UNIT 14

Introduction

1 General introduction

An introduction explains the rationale for undertaking the research and clearly describes the main purpose of conducting it. It places the research work in a theoretical context, and enables the reader to understand and appreciate the objective of the research. It generally consists of the following four moves.

MOVE 1 Establishing a territory

In this move, a "big picture" where the subject of an article falls is drawn with the following information: 1) the significance of the research in a broad context, which includes the reasons why the research is worth doing in the first place, particularly the practical reasons and theoretical reasons; 2) generalizations about the subject, which include general definitions of key terms, concepts, features and properties, advantages and disadvantages, historical development and current status of a material or a technique. Simply, this move is to inform readers of the background knowledge.

MOVE 2 Reviewing previous related research

This move usually summarizes the previous related research. It may include a brief review of the literature of previous and contemporary developments in this area to justify the need for the present research.

MOVE 3 Establishing a niche

This move starts to prepare for the present research by indicating a gap and raising questions. In this move, the particular area of the broader subject that the article is going to deal with is described with the following information: 1) indication of a gap in the previous research by extending previous knowledge in some way;

2) research questions raised by putting forward a specific hypothesis and describing the reasons.

MOVE 4 Occupying the niche

In this move, what the present research will accomplish in particular is described with the following information: 1) the purpose of the research, which can be exactly what problems the research intends to solve; 2) the overall structure of the article, which can be a very brief description of the experimental design and how it will accomplish the stated objective; and 3) the principal findings of the research, which might be what the research will have accomplished by the time the research is finished.

2 Reading skills

When reading the Introduction section of a research article, you need to employ the following skills as aids: 1) remembering the four moves in the Introduction section; and 2) identifying the four moves with the help of the syntactic and lexical clues.

01 Identifying the first move: Establishing a territory

- As to the significance of the research in a broad context, clues might be: present tenses for predicates; adverbs or adverbial phrases indicating current time; words such as "significant", "necessary", "important", etc. For example:
  - *The deep elimination of emerging antibiotic contaminants with high-efficiency and low-cost ways toward different water environments is one of the important goals and scientific frontiers in ensuring the global water safety.*
  - *Hydrogen production from dark fermentation has gained much attention in recent years because of the high hydrogen production rate, low energy requirement, and process simplicity.*
  - *Recently, improving aging and deteriorating structures has become an important issue in the area of architecture and civil engineering.*
- As to generalizations about the subject, clues might be: present tenses for predicates; descriptions of definitions, properties, applications, etc. For example:
  - *Nanomaterials are typically defined as materials smaller than 100 nm in at least one dimension. At this scale, materials often possess novel size-*

dependent properties different from their large counterparts, many of which have been explored for applications in water and wastewater treatment. (definition)

- *IN738LC (NiCr16CoAlTi) is one of the most widely used cast precipitation-hardened nickel-based superalloys. These superalloys are used in high temperature applications, especially in land-based and aircraft gas turbine engines, since they exhibit excellent microstructural stability, high temperature strength, and corrosion resistance.* (definition, application, and properties)
- *As the lightest of all metallic structural materials, about 33% lighter than aluminum (Al) and 75% lighter than ferrous (Fe) alloys (Cole and Sherman, 1995), Mg alloys exhibit high specific mechanical properties.* (properties)

02 Identifying the second move: Reviewing previous related research

As to a review of the previous research, clues might be: past or present tenses for predicates; names of researchers as subjects of sentences, etc. For example:

- *Yin et al. (2010a) reported that, during lap shear testing, failure initiation occurs at the tip of hook defect and therefore mechanical properties are strongly influenced by its dimension and curvature.*
- *In case of FSpW, Rosendo et al. (2011) studied the failure behavior of AA6181-T4 joints.*
- *A review of the literature has revealed that most research has focused on the forming process of titanium alloy tubular products.*

03 Identifying the third move: Establishing a niche

- As to the indication of a gap, clues might be: present tenses for predicates; words such as "unclear", "unsolved", "unexplored", "shortcoming", "drawback", etc. For example:
  - *However, the origin of the characteristics of both sp^2- and sp^3-bonded carbon in disordered h-BDD material is still unclear.*
  - *The main drawback is that the routinely made shells have just a few nanometers (nm) in thickness and are rather fragile, collapsing easily upon drying or mechanical stress that contributes to a high risk of a payload leaks.*
- To raise research questions, the author might state the specific hypothesis or objective, or an extension of a finding; and describe the reasons that lead to the selection of these research questions. For example:
  - *Thus, it is still a challenge to develop a facile method of fabricating uniform nonspherical oxide hollow structures with different shapes.*

