subject matter and the ability to teach a diverse student population; (iii) address non-cognitive issues that affect learning; (iv) provide open and responsive learning environments; (v) communicate high standards; (vi) engage in ongoing evaluation and professional development.

The Department of Education and Training, Government of Western Australia, identifies the following as features of effective teaching: (i) having high expectation; (ii) acknowledging individual differences among learners; (iii) using a range of pedagogies; (iv) encouraging student responsibility; (v) having mystery of their teachings content; (vi) providing a safe environment; (vii) monitoring progress and producing feedback; (viii) building positive relationships.

Educational delivery models

The mode of educational delivery largely remains face-to-face, where learning takes place within the confine of a brick and mortar classroom. It is the usual and normal practice and is as old as the origin of school system. Everyone acquaints with it. There is physical contact between the instructors and the learner. Communication process, assessment is real time in a physical location, well defined and known by all stakeholders in teaching and learning. The obvious scenario is that not every potential learner can converge in a place for want of suitable plant and facilities. Apart from the impossibility of such convergence, education is also limited by other restrictive factors. Accessibility is not only hindered by geography, fund, age, culture, religion, and individual preference are contributing factors.

These limitations by a segment of the society to attend school culminated into the introduction of distance education. Distance education is a form of education made available for those who are hindered by the factors of inaccessibility, and are subsequently provided opportunity for formal education. It is a form of education whereby learners are separated from instructors in terms of

location, space and time. Distance education has taken various forms in its evolutionary trend. It started with the use of print test in form of correspondence course, sandwich programme, part-time studies where learners who are part of workforce come to school at a window period employing face-to-face delivery method, and gradually to the use of electronic devices such as tape-recorded cassettes and videos, radio and television.

With the advancement of ICTs, another means evolved in the educational delivery system through the use of computer and internet. There are many rationales behind the adoption of e-learning aside the huge success in the field of information and communication technology. There is need for retraining of manpower in private and public sector of the economy. Many people find it extremely difficult to abandon their work for want of higher and relevant knowledge. E-learning provides a platform for educational access for such category of people. The questions of time, distance and space is enormously insignificant as learners can learn synchronously or real-time and asynchronously regardless of their location globally. E-learning allows for self-paced, individualized instruction, and aside it has potentials to offer educational services to a large percentage of population. For the fact that there is no need for a confined classroom removes limits in the number of students/learners.

However, e-learning is limited by some challenges; some are global in nature, while some are products of challenges of development confronting the African States with special recourse to Nigeria. Funding towards acquiring the required technology possess a daunting constraints. Access to computer in terms of acquisition and skill to operate remains a mitigating factor. More worrisome is erratic power supply, internet accessibility, problems which seem impossible to overcome. Aside the technology, teaching online requires unique pedagogical and andragogical skills in designing online content, teaching and evaluation. Scholars have argued that while technology is given utmost consideration over pedagogical revolution as the basis of success in e-learning, such e-learning ventures become exercise in futility.

In an attempt to solve the challenges of e-learning, most institutions adopted a hybrid system, which is between face-to-face and pure e-learning termed blended or integrated learning. Theoretically, a blended learning arrangement incorporates the advantages of both face-to-face and e-learning, thus promoting a holistic, balanced learning.

Paradigm changes and roles of teachers/facilitators

Traditionally, a teacher performs certain functions within and outside the classroom. In a face-to-face delivery mode, the fulcrum of a teacher is to give instruction having been academically and professionally certified. He is expected to provide additional services such as motivating the learners, offer guidance and counseling services. The evolution of e-learning has stimulated a shift in instructors' roles. The roles become more elaborate and multi-dimensional.

Several scholars have categorized various roles of online instructions; presenting divergent but related views. Berge (1995) categorized them as pedagogical, social managerial and technical. Gold (2001) view online instructions roles from two perspectives – organizational and intellectual roles. Goodyear et al. (2001) identified process facilitator, adviser/counselor, assessor, researcher, content facilitator, technological, designer and managers.

Research report by Heuer & King (2004) reveals the roles of online instructor to be planner, model, coach, facilitator, and communicator. Bjekic et al. (2010) identified model, diagnostic, planner, manager, initiator, author, creator, partner, educator, supervisor, administrator, evaluator, mediator, adviser, assessor, learner and self-realisateur as roles of online instructors.