- *Making the shells thicker and more mechanically robust is a tough challenge.*
- *In this paper, as an extension of [17], a 40 Gbit/s coherent optical receiver using a Costas loop is demonstrated.*

04 Identifying the fourth move: Occupying the niche

- As to the purpose of the research, clues might be: present or future tenses for predicates; words like "purpose", "aim", etc. For example:
  - *The purpose of this work is to investigate the failure mechanisms of AZ31 Mg alloy joints produced by friction spot welding.*
  - *To address this need, we have developed multilayered UCNPs modified with polyacrylic acid and compound 1 respectively, as probes (abbreviated as 1-PAA-UCNPs shown in Figure 1) for sensitive and rapid monitoring of Zn^{2+} ions.*
- As to the overall structure of the research article, clues might be: present or future tenses for predicates; words like "first", "second", etc. For example:
  - *The synthesis procedure of hollow silica colloids with different shapes is depicted in Scheme 1. In the first step, hematite colloidal particles with different shapes, such as pseudocubes, ellipsoids, capsules, and peanuts, are prepared by adjusting the amount of Na_2SO_4 in the reaction system;[30, 31] in the next step, colloidal hematite templates with different shapes can be coated with silica to form a hematite core-silica shell structure; in the final step, after the hematite cores are removed by dissolving in HCl solution, the hollow silica colloids with different shapes are produced.*
  - *In what follows, we will first describe the computational details in Section 2, then present our results and discussion in Section 3, and end with our final conclusions in Section 4.*
  - *This work aims to fabricate hydrolysis resistance phosphite antioxidants by hybridizing with LDH, and to understand the anti-hydrolysis mechanism. Then, as-fabricated hybridized phosphite antioxidants were in situ incorporated into optical PET materials during the polycondensation process, and the effect of hybridized antioxidants on the comprehensive optical performances of PET was examined.*
- As to the principal findings of the research, clues might be: past or present tenses for predicates; words such as "results", "findings", "found", etc. For example:
  - *In this work, the resulting carbon catalyst with optimal nitrogen doping and carbon microstructure exhibited very encouraging NRR activity, yielding an NH_3 production rate of 3.4×10^{-6} mol cm^{-2} h^{-1} and an FE as high as 10.2% at −0.3 V vs. RHE at room temperature and ambient pressure in 0.1 M KOH electrolyte.*

- *The results show that as-prepared hybridized antioxidants display much improved anti-hydrolysis capabilities and the resultant modified PET films demonstrate largely improved transmittance and chromaticity, and thus are expected to find wider optical applications prospects.*
- *As a result, a stable OPLL and binary phase-shift keying (BPSK) coherent receiver error-free (BER < 10^{-12}) up to 35 Gbit/s and BER < 10^{-7} for 40 Gbit/s are achieved. The BPSK receiver consumes less than 3W power.*

3 Sample analysis

01 Sample 1

(1) Increasing public health concern has grown in relation to the presence of micropollutants including pesticides, pharmaceuticals and personal care products, industrial compounds, fragrances, water treatment by-products, flame retardants and surfactants in the aquatic environment [1]. (2) Even micropollutants present at relatively low levels, such as part per billion or part per trillion in drinking water, can have adverse health effects following chronic exposure [2]. (3) The discharge of treated effluent from municipal wastewater treatment plants (WWTPs) is a major pathway for the introduction of micropollutants to surface water [3, 4]. (4) It is recognized that WWTP technologies are very often unable to entirely degrade such persistent substances [5, 6]. (5) Consequently, tertiary advanced treatment processes are required to achieve higher and more consistent micropollutant removal.

(6) Membrane processes including ultrafiltration (UF), nanofiltration (NF) and reverse osmosis (RO) have been widely adopted as tertiary treatment for secondary effluents purification and reuse [7]. (7) They show promising application potential with several advantages, including high product quality and ease to be scaled-up, and some disadvantages such as membrane cost and fouling. (8) Especially NF and RO are very efficient for micropollutants and effluent organic matter (EfOM) removal, generating a permeate stream practically free of micropollutants [8].

You can find Move 1 by reading Sentences (1)-(11), in which the present tense is used. Sentences (1)-(3) describe the background—a public concern: micropollutants in municipal water and their adverse health effects. Sentences (4)-(5) point out the significance of the present study: The WWTP technologies are unable to solve the problem, therefore "advanced treatment processes are required".

Sentences (6)-(8) describe the new treatment processes.

(9) However, membrane separation is a non-destructive technique and all contaminants are found in the retentate stream, which in some cases are discharged untreated into the aquatic environment. (10) Concentration of contaminants in the retentate could be several times higher than in the feed water [9]. (11) Therefore, specific treatments such as coagulation, activated carbon adsorption and advanced oxidation processes (AOPs) have been applied in order to reduce the pollutant load of retentate streams.

Sentences (9)-(11) describe some shortcomings of the new treatment processes, stressing the necessities of further research.

(12) In this way, several investigations have been performed based on RO retentate treatment by traditional or advanced methods, and the results have been summarized and discussed in review articles [9-12]. (13) These studies are mainly focused on the removal of EfOM from RO retentate and only some of them addressed the treatment options for removing contaminants of concern. (14) However, scarce information concerning UF and NF treatment for EfOM and micropollutants elimination is available. (15) AOPs such as ozone-based advanced oxidation and photocatalytic oxidation have demonstrated to be effective for breaking down various pollutants from NF retentate [7]. (16) EfOM and micropollutants removal from UF and NF retentates by other oxidants, such as chlorine and potassium permanganate, or by other treatment processes, such as coagulation and activated carbon adsorption, has rarely been investigated. (17) In addition, the hybrid process coagulation/ozonation, which improves the efficiency of ozone for the oxidation of trace organic contaminants in secondary effluents [13], has only been applied to remove organic matter from RO retentates [10].

You can find Move 2 in Sentences (12)-(13), which summarize the previous related research.

Sentences (14)-(17) indicate Move 3 by pointing out the research gap.

(18) According to these considerations, the main purpose of this study was to compare several advanced tertiary treatments, such as coagulation (Fe and Al), oxidation (ozone, chlorine and potassium permanganate) and adsorption (PAC) for removing micropollutants and EfOM from retentates generated during UF and NF of secondary effluents from a WWTP. (19) For that, the following 11 micropollutants were selected: acetaminophen (ACET), metoprolol (MET), caffeine (CAF), antipyrine (ANT), sulfamethoxazole (SUL), flumequine (FLUM), ketorolac (KET), atrazine (ATR), isoproturon (ISOP), 2-hydroxybiphenyl (HYD) and diclofenac (DIC). (20) Most of these contaminants have been found in different aquatic environments at concentrations in the range of ng L^{-1} to μg L^{-1} [2, 6]. (21) The elimination of these compounds was previously investigated by using single UF and NF and by sequential processes

Sentences (18)-(24) indicate Move 4. Sentence (18) tells the purpose of the study. Sentences (19)-(24) point out how the research was conducted in general and some major findings.

constituted by PAC adsorption and/or coagulation pre-treatments followed by UF [14,15]. (22) In the present work, we have evaluated the efficiency of individual processes, as well as the hybrid coagulation/ozonation process, to remove these micropollutants from UF and NF retentates; and their elimination has been correlated with physicochemical properties or molecular structure. (23) Additionally, the efficiency for EfOM reduction was evaluated by measuring mineralization (DOC removal), and changes in aromaticity and specific ultraviolet absorbance (SUVA). (24) These water quality parameters enable the assessment of final effluent quality to evaluate the suitability of its recirculation to the secondary treatment in the WWTP.

02 Sample 2

(1) Over the last decades, bacterial resistance to antibiotics has become an issue of growing concern worldwide (French, 2010), frequently attributed to the excessive use of antibiotics (Kim & Aga, 2007; Martinez, 2009). (2) Antimicrobial residues can impose selective pressures, capable of favoring the proliferation of resistant bacteria, with the progressive elimination of the susceptible organisms. (3) Simultaneously, antimicrobial residues may induce bacteria to transfer horizontally antibiotic resistance genes to other community members (Davies & Davies, 2010; Gillings, 2013). (4) It is estimated that antibiotic concentrations measured in environmental samples, such as rivers, can inhibit wild-type bacteria (Tello et al., 2012). (5) Due to such inhibition, antimicrobial residues would be also implicated in the rearrangement of the bacterial communities. (6) This hypothesis was recently supported by the demonstration of significant correlations between the concentrations of antimicrobial residues, antibiotic resistant bacteria or their genes and rearrangements of the bacterial communities in surface and wastewater (Huerta et al., 2013; Novo et al., 2013). (7) In spite of these evidences that could lead to an apparently simple cause-effect relationship, the complexity of propagation of antibiotic resistance in the environment is widely recognized. (8) Intriguing questions are, for example, the effect of sub-inhibitory concentrations of antibiotics on the bacterial communities or on the stability of the resistance phenotypes, even in the absence of selective pressures (Andersson & Hughes, 2010, 2012). (9) The association between the classes of

You can find Move 1 by reading Sentences (1)-(5), which mainly introduce antimicrobial residues and their impacts.