Rationale for the changes

E-learning is not just about converting notes into digital form and depositing them into a website. Looking at e-learning from this standpoint has always resulting to a failed adventure (Collins & Berge, 1996). Creation of online courses subsequently connotes changes in instructor roles (Palloff & Pratt,

2011). Kelly (2004) argues that monitoring student progress in a virtual environment is more challenging than normal face-to-face classroom. This necessitates additional efforts on the part of the instructors. Kelly (2004) observes that the technical requirement of online environment 'requires skills in cross-functional teaching to provide a seamless integration for the student' which suggest a shift in roles.

Yi (2012) identifies teaching, research and service as the three main roles of faculty members in face-to-face education and argues that the online teaching environment is more challenging. There is need for instructors to be skillful in information and technology roles, and consistently be familiar with updated course for technical competence. According to Yi (2012), faculty roles in online are 'to transmit, develop, and innovate information and knowledge to distance learners'. In essence, technology involved in online learning has informed a modification of instructors' roles and should be able to solve technical problems encountered during teaching and learning process (Egan & Akdere, 2005). The constructivist theory which provides fundamental framework for online learning necessitates a change in teachers' role from mere delivering of knowledge to that of facilitator and content developer. An online instructor must be competent in content designing (Williams, 2003).

Flexibility nature of e-learners and e-content provides enabling environment for instructors to add value to the existing content to achieve learning objectives. The designing of content is not limited to instructional designers and instructors, learners can also contribute positively to designing by integrating desirable learning experience in the course of teaching and learning process. It is observed that the role of teacher in an online environment is being redefined in areas of dialogue, involvement, support, and control.⁹⁾ Youngblood et al. (2001) observe that instructor's role has translated to facilitator that should foster collaborative learning among the learners. Heuer & King (2004) argue that dynamism of online environment stimulates the instructors' shifts in roles in the course of online teaching and learning process.

Principles of online teaching

Pedagogical and andragogical principles

Know your content – Either traditional face-to-face or in an online environment. Instructor is expected to be well grounded in the knowledge of the subject matter. Online learning requires no less but rather more demanding. It also suggests that instructor should be open-minded and allow learners' creativity as learners are not just recipients but also creators of knowledge. As facilitators of learning, an in-depth knowledge of the subject matter is highly indispensable.

Create your content– Instructors are not only to teach but they can also create the course content in accordance with the curriculum goal. Equivalency theory can be adopted by respective instructors. The fulcrum of the theory is the need for instructors to adapt and teach what obtains in the face-to-face classroom for a particular course, even though it may not exactly be the same. In this case, similarity is placed above sameness. This does not nullify the official, planned curriculum, but rather places additional responsibility on the instructors the need to adequately respond to heterogeneous needs of their diverse audience. Online students are divers and could spread across continents, race, and age, and groups, religious and occupational persuasion, and to adequately address the resultant diversities, meet their learning expectation and challenges requires ^{instruc-}
^{tors} who can respond to the contingent needs of learners by creating required contents in addition to official, planned curriculum to address such expectations. Online instructors must be able to innovate. Online teaching is the innovative application of Information Technology (IT) to teaching.

Know the relevant learning theories to online learning – Online learning is noted in the Vygosty (1978) theory of social construction where learners are to create their learning based on their initial interaction with previous learning

environment. Instructors need to facilitate, motivate and guide the learners. Constructivism theories guide the design and construction of Learning Management Systems (LMS) where teaching takes place in online environment.

Do the teaching – Teaching can take synchronous or asynchronous form. While teaching instructors should note that: (a) for teaching to be effective, online preparation is important; (b) communicate clearly and avoid ambiguity. There are no noticeable facial clues from your audience because of barrier in time and space, so instructor's communication skill is very important; (c) in some cases, what are required more over and above communication skill in teaching online are your writing skills. You will employ writing skills to effectively pass across instructions to your audience; (d) take into consideration Pelz (2010) principle of e-teaching by: (i) allow students to do most of the work. Reverse "I talk you listen" style to a situation where you allow them to do the discussion while you provide the guidance/direction. To achieve this, Pelz (2010) submits that instructors should allow students to lead the discussion, find and discuss web resources, allow peer assistance, give them opportunity to grade their assignment and give them assignment or work on case study analysis; (ii) allow interactivity among the learners through collaborative research paper and research proposal project. Instructors should ensure individual contribution in the project is determined and appropriately rewarded; (iii) instructors should strive for presence, socially and cognitively. Appointment with online students must be religiously kept. The audience is busy people in their own world. They are always people with occupational demand, family responsibilities and other personal issues. Once appointment is consistently not kept, learning process will be completely terminated. Failure to keep appointment may directly lead to drop outs; (iv) give timelines and enforce compliance. Be timely with all postings, grades and responses, projects submission, submission of assignments, allow for feedback from the learners and use the received information as basis for further action within and outside the confines of formal teaching time. As instructors, you are also expected to give prompt feedback to learners.