You can find Move 2 by reading Sentences (6)-(12), which introduce the related studies and some of their findings.

antimicrobial residues found in a given environment and the major types of antibiotic resistance occurring in the same site is also not well understood (Oberlé et al., 2012; Huerta et al., 2013; Novo et al., 2013).

(10) Health care facilities, where the use of antibiotics is more frequent and intensive and where antibiotic resistant bacteria may have a selective advantage over the susceptible counterparts, are regarded as important reservoirs of antibiotic resistance (Kümmerer & Henninger, 2003; Jakobsen et al., 2008; Galvin et al., 2010; Harris et al., 2013; Varela and Manaia, 2013). (11) In addition, in urban areas, wastewater treatment plants represent important receptors for antimicrobial residues and antibiotic resistant bacteria (Manaia et al., 2012; Michael et al., 2013; Rizzo et al., 2013). (12) This situation may be worsened when untreated effluents from health care facilities are received in the urban wastewater treatment plants. (13) Nevertheless, there are no legal requirements for hospital effluents treatment prior to its discharge in the municipal collector. (14) In spite of the potential risks of hospital effluents regarding their role as possible suppliers of antibiotic resistant bacteria to the environment, these effluents represent useful models to assess both the relationship between antibiotic residues and antibiotic resistance, and the influence that they may display in the receiving wastewater treatment plant.

Sentences (13)-(16) indicate Move 3 by describing the research gap.

(15) The potential effects on microbiome due to pollution with antibiotics have received little attention. (16) However, additional knowledge in this area is fundamental to assess the risks associated with the environmental spread of resistance genes and to control potential adverse effects on human well-being (Gillings, 2013). (17) The current study was based on the hypothesis that hospital effluent is an important supplier of antimicrobial residues and of antibiotic resistant bacteria to the receiving wastewater treatment plant, yielding higher levels of both types of contaminants. (18) Moreover, it was hypothesized that given the different levels of antimicrobial residues and antibiotic resistance observed in hospital and municipal effluents, these wastewater systems would provide interesting insights into the relationship between antimicrobial residues, antibiotic resistant populations and bacterial communities. (19) The assessment of those hypotheses also aimed to infer about the impacts that hospital effluents may have on the occurrence of antimicrobial residues and of antibiotic resistant bacteria in the respective municipal wastewater treatment plant.

Sentences (17)-(19) indicate Move 4. Sentences (17)-(18) introduce the hypothesis, and Sentence (19) describes the aim of the study.

READING PRACTICE

Read the following introduction of a research article and analyze it in terms of the four moves mentioned in this unit. Put the numbers of the sentences in the corresponding grids in the right column of the table.

(1) America's population is growing older. (2) The growing size of America's population of seniors has drawn attention to its economic and social well-being. (3) According to the U.S. Bureau of the Census, it is anticipated that if this trend in growth continues, by the year 2030 there will be approximately 70 million Americans aged 65 or over. (4) Several studies have examined issues related to the present and future provision and quality of community-based services for the elderly (Kelly, Knox, & Gekosiki, 1998; Buys & Rushworth, 1997; Damron-Rodriguez, Wallace, & Kington, 1994; Krout, 1994; Benjamin, 1988; Soldo & Agree, 1988; Mahoney, 1978). (5) Furthermore, governments, foundations, non-profit organizations, and other stakeholders continue to work on how to provide cost-effective community-based services to members of the society including the elderly. (6) One approach has been an emphasis on community collaborations to address the planning and delivery of such services. (7) Funding agencies (e.g. U.S. Department of Housing and Urban Development [HUD]) have encouraged university-community collaborations. (8) An example is HUD's Community Outreach Partnership Center initiative, which involves university faculty, staff, students, and community residents and agencies/groups as partners in the development and implementation of research/community programs. (9) Little, however, is known about participants' views on university-community collaborations. (10) Human-service agency workers are major participants of university-based collaborations; hence, the purpose of this study was to investigate their views on community-based services to the elderly in northwest Ohio. (11) In particular, the study sought to provide an avenue for them to communicate their understanding of university-community agency collaborations and identify how their agency can work collaboratively with the university.

Four moves	Sentences in the moves
Move 1—establishing a territory	
Move 2—reviewing previous related research	
Move 3—establishing a niche	
Move 4—occupying the niche	