Technological principles

Online learning is learning driven by the use of information and communication technologies. It is learning with the aid of computer, internet and internet facilities. Online learning instructors should not only have capacity to use technology but should also be able to explore new technologies. Technological skills should include: (a) the ability to create and use blog to teach; (b) use of social media such as face book, Skype etc.; (c) giving of feedback with the use of e-mails; (d) the ability to use Learning Management System (LMS); (e) Use of video recording devices such as audacity.

Instructors should learn how to integrate new technologies in an instructional setting and to know when to use technologies and why they should be used.

Managerial principles

Effective teaching should conform to global best practices. Quality and expectations commence from the nature of national policy or goals and institutional policy, vision and mission statement. Quality design, organizational focus, administration, teaching methods, funding and cost, assessment policy, are closely linked with the institutional policy. Before converting to online, there is need for institution to evaluate the existing face-to-face system, weigh area of need through systematic conduct of needs assessment and arrive at logical conclusion on the adoption or rejection of e-learning.

Classroom management by instructors focuses on setting of expectations before the commencement of the course, posting of announcement as and when due at the LMS portal, stating rules and regulations such as netiquette, submission of assignment due dates, rules moderating students posting, assigning of students to various group work. Management issues also focus on students monitoring in respect to attendance, quality contribution in forum discussion, speed at which assignment and project works are submitted, the occurrence of dropout

and attrition rate, instructors' commitment to teaching. It is expedient to ensure that instructors are able to register their presence cognitively and socially online.

Social principles

To reduce the rate of drop out in online environment, instructors should endeavor to build a community of learners. Online environment is characterized by feelings of isolation among learners. Instructors should utilize their online teaching skills to build a sustainable interaction among learners regardless of their location, race, status, and age. The extent to which learners are able to create friendly atmosphere will determine the depth of group dynamism in the class.

Conclusion

Effective teaching strategies help to activate students'/learners' curiosity about a class topic, engage students in learning, develop critical thinking skills, keep students on task, engender sustained and useful classroom interaction, and in general, enable and enhance the learning of course content. Commonly used teaching methods may include lecture, class participation, demonstration, project-based learning, or memorization, but some combination of these usually results in the most effective strategy; that is, a strategy that engages a diversity of teaching and learning styles through varied instructions. Thus, the promotion of effective of teaching and learning in online environment requires effective combination or blending of both pedagogical and andragogical principle/models for productive e-learning activities.

Recommendations

- (1) The facilitators/instructors in online teaching and learning should as a matter of necessity acquire skills both in pedagogical and andragogical models of teaching.

- (2) Stakeholders in education should ensure adequate provision of online facilities especially, regular power supply without which online teaching and learning will remain a mirage.
- (3) Online/E-learners need to be ICTs compliant. The learners need to acquire relevant ICTs skills as well as equip themselves with necessary ICT gadgets such computers, laptops etc for easy dissemination of educational content to them.

NOTES

1. <https://www.edglossary.org/hidden-curriculum/>
2. <https://sites.google.com/a/boisestate.edu/edtechtheories/online-learning-environments-and-their-applications-to-emerging-theories-of-educational-technology>
3. <http://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=B98235727388868A2BF5AEC199B02695?doi=10.1.1.498.9788&rep=rep1&type=pdf>
4. <http://infed.org/mobi/andragogy-what-is-it-and-does-it-help-thinking-about-adult-learning/>
5. <http://www.businessdictionary.com/article/1095/andragogy-vs-pedagogy-d1412/>
6. <https://www.suttontrust.com/wp-content/uploads/2014/10/What-Makes-Great-Teaching-REPORT.pdf>
7. <https://onlinelearninginsights.wordpress.com/2012/09/22/learning-online-is-not-a-spectator-sport-how-to-make-it-active/>
8. http://www.cheri.com.au/PDF_Files/CHERI%20XI%20Conf%202006/1HookJulie.pdf
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